A Participatory Action Research in Transforming Hygiene Behaviour of Students through Ecological Sanitation Toilet

Govinda Prasad Devkota

A Dissertation

Submitted to

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A Dissertation for the Degree of Doctor of Philosophy in Health Education

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Abstract

Govinda Prasad Devkota for the degree of Doctor of Philosophy in Health Education presented on Title: *A Participatory Action Research in Transforming Hygiene Behaviour of Students through Ecological Sanitation Toilet*

Abstract Approved

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Through participatory action research, This participatory action research explored the patterns of sanitation and hygiene behaviour changes among the public school students through various intervention activities. Using a pragmatism worldview and social-ecological framework, Integrated Behavioural Model for Water, Sanitation and Hygiene (IBM-WASH) was applied to explore the sanitation and hygiene behaviour change. Participatory action research (PAR) methodology embedded with multi-phase mixed methods (QUAL-quan), was used to carry out the research and collect the data in the pre- and post-intervention phases.

Research site was a public school in Chitwan, Nepal, purposively selected and needs-based interventions were made to see their impacts on the health hygiene of students. Research participants were 4-8 grade students, teachers, members of the school management committee, members of the participatory action research committee, and parents of the school where the research was carried out. Three PAR phases included needs assessment, intervention, and impact evaluation. For sanitation and hygiene-related behaviour change, 25 activities were implemented under three participatory interventions, i.e., educational, technological and behavioural. A thematic framework was used to analyse qualitative data, while univariate and bivariate chi-square tests were performed on quantitative data collected during the pre- and post-interventions in order to show the associations between the dependent and independent variables.

The needs assessment findings showed that the use of dogmatic methods was prevalent in classroom teaching. Major issues identified during this phase were; toilet-student ratio, was 1:96 for boys and 1:139 for girls, much higher than WHO/UNICEF’s standard (1:50 for boys and 1:30 for girls); hand washing stations (HWSs) and toilets lacked running water and soap; cleanliness practices were poor; and students were ignorant about the ecological sanitation system.

After the interventions, the school has adequate toilet facility with a student-toilet ratio of (1:38 for girls and 1:32 for boys) which meets WHO / UNICEF minimum standards (1: 50 for boys and 1: 30 for girls). Provision of soap and cleaning materials at handwashing stations are available and awareness and behaviour change of sanitation and hygiene of co-researchers were significantly improved. The school now has Eco-san toilets that are useful for agricultural fertiliser (urine fertiliser) for the school garden. Hygiene behaviours have changed a lot with strong association between sex and soap used to wash hands ($\chi2 = 14.947$, $p =< 0.001$) and a significant link between hand hygiene sessions and the practice of handwashing with soap and water (HWWS) ($\chi2 = 63.347$, $p =< 0.001$) have been observed. Soap availability was found to be statistically significant (χ^2= 197.613, $P < 0.001$) between pre- and post-intervention studies.

This research implies that installation of eco-san toilets in public schools in Nepal would ensure better hygiene, environmental sanitation, and organic food production using urine fertilizer. It also implies that participatory pedagogy could contribute to transform teaching learning process as it empowers the learners with skills and awareness to connect education with real life.

Declaration

I hereby declare that this dissertation has not been submitted for candidature for any other degree.

I understand that my dissertation will become a part of the permanent collection of Tribhuvan University Library. My signature below authorises the release of my dissertation to any readers upon request.

Govinda Prasad Devkota

June 2023

Dedication

This dissertation is dedicated to the loving memory of my late Mother Daya Kumari Devkota, who passed away in 2076- 06-20 while I was out of Nepal for my PhD study and Father Surya Prasad Devkota, who inspired me to believe in my inherent potential. It is devoted to my wife Radha Devkota, daughter Elina Devkota and loving son Elish Devkota. May this work inspire our children to work hard and achieve their desire.

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Recommendation Letter

The undersigned certifies that Mr Govinda Prasad Devkota has prepared a PhD dissertation entitled **A Participatory Action Research in Transforming Hygiene Behaviour of Students through Ecological Sanitation Toilet** under our supervision. We have read and recommended this dissertation submitted by Mr Devkota for the Degree of Doctor of Philosophy to the Faculty of Education, Tribhuvan University's research committee for its final viva.

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Date: June 2023

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Approval Letter

Faculty of Education
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This Dissertation entitled **A Participatory Action Research in Transforming Hygiene Behaviour of Students through Ecological Sanitation Toilet**, presented by Govinda Prasad Devkota to the Research Committee of the Faculty of Education Tribhuvan University for the degree of Doctor of Philosophy in Health Education has been approved.

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Govinda Prasad Devkota

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Abbreviations

CIUD	:	Centre for Integrated Urban Development
DoE	:	Department of Education
DWSS	:	Department of Water Supply and Sewerage
Eco-san	:	Ecological Sanitation
EMIS	:	Education Management Information System
ENPHO	:	Environment and Public Health Organization
EPPI-Center	:	The Evidence for Policy and Practice Information and Coordinating Centre
ESS	:	Environmental Sanitation Section.
FGD	:	Focus Group Discussion
GON	:	Government of Nepal
GSE	:	Graduate School of Education
SHE	:	Sanitation and Hygiene Education
HWSs	:	Handwashing Stations
HWWS	:	Hand Washing with Soap
IBM-WASH	:	Integrated Behaviour Model- Water Sanitation and Hygiene
IDI	:	In-depth-Interview
IEHE	:	Institute of Environmental Health and Engineering
IFS-UTS	:	Institute for Sustainable Futures, University of Technology
IRC	:	International Water and Sanitation Centre
JMP	:	Joint Monitoring Program
MDGs	:	Millennium Development Goals
MOEST	:	Ministry of Education, Science and Technology
NEWAH	:	Nepal Water for Health
NFCFS	:	National Framework of Child- friendly school

NHRC	:	Nepal Health Research Council
Norad	:	Norwegian Agency for Development Cooperation
NORHED	:	The Norwegian Programme for Capacity Development in Higher Education and Research for Development
NPC	:	National Planning Commission
PAR	:	Participatory Action Research
PhD	:	Doctor of Philosophy
PNA	:	Participatory Needs Assessment
PTA	:	Parent Teacher Association
SACOSAN V	:	Fifth South Asian Conference on Sanitation
SDGs	:	Sustainable Development Goals
SMC	:	School Management Committee
SPSS	:	Statistical Package for the Social Science
SSHE	:	School Sanitation and Hygiene Education
SSRP	:	School Sector Reform Plan
TU	:	Tribhuvan University
UDT	:	Urine Diversion Toilet
UN	:	United Nations
UN-Habitat	:	United Nations Human Settlements Programme
UNICEF	:	United Nations International Children's Emergency Fund
USA	:	United States of America
WAN	:	Water Aid Nepal
WASH	:	Water Sanitation and Hygiene
WHO	:	World Health Organization

Chapter 1. Introduction

Overview of the Chapter

This chapter provides the overall context of the research entitled ‘A Participatory Action Research in Transforming Hygiene Behaviour of Students through Ecological Sanitation Toilet’. The chapter begins with the research problem, exposing the gaps between the dogmatic teaching and activity-based learning regarding the sanitation and hygiene education in our education system. The chapter then discusses how this research was planned to address the gap with a school-based intervention consisting of a number of activities that such as interactive workshops, classroom sensitisation, preparation of sanitation and hygiene-related Information Education Communication (IEC) materials, teacher workshops, participatory classroom teaching, sanitation fair and observation visit. The chapter also outlines the details of the intervention that focused on promoting correct and consistent handwashing practices and implementing the most appropriate sanitation solution that is installation of urine diversion toilet to apply human urine as fertiliser in the school garden. Finally, the chapter mentions the research objectives, research questions, significance of the study, delimitation of the study and definition of the terms used in this document.

Background

This study was conducted to promote sanitation and hygiene behaviour of students through interactive teaching and learning at a basic level school where they learned proper management of human faeces and urine. Students studying at the basic school were the co-researchers or learning communities throughout the study. The researchers collaborated with teachers, students, school management committee

(SMC) members, participatory action research (PAR) committee members, and Eco-club and child-club members. This study focused on developing hand washing practices with soap and water among students and using the toilet properly. The study also introduced the concept of ecological sanitation (Eco-san) toilets to use human urine as agricultural fertilizer.

This research considered that human populations are wholly dependent on healthy environments to survive and thrive worldwide as Winblad & Simpson (2004) stated that sanitation and hygiene are the fundamental to human health and sustainable development requirements.

Sanitation and hygiene. Sanitation and hygiene are critical to health, survival and development. Although the Sustainable Development Goals (SDGs, 2016-2030) suggest to 'ensure availability and sustainable management of water and sanitation for all', improved sanitation, pure drinking water and hygiene are still precarious in many countries in the world. Several countries worldwide still face challenges in providing adequate sanitation for their entire population, leaving people at risk for diseases related to water, sanitation and hygiene (WASH). Evidence shows that 3.6 billion people worldwide lack improved sanitation, including 1.9 billion people with basic sanitation (WHO/UNICEF (JMP), 2021). According to the Joint Monitoring Program (JMP) of the World Health Organization (WHO) and UNICEF, 54% of the global population has access to safe and managed sanitation services while 24% has basic sanitation (WHO/UNICEF (JMP), 2021). Overall, 6.7 million deaths were reported globally in 2019 due to poor sanitation. Out of total deaths, 5% was in low and middle-income countries and it was resulted from unsafe sanitation (Ritchie & Roser, 2021; WHO/UNICEF (JMP), 2021). This shows that despite the growing awareness of sanitation through media campaigns and interventions, persistent gaps in sanitation access exists in rural areas compared to other development challenges (Joshi & Amadi, 2013).

In terms of the availability of the sanitation facilities, seven out of ten people (71%) have basic handwashing facilities with soap and water. In the South Asian region, 69% of handwashing coverage was reported in 2015-2020. Similarly, on average, only 17 % washed their hands with soap and water after defecation, with an even smaller proportion doing so before handling food (13%) and after feeding a child (5%) globally (WHO/UNICEF (JMP), 2021). Diseases caused by unsafe water, poor sanitation and hygiene (WASH) are significant causes of mortality and morbidity (Prüss-Ustün et al., 2014). Also, the lack of safe WASH services affects children's nutrition and stunts growth, possibly leading to cognitive impairments (Dangour et al., 2013; Spears et al., 2013).

Sanitation means preventing human contact with the hazards associated with human waste. Sanitation is a broad term and it means more than just toilets. Sanitation in the school education context refers to facilities and services for safely managing human excrement from toilet to containment, storage and treatment onsite and used as fertiliser in the school garden. It can be understood as an intervention that reduces human exposure to disease by providing a clean environment to live. It involves behaviours and facilities which work together to form a hygienic environment. In the context of Nepal, there was no record-keeping system of sanitation coverage (particularly before 1980). Estimation of disinfection inclusion was 2% nationally and it was present more in urban territories than in Terai, slopes and hilly locales of Nepal (Dahal et al., 2014). Similarly, sanitation coverage in mountains, hills and Terai was 60.10%, 75.10%, and 48.80%, respectively (Budhathoki, 2019).

Ecological sanitation (Eco-san). The sanitation component of this study focused on Eco-san, which refers to the proper treatment of wastewater and nutrient recycling, returning the nutrients to nature and achieving a balance between community development and the environment (Winblad & Simpson, 2004). Since "humanure" has been regarded as a fertilizer for as long as agriculture has been practised, it is also an ancient method. It should be viewed as a healthy closed-loop system for managing human excrement, but the practice has been deemed unhygienic and taboo with the development of sanitation. As a result, it has been forgotten or even banned in some countries (Esray, 2002).

Some models and methods of Eco- san toilets include compost toilets, urinals, and urine diversion toilets (UDT). Eco-san/UDT is a new paradigm of improved sanitation followed by 'sanitise' and 'reuse' for agricultural production. This study is based on the Eco-san/UDT innovations applied to produce nutrients for plants and crops. The most critical soil nutrients found in human urine are Nitrogen (N), Phosphorus (P) and Potassium (K). For instance, nitrogen is essential to protein synthesis, so it is highly demanded during leaf and seed proteins (Heinonen-Tanski & van Wijk-Sijbesma, 2005). The phosphorus (P) requirement can be more significant in poor soils and it can be bound to the non-soluble salts of aluminium, iron or calcium (Heinonen-Tanski & van Wijk-Sijbesma, 2005). The eco-san toilet is an intervention package for students' sanitation and hygiene behaviour change in this PAR. This study also touches the SDGs target of Nepal government to some degree as she aims to reduce sanitation and hygiene problems by the end of 2030 through multi-sectoral efforts. By introducing eco-san, the school health program would be a cost-effective intervention to transform the sanitation and hygiene behaviour of students and the community through school education.

Ecological sanitation is an innovative sanitation technology that uses human waste as a resource to create a sustainable solution to the environmental pollution caused by human waste (Mihelcic et al., 2011). In short, these technologies sanitise and recycle while preventing pollution and adding food production (Haq & Cambridge, 2012). The technology Urine Diversion Toilet (UDT), the main component of this research, deposits faeces into one chamber at a time and diverts urine into separate chambers (Mihelcic et al., 2011).

Sanitation and hygiene behaviour change have become a global concern and priority in research and international development (WHO/UNICEF (JMP), 2021). In many of the world's low and middle-income countries, and even in some developed areas, frequent outbreaks of various WASH and grey-water-borne diseases (cholera, diarrhoea), gastrointestinal disorders and other infectious diseases are still prevalent (López-Vélez et al., 2022). Cholera epidemics have had a recorded history in east Africa since the 1830s. A water supply and poor sanitation conditions in East Germany and Africa were recognised as early as 1914 (Olago et al., 2007). Likewise, nearly 1.8 billion people in South Asia still lack access to proper sanitation (Bhattacharya & Das, 2017). Despite the substantial progress in sanitation and hygiene sectors, that is to say, 1.2 million schoolchildren have been reached through hygiene promotion activities, many school children still lack awareness and access to clean water and soap to enable them to correctly and consistently wash their hands at critical times (before taking meal and after use toilets), which affects their quality of education all across South Asian countries (Bhattacharya & Das, 2017; WHO, 2019).

Poor sanitation contributes to substantial morbidity and mortality globally. WHO/UNICEF (JMP) (2021) accounts for the death of a child every 20 seconds, and 88 % of these deaths is caused by diarrheal disease and insufficient water sanitation. It also estimates that access to good hygiene and safe water supply could save 1.5 million children per year. Production and consumption of water contaminated with infectious agents, toxic chemicals, and radiological hazards increase public health and environmental hazards, particularly in low-income countries. Global incidence of sanitation and hygiene-related illness, particularly diarrhoea, has increased by 13 % from 2000 to 2010 (Pickering et al., 2015). Thisis slowly declining, falling to approximately 8 % in the last decade (2011-2020) (Cissé, 2019; WHO/UNICEF (JMP), 2021) but still sanitation and hygiene-related illnesses result directly from excluding the urban poor in national sanitation policy, planning, and intervention.

Sanitation and hygiene education. Hygiene generally refers to the practices concerned with protecting our health and healthy living. It focuses mainly on personal hygiene, which looks at the cleanliness of hands (Manandhar & Chandyo, 2017). Similarly, in their progress report on WASH in schools, UNICEF and WHO define hygiene as the conditions and practices that help maintain health and prevent diseases, including handwashing, food hygiene and menstrual hygiene management (WHO/UNICEF, 2020). Sanitation and hygiene education is a healthcare science, a broader school health education form. It is also a process to understand the factors influencing hygiene behaviours and identify hygiene-related problems, their route causes, and identify preventive measures. One of the essential characteristics of hygiene education is that it builds on concepts, ideas and practices for further improvement.

Hygiene education focuses on improving personal knowledge, skills, and practices to modify individual's healthy behaviours Safe hygiene practice includes healthy behaviours, such as handwashing with soap (HWWS) before eating and after using toilet. Hygiene education and promotion aim to transfer knowledge and understanding of hygiene and associated health risks to help children change their behaviour to follow better hygiene practices. School sanitation and hygiene education is a specific form of the broader school health education. It deals only with water and sanitation-related health problems in and around school. School health education is concerned with all activities promoting sanitation and hygiene behaviour and reducing health risks caused by poor sanitation and hygiene of school children.

Sanitation and hygiene education primarily aims at changing behaviour towards good or safe practices concerning personal, water, food, and domestic and public hygiene. It also aims to protect poor hygiene and improve sanitation, particularly human waste management. Behaviour development in small children works well as children often do not have destructive behaviours but willing to develop good ones. Sanitation and hygiene behaviour development in schools can be achieved if supported by classroom pedagogy with related content and the availability of technological facilities. Here technological facilities denote the facilities related to the infrastructure development. School sanitation and hygiene education can contribute to improving students' health through behaviour change. The role of School Management Committee (SMC), schoolteachers, students, community people and local governments can also support to bring about this change.

Learning sanitation, hygiene, and health are interlinked. Children spend most of their time in school. In contexts where sanitation and hygiene conditions are poor, children are exposed to diseases and they are at risk of infections, which causes increased absenteeism (Benard et al., 2016). Schools are expected to ensure that children are healthy and they are learning in schools. Thus, schools should teach children how to prevent diarrhoeal diseases and other sanitation-related illnesses. The widespread adoption of safe hygiene practices through an interactive, child-centred participatory approach builds life skills (World Health Organization, 2021). Such a practice empowers school children to make a good choice of lifestyle.

Good education about hygiene is as essential as good sanitary facilities. Participatory sanitation and hygiene education allows children to learn about sanitation and hygiene-related behaviours and why different behaviour patterns lead to good or bad health, which also determines good educational performance. When children understand and think together about sanitation and hygiene education in school, they are aware of their healthy behaviours. Students are the most potent school resources through their input and desire to learn as they struggle for adequate, appropriate and accessible sanitation and hygiene education. Combining proper sanitation and hygiene education allows students to lead healthier lives and promote their academic achievement their health and education simultaneously. Considring the importance of such a participatory model of educating children to develop their healthy behaviours, I decided to undertake this research as a part of my PhD. Through this research, I was able to allow students to transform or make fundamental changes to their sanitation behaviours through eco-san and hand hygiene.

Sanitation and hygiene behaviour change is most successful when it focuses on a few behaviours with the most significant health impact. Changing a single behaviour can make an enormous difference. An

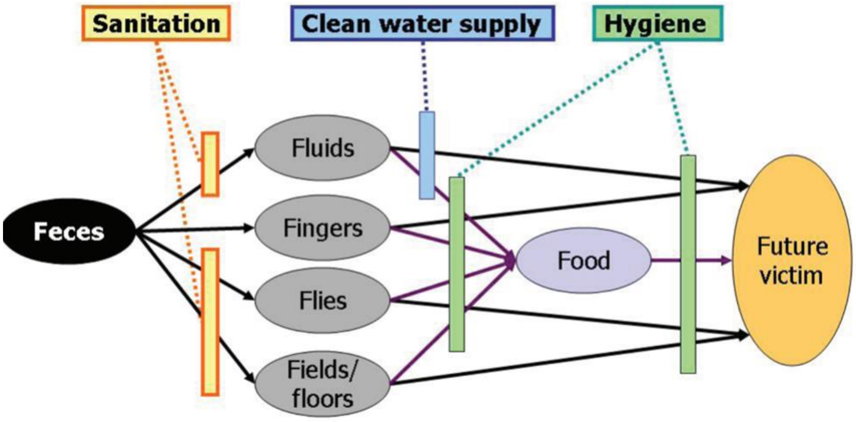

Figure1.1: F-diagram

example of prompting hygiene behaviour that stresses a particular action and its effect is sanitation. Related F-diagram (Wagner et al., 1958) shows the path by which germs can spread from person to person.

Effective sanitation and hygiene education teaches health risks and poor hygiene practices. The participatory approach based on classroom pedagogy focuses on changing students' sanitation and hygiene behaviour and transforming the hygiene behaviour of their families and the wider community to improve their healthy life styles (Moonie et al., 2008).

Ensuring that all aspects of appropriate sanitation and hygiene behaviours are addressed through sanitation and hygiene education (SHE) which focuses on the development of (i) knowledge and understanding of practical and theoretical information on sanitation and hygiene, (ii) attitude and personal opinions about Eco-san and HWWS that influence actions and responses to poor sanitary and unhygienic situations, and (iii) practical skills to carry out specific sanitation and hygiene behaviours. For sanitation and hygiene in schools to be sustainable and effective, it requires the active involvement of students, teachers, the School Management Committee/ Participatory Action Research (SMC/PAR), and many other stakeholders. Unfortunately, in Nepal, health and hygiene education in school is still far from satisfactory. Only a few (2.5%) schools have health and hygiene education as part of the curriculum and teacher training (Adhikari, 2017).

The school environment is most effective in teaching the younger generation about the importance of good hygiene and improved sanitation benefits. Teachers in primary schools are committed professionals, and students are enthusiastic and eager to learn new things and develop new skills. The need for hygiene and improved sanitation is overwhelming in families/homes, and schools. Therefore, placing a teaching component for HWWS and Eco-san seems logical in the school. School curricula can be built around this need and its required skills. In health education and related activities, students can learn the ins and outs of making and using Eco-san toilets, using human urine as fertilizer in the school garden, and HWWS.

Research Problem

The sanitation coverage in Nepal is 95% in six provinces and below 90 % in province no 2. However, 10.8 million people in Nepal still do not have access to improved sanitation (DWSS, 2018; Shrestha et al., 2020). There have been several initiations, mainly at the policy level, towards school and community-based sanitation and hygiene. The then Department of Education (DOE), currently Center for Education and Human Resource Development (CEHRD)and the Department of Water Supply and Sewerage (DWSS), under the support of UNICEF, implemented some reforms in the school sector (DWSS, 2018). Reform activities in the schools were constructing toilets, hand washing stations and sanitation awareness. Despite these efforts and initiations, observation shows that Nepal encountered numerous challenges related to sanitation and hygiene.

Similarly, the school sanitation and hygiene education (SSHE) approach was introduced in Nepal in 2006 and institutionalised in school as the centre of learning and motivation hub for sustained sanitation and hygiene behaviours. But there were no significant changes in schools and community (Adhikari, 2015). The Rural Water Supply and Sanitation National Policy, Strategy and Strategic Action Plan, 2014, also recognised schools' role in community sensitisation and behavioural promotion (RWWSP, 2014). However, policy implementation and significant community transformation through school education were lacking. Likewise, the Sanitation and Hygiene Master Plan, 2011 and School Sector Reform Plan (SSRP 2009-2015) stepped forward to enhance capacity for sanitation and hygiene. It applied local resources and reduced dependency on sanitation in school and community settings. But still, we are facing poor sanitation and hygiene practice among public school students of Nepal. Sanitation and hygiene behaviour change criteria were nor properly imposed in all schools to achieve better health status of basic level students. The National Framework of Child-friendly Schools (NFCFS) 2015 defines Water, Sanitation and Hygiene (WASH) as a fundamental requirement for health-promoting school environments (WAN, 2015). However, the school-based WASH sector in Nepal continues to be problematic. Coordination issues exist between key government agencies and local bodies for promoting research-based participatory action on WASH and Eco-san and poor support for Eco-san toilets by applying human urine as an agricultural fertiliser (GON, 2016; ISFUTS, 2011).

There are soap products in the market that help in reducing germs, damaging some virus particles, and decreasing the risk of infection, but it is challenging to manage soap in schools due to a lack of a regular budget (Devkota et al., 2020a; Potdar et al., 2019). In addition, the Eco-san toilet with the urine-diverting mode is also challenging in a school setting because applying human urine with care is necessary. Poor agro-productivity, salinity, and phosphorus (pH) levels in the soil, as well as volatilization of intrinsic ammonia, a greenhouse gas can result from improper urine application, as can crop failures (Prithvi Simha & Mahesh Ganesapillai, 2017). Cross-faecal contamination of the relatively sterile and source-separated urine in Eco-san or urine diversion toilets is another issue to consider. Enterococcus, Escherichia coli, salmonella, helminths, ova such as Ascaris, Rotavirus, and bacteriophages may be present in the infected urine (Nyberg et al., 2014). Likewise, the probability of bad-smelling, storage, proper dilution with water, and supply without a drip-irrigation system are other challenges of the Eco-san system with urine-diverting mode (Devkota et al., 2019).

Toilets are needed in all schools and homes, but the practical knowledge about building toilets and how they work may be little known. In Nepal, such practical knowledge is all-important. The new sanitation, which brings a more ecological approach, offers even more benefits than providing toilets alone. The ecological sanitation toilet is a sustainable solution using less water than other sanitation options. However, adequate research in this field is still lacking. The potential to grow more vegetables and grains using compost created from toilets and human waste and grow various vegetables has more practical applications within the school. Human urine causes nutrient production, helps increase organic food production, and helps substitute chemical fertiliser. But it is still a missing resource in our context. The population is expanding; thus, agriculture must provide more food while the soil's natural nutrients are depleted. Minerals are mined to manufacture chemical fertilisers, yet Phosphorus (P), a vital nutrient, lacks soil (Van Vuuren et al., 2010).

Even though specialists have concentrated on the science and adequacy behind Eco-san and supplement reusing, a practical solution through school education is still lacking. However, Participatory Action Research (PAR) has increasingly been used as an overarching name for orientation for research practice. PAR places the research in the position of co-researcher and puts heavy participation in the field (Kidd & Kral, 2005). Such practice is also not common yet in Nepal, especially in a school setting. Participatory Action Research (PAR) approach aims at a bottom-up way or learner-focused approach on encouraging learning communities to solve hand hygiene and Eco-san issues through participatory SHE and change students' sanitation and hygiene behaviour. Likewise, Eco-san is an innovative technology for rural areas of Nepal. It is an effective means to change the children's sanitation and hygiene behaviours, improve their education, and strengthen their livelihood.

Several studies (Austin et al., 2005b; Chariar & Ramesh Sakthived, 2011; Heinonen-Tanski & van Wijk-Sijbesma, 2005; Huussiru, 2017) have shown that the Eco-san system (construction and its application) is not only a paradigm shift in sanitation but also a sustainable solution to environmental pollution. Also, human urine produced from Eco-san is a rich source of soil nutrients. The technological components of Eco-san include urine diversion toilets, turning human waste into agricultural fertiliser, sanitisation and treatment plant of urine. The effectiveness of conventional and modern Eco-san pan/commode, the superstructure of an Eco-san toilet and the source separation of urine and faeces are also developed as a technology-based intervention in the school. Also, its educational includes the awareness/knowledge of Eco-san on students, teachers, parents and the local people, their perception, cultivation experiments using urine fertiliser, health perspectives of Eco-san, and employment and livelihood support by using Eco-san.

In Nepal, to my knowledge, the use of Eco-san in the academic setting, combined with sanitation and hygiene behaviour, has not been researched through participatory Eco-garden pedagogy. Therefore, this study made an attempt to make an intervention based on a participatory action research approach to ensure sanitation and hygiene, particularly when using the Eco-san toilet, using human urine as a fertilizer in the school's Eco-garden, and washing hands with soap.

Objectives of the Study

Main objective of this study was to develop, implement and evaluate interventions to improve sanitation and hygiene behaviour through classroom teaching and learning. Following specific objectives were developed to achieve this overarching objective.

i) To assess knowledge, perceptions, and practices of students and teachers towards sanitation and hygiene, and the use of Eco-san toilets in school,
ii) To assess the effectiveness of the participatory interventions to change sanitation and hygiene behaviour and the use of Eco-san toilets in the school setting,
iii) To identify the contributions of the participatory pedagogy for using Eco-san toilet and handwashing with soap (HWWS).

Research Questions

The study was expected to answer the following research questions:

i) What are students' and teachers' knowledge, perceptions, and practices towards hand hygiene, Eco-san toilet, and application of urine fertiliser?
ii) How did the students, teachers, and SMC/PAR committee members perceive the possibility of using an Eco-san toilet to produce fertilisers?
iii) What is the potential for Ecosan to become more feasible and adopted approach within mainstream sanitation in the school?
iv) Why do the students, teachers and participatory action research committee prefer sanitation and hygiene interventions following the PAR approach?
v) How can the researcher and co-researchers collaborate to co-create knowledge on sanitation and hygiene?

vi) What are the pedagogical implications of participatory interventions, and how could this contribute to curriculum development?

Rationale of the Study

The Government of Nepal has made considerable efforts to improve the sanitation and hygiene situation in the country by formulating and enforcing Water, Sanitation and Hygiene (WASH) policies, guidelines, and acts for the last two decades (Government of Nepal, 2011b). In 1997, the government formulated a comprehensive 20-year Water and Sanitation Strategy by setting a target of achieving 100% sanitation coverage in the country by 2017 AD (Government of Nepal, 2011a). Recently, the government at the national level promoted hand sanitation and hygiene through a sanitation and hygiene campaign (GON, 2016). However, public schools across Nepal lack adequate sanitation and hygiene services facilities. More importantly, among the 33,160 public schools, only 79% of schools have toilets, whereas only 36% have separate toilets for girls (WHO/UNICEF, 2017). Significantly, almost all school toilets do not meet the students-to-toilet standard set (Shrestha et al., 2017). Sanitation and Hygiene Master Plan (SHMP) (2011) and Child-Friendly School Framework (CFSF) emphasised separate toilets for girls and boys. They highlighted a minimum standard of 50:1 student toilet ratio for boys and a 30:1 for girls. Similarly, 54% of the population of Nepal lacks handwashing facilities in schools (GON, 2016).

There is a high prevalence of sanitation and hygiene-related diseases in many low and middle-income countries, causing substantial morbidity and mortality (Ergin et al., 2011). If water and sanitation-related disease transmission routes are to be identified, improved hygiene practices are necessary. At the same time, appropriate hygiene education can positively impact intentions to change hygiene behaviour. Better hygiene education and sanitation facilities could help children transform their intention to change into real change.

Sanitation and hygiene are crucial for human life in general and the healthy functioning of every school (Celia McMichael, 2019). This intervention is anticipated to improve hand hygiene and Eco-san knowledge of both researcher and co-researchers. The main approach throughout this study was to promote participatory teaching and learning and the co-development of life-relevant and skill-based education by focusing on improving sanitation and hygiene behaviour. It also contributed to a sustainable solution for handwashing with soap (HWWS) at key times and used Eco-san toilet in a school. School community processed human urine to produce organic vegetables, fruits, and grains in the school garden. Students' participation in maintaining their school's sanitary environment also improved. The HWWS and Eco-san innovations, as well as the use of human urine as fertiliser in the school garden, were made possible by the PAR strategy, which this study used.

There is a severe water shortage and environmental degradation in many cities of Nepal. Many urban areas are the most polluted (McMichael & Robinson, 2016; Pathak et al., 2015; Wali et al., 2020). Similarly, semi-urban regions are also gradually being polluted, as sewerage discharged from centralised systems pollutes surface water and cause seepage from septic tanks, while pit latrines pollute groundwater. Moreover, several studies on applying human excreta as agricultural fertiliser (Heinonen-Tanski & van Wijk-Sijbesma, 2005; Kumwenda et al., 2014) proved that it is not a waste of resources. Rather, it can effectively produce more nutritious food and minimise the purchase of chemical fertilisers. Even if the sanitation crisis may be communicated to and understood by more people, developing nations like Nepal still need to find Eco-san toilet alternatives to current technologies (Kabir Rajbhandari, 2008). This rising need for a holistic strategy to call for sanitary, sustainable, and eco-friendly, hence the option of Eco-san toilets, is due to the nation's inadequate sanitation and hygiene status.

In generating awareness and demonstration models, the school environment is perhaps one of the best to teach the younger generation the importance of good hygiene and the benefits of Eco-san toilet. As I found from the field, teachers and students in basic schools are committed professionals and enthusiastic, eager to learn new things and develop new skills. Therefore, placing a sensitised component for HWWS and Eco-san in the school seems logical and school curricula can be built around this need and its skills. Eco-san toilet construction's technicalities, its use, application of human urine as an agricultural fertiliser in the school garden and HWWS can be taught in school education, which helps to promote sanitation and hygiene behaviour of students widely.

Generally speaking, this study is added to the current knowledge base of how the health educators of basic-level state-funded schools in Nepal comprehend and practice transformative pedagogy. Likewise, this investigation provides findings that may inform future educational policy to improve Nepal's current teaching and health education. It may also help to improve students' sanitation and hygiene behaviours through school-based interventions.

Delimitations and Limitations of the Study

In this study, I have put what I can do in delimitation and what I can not do in limitation.

Delimitations. Several theoretical models and frameworks have been developed to determine the primary factors that contribute to improved practices in sanitation and hygiene. However, their scope and focus differ: Some of them focus on specific behaviours, like washing one's hands with soap, using an Eco-san toilet, using human faeces as fertilizer in agriculture, etc., and others place a more general emphasis on hygiene and sanitation practices; Integrated Behaviour Model for Water Sanitation and Hygiene (IBM-WASH) focuses on individual-level factors that influence behaviour, while others take a broader ecological approach that examines the individual, community, environmental, and policy levels (Aunger et al., 2010). This study was grounded on the theoretical influence of the IBM-WASH, which accommodates the diverse drivers and barriers to sanitation and hygiene-related behaviours, from individual to societal. Finally, it emphasizes the more prominent contextual, psychosocial, and technological factors influencing behaviour change interventions. (Dreibelbis et al., 2013a). The intervention's multiple phases appear to be crucial to its effectiveness. Besides this theoretical delimitation, this study was delimitated to some practical aspects. Research regarding hygiene and Eco-san among basic school students was conducted in three phases: phase I: Needs assessment survey, phase II: Implementation of the participatory actions as an intervention program and phase III: Assessment of the effectiveness of the interventions.

This study was based on a collaborative, participatory action research methodology in multiple phases. The mixed methods (QUAL-Quan) of this PAR used a survey, situation analysis (record review), focus group discussion (FGD), in-depth interview (IDI), observation, transect walks and reflective notes to collect the data. As analysis of quantitative data, it was based on univariate, bivariate and multivariate data analysis. A framework analysis (Green & Thorogood, 2006; Lacey & Luff, 2001; Smith & Firth, 2011) was used to analyse qualitative data. Pre-intervention data were compared with the data of post-intervention.

A public school in the Chitwan district of Nepal was selected because of i) the multi-ethnicity students' composition, ii) the school has a large number of students, iii) owing land for the Eco-san toilet and Eco-garden, iv) more than three female teachers, v) having dedicated teachers to co-create knowledge and collaborative learning, vi) active and functional school management committee, parent-teacher association and child club, and vii) having facility of electricity and drinking water. So, one public school was selected as the sampling unit of the study. Participants (teachers, students and PAR/ SMC, parents and student club members) were recruited as the learning community of that school. This study selected a public school as an action school, and research participants and educational, technological and behavioural interventions were limited to the basic level students (grades 4-8). Likewise, many issues, such as teaching methods, using IEC materials, students' participation in teaching and learning, and content coverage of sanitation and hygiene education, are incorporated into the participatory local curriculum.

Limitations. This study has been unable to find a way out of its sustainable use of a participatory local curriculum. Due to technical issues like urine clotting while supplying urine from the drip-irrigation system, the ratio of urine and water dilution according to the nature of plants cannot be provided to the Eco-garden. Since only participatory actions were taken during school hours, the impacts on class continuity were not observed. Several previous studies have stated that pathogens in the urine fertiliser have not been appropriately treated, which can harm human health (Heinonen-Tanski & van Wijk-Sijbesma, 2005; Prithvi Simha & Mahesh Ganesapillai, 2017; Simha et al., 2018; Vinnerås et al., 2008b). Still, this PhD research has not been able to conduct a lab-based study to find the presence of pathogens in vegetables produced using urine fertiliser from the school garden.

Structure of the Dissertation

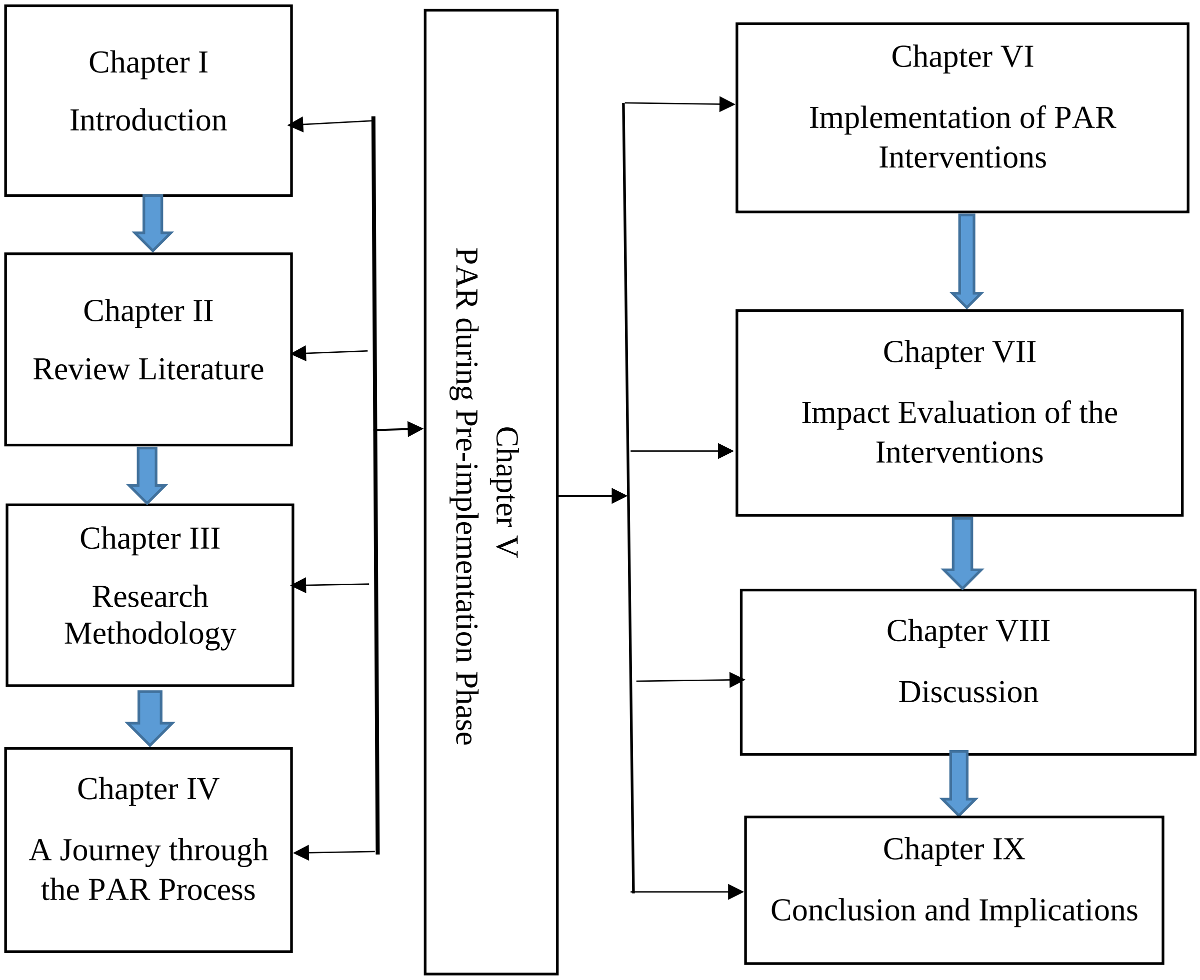

Figure 1.2. Structure of Dissertation

Chapter I has introduced key concerns and terms of this research. It has laid out the study's background and significance, followed by the research questions and objectives. The subsequent sections highlight the global data on the importance of participatory pedagogy in changing students' sanitation and hygiene behaviour.

Chapter II provides a detailed literature review examining research results so far on the improvement of sanitation and hygiene behaviour of students using participatory action research (PAR) in school and addressing the needs of students in terms of sanitation and hygiene education, hygiene promotion behaviour and application of human urine as an agricultural fertiliser in school garden. This review establishes the connection between current approaches to improving sanitation and hygiene from different perspectives regarding the existing school curriculum, national health education, sanitation and hygiene policies, programs, and theoretical bases. It highlights the Integrated Behaviour Model for Water, Sanitation and Hygiene (IBM-WASH), Diffusion of Innovations (DOI) theory, and Participatory Sanitation and hygiene Transformation (PHAST) approach. It summarises Nepal's key policies and practices in the sanitation and hygiene education sectors. The overview of Nepal's school curriculum, especially on health education and its content coverage from the past to the present, is incorporated in this chapter. A conceptual framework is developed and presented at the end of this chapter.

Chapter III focuses on the paradigmatic arena, methods, instruments, and approaches to collecting and analysing qualitative and quantitative data necessary for PAR in this study**.** This chapter also summarises the methodological issues, study challenges, potential biases, limitations, and ethical considerations.

Chapter IV details the journey of the PAR process from the field entry to the follow-up visit. The main components shown in this chapter are the scene-setting with informal talk, concept mapping, PAR committee and child club formation, and drafting of the other PAR process strategies. It reflects through the practical steps and the potential issues in the PAR process's planning, management, facilitation, and conclusion. The chapter finally incorporates a glimpse of the learning community's engagement and participation, the process of participatory actions and its evaluation and sharing of our reflection with the expert community.

Chapter V describes the results of the need assessment phase (PAR cycle I) and explains how the collected data were used to measure the real need of learning communities, identifying opportunities and strategies for further improvement, especially in students' sanitation and hygiene behaviour. It also provides possible participatory activities as an intervention for the subsequent cycles.

Chapter VI mentions the participatory activities suggested by cycle I i.e. needs assessment, their operation process, challenges encountered during this operation, and the reflection of researchers and co-researchers. This study also considered cornerstones in session activities performed as a PAR intervention to change students' sanitation and hygiene behaviour.

Chapter VII presents the overall achievement of students' sanitation and hygiene behaviour and teachers' pedagogical implications after various participatory activities as intervention (see appendix 10) strategies based on the needs assessment. Similar tools and data collection methods were implied in the need assessment phase or PAR cycle I used in cycle III to evaluate the PAR intervention. It also draws the overall findings and discussion of my PhD research.

Chapter VIII discusses the overall findings from the participatory action research conducted in a public school in Chitwan. The study also synthesises the findings derived from empirical data and findings from the review of literature presented in the previous chapters. Major themes such as i) awareness and practices/skills of handwashing with soap; ii) knowledge, perception and application of ecological sanitation; iii) impact of the participatory curriculum in changing sanitation and hygiene behaviour; iv) pedagogical transformation and improvement in classroom practices; v) reflections on participatory action research and sustainability of the interventions; vi) reflection on theoretical, analytical framework; vii) cross-collaboration in PAR activities in the school, viii) challenges with the implementation of participatory action research were interpreted in this chapter.

Chapter IX, the final chapter, draws on the study's conclusions, addressing the critical research questions and objectives. It concludes with the information on the use of Eco-san toilet and the application of human urine as an agricultural fertiliser in the school garden. Likewise, the conclusion was also made on pedagogical practice and sanitation and hygiene education in transforming the HWWS behaviour of students. This chapter also offers some implications for the policymakers, academics, and researchers.

Operational Definitions of the Terms Used.

Action school: An action school is a public secondary school selected by the *Rupantaran* project and initially implements sanitation and hygiene-related activities as interventions.

Basic School: The School runs from grades 1-8.

Basic Sanitation: Managing human excrement at the household level denotes basic sanitation. This term is used as an indicator for measuring the Sustainable Development Goal target 6.

Co-researchers: Co-researchers in participatory action research refer to learning communities or research participants involved in the research process and provide efforts.

Public school: Schools receiving government grants allowed to spend in line with their priorities is named public school. School management committees (SMCs) should undertake such schools' day-to-day management and supervision.

Contextualisation: The process of putting information into context, making sense of data from the situation or location in which the information was found.

Drip-Irrigation: Drip irrigation is a crop irrigation method that uses pipes, automatic supplying, or piping to deliver diluted human urine directly to individual plants.

Dry Toilet: A toilet that does not use water to carry away excreta.

Ecological sanitation (Eco-san): The process of properly treating wastewater and recycling nutrients is called ecological sanitation. The goal is to return nutrients to nature and strike a balance between community development and the environment.

Eco-san Toilet: A toilet that separates urine from faeces during toilet use.

Hygiene: Hygiene is a set of habits that help maintain and improve health by washing hands frequently with soap and water, especially after using the toilet and before eating food.

Improved Sanitation: Improved sanitation in the study means connection to public sewer or septic tank, pour-flush latrine, pit latrine with slab, ventilated improved pit (VIP) latrine, composting toilet and ecological sanitation.

Participatory Action Research (PAR): A type of applied research grounded in a participatory world view, which emphasises co-learning, participation and transformation through a democratic, collaborative learning model (Balakrishnan & Claiborne, 2017)

PAR Committee: PAR committee is a committee formed in the PAR process representing participation from teachers, school management committees, parents, health facility staff, community leaders, etc.

Participatory Pedagogy: Teaching and learning with students' participation or engagement.

Reference School: The school where the second step of implementation of intervention activities after achievement evaluation of the intervention activities happened in action school using the train-the-trainer model.

School Sanitation and Hygiene Education (SSHE): The combination of educational and technological components required to create a healthy school environment and encourage or develop students' safe hygiene practices.

Self-efficacy: The situation-specific confidence that people can cope with high-risk situations without relapsing to their former behaviours.

Transformation: Sustainable change of HWWS and using Eco-san toilet, including applying human urine as fertiliser by students and the wider community.

Chapter Summary

Chapter one has introduced key concerns and terms of this study. It has explained the importance of sanitation and hygiene education and Eco-san innovations, including human urine application as agricultural fertiliser. Four objectives and seven research questions are designed to analyse basic-level students' transforming sanitation and hygiene behaviour. Finally, the chapter has drawn this study's delimitations and key terms.

Chapter 2. Literature Review

Overview of the Review

This section presents the key findings of the literature review. The review mainly focused on theoretical, empirical, and thematic review. Additionally, literature related to curriculum, educational policy, and methodological considerations with reference to hygiene and sanitation was also reviewed. Electronic database searches and grey literature such as research articles, reviews, case reports, and manuals published in peer- and non-peer-reviewed electronic journals, magazines, newspapers, books, and reports, served as the basis for the literature review. Systematic database search was combined with manual search. Finally, an integrated conceptual framework based on theories, models and concepts was created and the objectives and research questions were built on the insights derived from the review.

Review Methods

This study reviewed electronic research databases and synthesised published and grey literature. Resources included research articles, essays, reviews, policy reports and manuals published in peer and non-peer-reviewed electronic and print journals, magazines, newspapers and reports. This review's search strategy included systematic searches in electronic databases, manual searches, and grey literature searches.

A keyword search was the primary strategy used to map all relevant articles from multiple databases; Medline or PubMed (1946 -2019), SciFinder (1970- Dec. 2020), Web of Science/Multi-disciplinary databases (1945- 2019), Oria (1956-2019), Eric (1966- to date), CINAHL Plus (1990- 2020). The outputs were downloaded into the RefWorks database and screened later, following the EndNote criteria for each search. The main review criteria included i) Original research or systematic review, ii) Making specific reference to sanitation, Eco-san toilet, HWWS, Sanitation and hygiene education, human urine as fertiliser, drip irrigation system, iii) Search terms had to be in the title, abstract or keywords on the database, and iv) Only English language publication. Books, book reviews, thesis /dissertation, editorials, reports, policy papers and news articles identified from other sources were also added to the review. The key terms were also used for manual searches, google scholar searches, library searches, and specialist agencies' websites.

Overall, 309 journal articles related to participatory action research (PAR), participatory pedagogy, sanitation and hygiene education, and Ecological sanitation (Eco-san) were analysed for the review. Similarly, 46 books, 45 policy documents and 24 working papers were reviewed. Here is the flow-chart of the literature review used in this research.

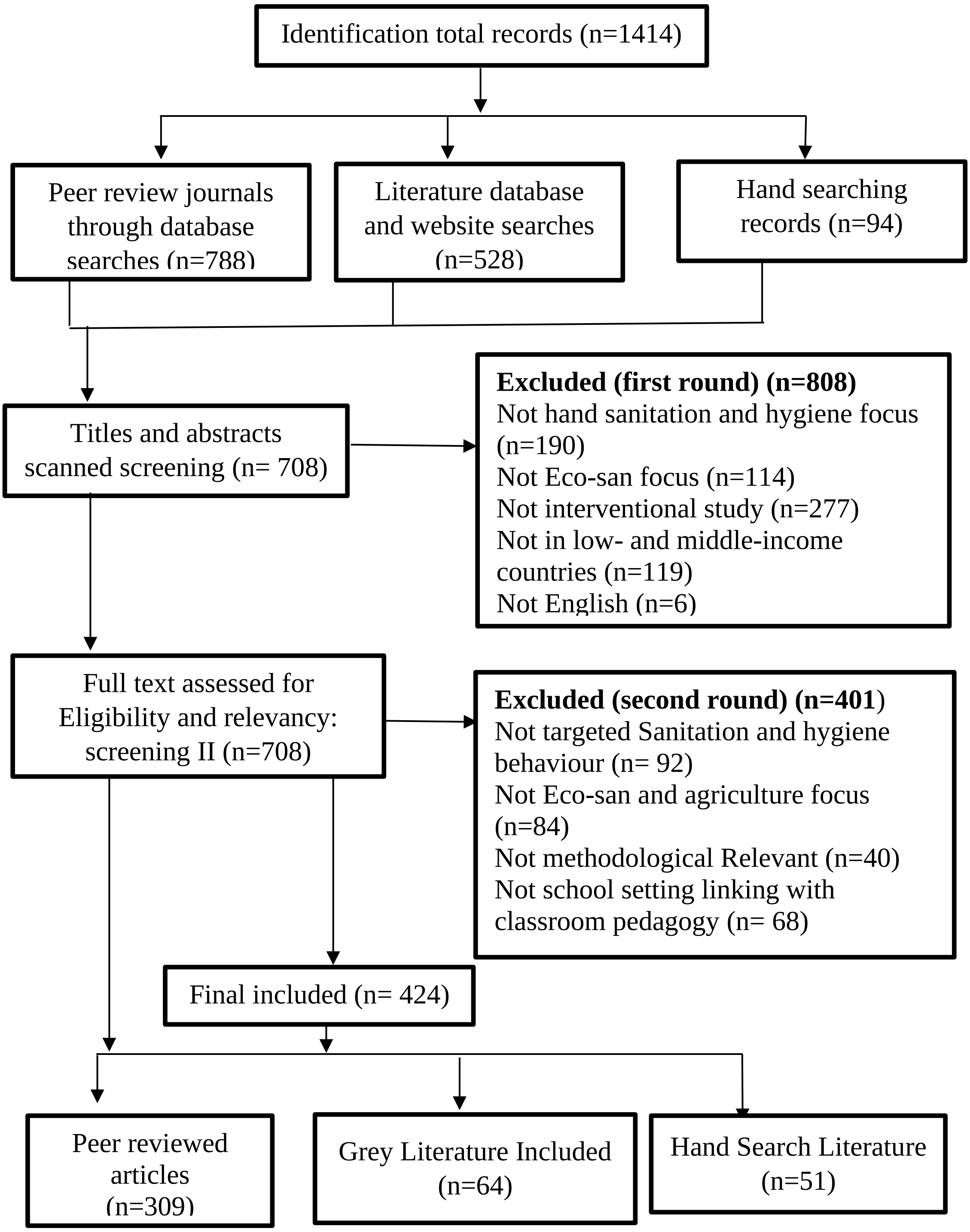

Figure 2.1. Flow Chart of Literature Review

Review of Theoretical Literature

Promoting and providing hand hygiene and Eco-san practices are viable solutions to reducing the high morbidity and mortality rates due to enteric illnesses in Nepal (WAN, 2015). Several theoretical models, explanatory frameworks, and approaches to guide behaviour change related to WASH have emerged. The design and evaluation of such theories and models inform hygiene behaviour change and maintenance. Attributes of hygiene behaviours, such as the steps to be followed during the health behaviour, time and the place where the behaviour is carried out to have a health impact (Rimal et al., 2011), were studied.

This section of the theoretical review looks at the common approaches used in social mobilization and interventions to encourage behaviour change and communication for social change. The review explicitly addresses methods likely to encourage ecological sanitation and hand hygiene behaviour in basic-level students in the public schools of Nepal. It explores the Diffusion of Innovation (DOI) and Integrated Behaviour Change- WASH (IBM- WASH) model and how these theories promote hand hygiene and Eco-san among students and intervention among basic level students' behavioural change. IBM-WASH was identified to be relevant for this study as it identifies three dimensions, i) contextual factors of the sanitation and hygiene behaviour (access to water and soap, toilet brush, *harpic*/detergents), ii) psychological factors (disgust related to handling human excreta, perceived risks of diseases, perceived fear of losing dignity due to handling human excrement) and iii) technological factors (uses of HWSs, soap, UDT, human storage urine, urine application through drip- irrigation system). Likewise, we analysed the data using the IBM-WASH framework. We arranged the study findings according to the framework dimensions at the behavioural, individual and interpersonal levels related to sanitation and hygiene behaviour of the basic level students in the public school setting (Dreibelbis et al., 2013b).

In addition, the diffusion of innovation (DOI) theory concept was used to see and evaluate the potential for Eco-san toilet/UDT use and application of urine fertiliser in the school garden. During the second phase (intervention phase) of the PAR, demonstration of HWWS, model UDT, urine storage and supply to the school's Eco- Garden, which the students could learn through observing the innovations. Then the adaptation possibilities of the Eco-san innovation in the school was done. In the same way, identified relative advantages, co-construct new knowledge, compatibility and complexity in the innovation brought up as a concern. Finally, knowledge, persuasion (evaluation of the innovation) and implementation (adaption) of the Eco-san system (Rogers, 2010) was shared. This thesis develops existing transformative education by drawing from theories of the IBM-WASH model to transform students' sanitation and hygiene behaviour.

The literature review this section presents the theories and behaviour change models, describes the most prevalent, and links it with this PAR. Central elements and cross-cutting themes of some theories and models are summarised in this section, which derives from social science and is especially linked with human behaviour. This review supported in explaining the application of Eco-san innovation and the behaviour-changing pattern in the study. The review is also focused on health behaviour change patterns relating to school settings' social and physical environments. The theories of Diffusion of Innovation (DOI) and Integrated Behaviour Change Model in WASH (IMB-WASH) were used as reference theories to the analysis of handwashing with soap practices, Eco-san innovation and application of human urine as agricultural fertiliser. The resulting behaviour was considered to be an agent of change. Being a change agent that we saw around us to think more critically and hopefully re-evaluate our existing behaviour and ways of doing things. We can build a foundation for change through health communication, demonstration and providing health facilities (HWSs, soap, UDT and cleanliness materials). In this research students gathered to reconnect and hear from transformational teachers in school education, inspirational guidance and supportive health facilities to be the change agent in the community.

The diffusion of innovations theory. The Diffusion of Innovations theory has widely used in health promotion and communication for decades (Rogers, 2010) and equally popular in social science fields, such as education, anthropology, geography, communication studies, sociology, and health research (Dearing, 2009,122; Dearing & Cox, 2018).The theory can explain people's actions or lack of action, which is essential when analysing why people do or do not adapt to new ideas. The theory is helpful for the PAR approach performed in this study due to the focus on adaption of new way of doing and behaviour change. It supports in analysing the action and further distinguishes possibilities for additional Eco-san projects (Dearing, 2009).

The theory, founded by Evert Rogers and being used for over 75 years was (Sanson-Fisher, 2004) says that diffusion is "*the process in which an innovation is communicated through certain channels over time among the social system members*"(Rogers, 2003, p.23). An innovation is *"an idea, practice, or object perceived as new by an individual or other adoption unit" (p.23)*. The idea of innovation is communicated among people in the social system, but it might be adopted or not. The diffusion of innovation theory has developed characteristic elements essential to value in successfully adopting new ideas. Four factors are vital: innovation, communication channels, time, and social systems (Rogers, 2010). These characteristics were used as references to this study as the Eco-san system is an innovation for the school setting in Nepal.

Furthermore, five characteristics have been pointed out as commonly used by people to evaluate innovations and the possible adaption rate. These are relative advantages, compatibility, complexity, trialability and observability. Comparative advantage is perceiving a new idea and replacing an old theory or practice. Whether the statement is positively met depends on social prestige, economic considerations and other subjective concerns. Compatibility concerns the idea that aligns with the receiver's beliefs, lifestyle behaviour, and needs. Complexity is interpreting how easy it is to use and understand the concept. Trialability is to which degree the adopter can trial the new idea, i.e. use an Eco-san toilet in this study. Lastly, observability means people can see how innovations and communication channels spread ideas (Rogers, 2010).

Time is the next vital element of DOI. The time dimension is connected to the five categories of adopters that Rogers has developed, linked to time in the sense of early and later adopters (figure 2.2). The first category is the innovators, the lead adopters and a typical stereotypical role put upon school children that are more commonly adapted to new ideas. They do not see uncertainty as a problem and are not dependent on other people’s decisions to adopt. Further, early adopters often have higher status and power positions and have the resources needed to embrace innovation. Other people used to see these people as role models, affecting their adoption decision. Dearing and Cox (2018) addressed that we also find the so-called opinion leaders within the group. They further stated, *"If the opinion leaders adopt and inform others about advantages of the innovation, it is most likely that others will adapt much faster too*” (p. 37). The early majority is the third category, which tends to be more reflective up-on an idea before being adopted.

After this category, the late majority of adopters follow, who need more persuasion before adopting. Laggards are the last category of adopters, who are slow adopters and oppose new ideas. In this research these categories are used to explain the specific behaviour and potential for the Eco-san pilot project. Time is also connected to the rate of adaption; Rogers (2003, p.23) describes it as *"the relative speed whit which members of a social system adopt an innovation"*. This process is often explained in an S-curved adaptation process, meaning adaptation begins slowly. The innovators and early adopters accept the idea first. Followed by the early majority, which will push the curve up; a late majority will follow, and the laggards after that (Rush & Marshall, 2015), as shown in Figure 2.2.

The last fundamental element in Rogers' theory is the social system, which can be any set of organisations in different settings, although the exciting structure is crucial. Most interesting is the opinion leaders' role and the pressure to adopt among potential adopters (Dearing, 2009). The structure of the system can hence develop an innovation or convict it. The norms and established behaviour are interesting for the researcher to discover and overcome the obstacles that may negatively affect the adoption rate (Rush & Marshall, 2015). The diffusion of innovation theory and the critical approach can illuminate structures in the system and the norms inherent in the lifeworld (social system) further to analyse the potential of up-scaling possibilities of the Eco-san and find emancipatory solutions for the development project.

Dissemination Science studies how evidence-based practice, programs, and policies can be best communicated to an inter-organisational societal sector of potential adopters and implementers to produce effective results (Dearing & Cox, 2018). Science has taken Rogers' theory to further focus on creating sustainable adaptation by acting proactively and using the theory as a framework for implementing interventions. However, knowing if it will adopt an innovation in a specific setting can still be hard. Therefore, experimental demonstration is a method used to measure whether an intervention is effective or not. As the findings of this study have shown, a demonstration project for deeper understanding and adoption is vital for the participants. The experimental Eco-toilet example can explain adaptation in the local context in triangulation with the diffusion of innovations theory concepts and the critical reflection approach.

Diffusion occurs through a combination of (i) the need for individuals to reduce personal uncertainty when presented with new information, (ii) the need for individuals to respond to their perceptions of what specific credible others are thinking and doing, and (iii) to generally experienced social pressure to do as others have done (MacVaugh & Schiavone, 2010). The scenario of scaling up HWWS and Eco-san toilets in Nepal seems encouraging in community settings and schools. This study planned to implement an Eco-san toilet, an effective model of Eco-san, and construct and apply human urine as fertiliser in the school garden. Figure 2.2 gives the guideline for measuring the diffusion of Eco-san toilet innovations in school and the community setting.

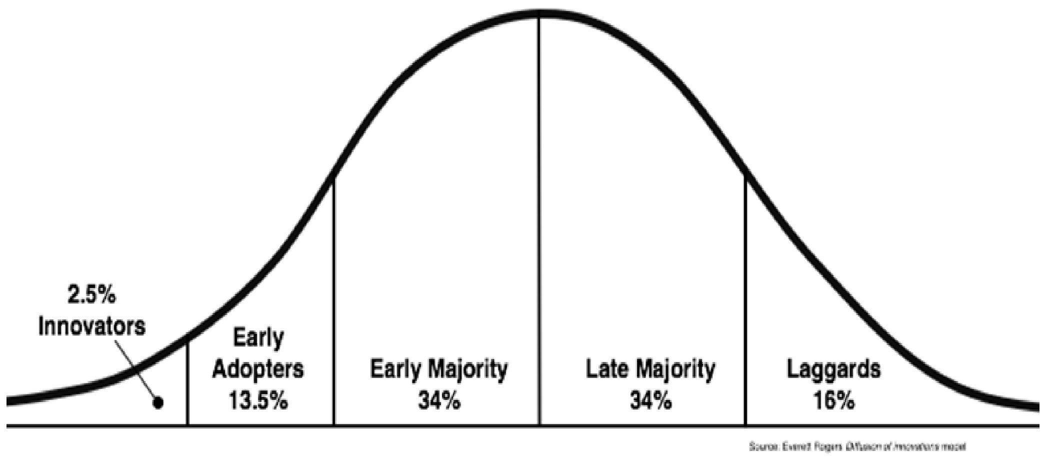

Figure 2.2. Adaptor's Categories of Innovation. Source: Rogers, E. M. (2003).

Needs or motivations differ from one person to another according to their degree of innovativeness: The first category of people to adopt (innovators) tend to do so because of novelty and having little to lose; the next group to adopt (early adopters, including the subset of opinion leaders) do so because of an appraisal of the innovation's attributes; and the subsequent large majority assumes because others have done so and they come to believe that it is the right thing to do (an imitative effect). These motivations and time of adoption are related to a prediction by each adopter's structural position in the network that ties the social system together (Dearing, 2009). Diffusion approaches to spread effective social work programs can focus on the tailoring of messages according to each individual’s stage in the individual-decision process, legitimisation by high-status persons as a cue to attention for others, employment of change agents to interact with potential adopters, advocacy by organisational champions, or the cooperation of informal opinion leaders. Our interventions must be high in reach but low in cost to demonstrate the worth of intervention (Dearing, 2009) most persuasively. The decision-making process of diffusion occurs through a five-step process that include awareness, interest, evaluation, trial, and adoption. These steps were critical to adopting the Eco-san toilet and applying human urine in agriculture. The adoption process happened only through a series of communication channels among the learning communities. During the process it may also be the case that an individual may reject an innovation during or after adoption (Rogers, 2010).

The Integrated Behavioral Model for WASH (IBM-WASH). The "holy grail" of health promotion and behaviour modification are essential to preventing numerous serious and persistent health issues (Aunger et al., 2010; Langford & Panter-Brick, 2013). Even if communities are informed about health risks and simple ways to reduce them, behaviour change is a challenge to initiate and maintain. An essential strategy for reducing diarrheal disease and other WASH-related illnesses in school settings is through hygiene behaviour change interventions, often combined with providing or promoting low-cost water, sanitation, and hygiene (WASH) and Eco-san technologies. IBM-WASH links were adopted and maintained to significantly improve health, sanitation and hygiene-related behaviours and technologies.

Numerous factors can affect people's health-related behaviour, including reminders, health messages, role models, services, and skills, as well as altered physical environments (such as products or facilities) and altered social contexts (such as establishing school-health clubs). People can also be coerced through the threat of punishment and the influence of social institutions (Aunger et al., 2010).

Several theoretical models and frameworks have been established to pinpoint the major forces behind and obstacles to better hand hygiene and Eco-san-related behaviour. They vary in scope and focus, though; some address particular behaviours (such as handwashing with soap (HWWS), water treatment, and the prevention of diarrheal disease), while others concentrate more broadly on WASH/Eco-san practices; some concentrate on individual-level factors that influence behaviour, while others have a broad ecological approach that examines the individual, community, environmental, and policy levels. A model for changing hygiene behaviours is provided by Mosler (2012), focusing on psychological aspects of health such as attitude, risk perception, and self-control. Aunger et al. (2010) and Curtis et al. (2011) emphasise the significance of habit and emotional motivators (such as disgust, connection, and nurture) for ongoing handwashing. Figueroa and Kincaid (2010) focused on efficient communication strategies for promoting hygienic and sanitation practices.

Theoretical IBM-WASH models for behaviour modification included contextual factors (such as gender and socioeconomic status) but mainly concentrated on individual-level features instead of larger structures and social ecology (Dreibelbis et al., 2013b). The factors that influence the formation of habits and the attributes and characteristics of WASH behaviour are rarely discussed.

Based on a review of published articles and other writings about behaviour change in sanitation and hygiene, Dreibelbis et al. (2013) created a comprehensive framework for analysing the behavioural determinants of WASH. They inform intervention development and present scholarly discussion of existing WASH-related behavioural models within an ecological framework. They have identified three dimensions that influence behaviour change and adoption of new technologies/practices: a) contextual factors (e.g., access to water and soap at handwashing station and toilet), b) psychosocial factors (e.g., shared values, shame associated with undesirable behaviour, perceived disease risks), and c) technological factors (e.g., availability of user-friendly technological). These dimensions have functioned at five levels (rows): habitual, individual, interpersonal/household, community, and societal/structural (column) (see Table 2.1). The IBM-WASH model was used in this study to help develop interventions through a series of activities. Without a predetermined evaluation of the most important factors, it offered a comprehensive explanation framework that combined a body of theory regarding the modification and upkeep of WASH behaviours.

Table 2.1. *The Integrated Behaviour Model for WASH (IBM-WASH).*

Levels	Contextual factors	Psychosocial factors	Technology factors
Societal/Structural	Policy and regulations, climate and geography	Leadership/advocacy, cultural identity	Manufacturing, financing, and distribution of the technology/product, current and past national policies and promotion of technology
Community/ School	Access to markets, access resources, the built and physical environment	Shared values, collective efficacy, social integration, stigma	Location, access, availability, individual vs collective ownership/access, and maintenance of the product/ technology
Interpersonal/ Household	Roles and responsibilities, household structure, division of labour, available space	Injunctive norms, descriptive norms, aspirations, shame, nurture	Sharing of access to product/ innovations modelling of the use of technology
Individual	Wealth, age, education, gender, livelihoods/employment	Self-efficacy, knowledge, disgust, perceived threat	Perceived cost, value, convenience, and other strengths and weaknesses of the technology/ product
Habitual	Favourable environment for habit the formation, opportunity for and barriers to repetition of behaviour	Existing water and sanitation habits, outcome expectations	Ease/Effectiveness of routine use of technology

The interventions to improve sanitation and hygiene practices ultimately foster and maintain behaviour change at the individual, school, and structural levels. Several models have emerged in response to this role of interventions. Yet, existing frameworks have several limitations, such as a lack of focus on WASH practices' contextual, psychosocial, and technology dimensions or reliance on individual-level theories and outcomes. Moreover, theoretical models have rarely been used to develop and evaluate WASH interventions (Fiebelkorn et al., 2012). The IBM-WASH framework provides a simple, adaptable tool for understanding WASH behaviour and habit formation informed by existing theoretical insights at multiple levels and dimensions. The development of the framework also underscores several research gaps associated with WASH research and evaluation.

As outlined earlier, this model has three dimensions/factors; contextual, psychosocial, and technology. Each dimension has five levels: societal/structural, community, household/interpersonal, individual and habitual (Dreibelbis et al., 2013a). Various studies, conducted worldwide on contextual factors, psychosocial and technological factors of structural, community, interpersonal/ household, individual and habitual levels, have supported the IBM -WASH model as an effective WASH behaviour change model in recent years. A review of IBM-WASH-based research and articles shows that this model has practical applications (Hussain et al., 2017; Karakaya et al., 2014).

Contextual factors. This factor mainly evaluates students' acceptability and feasibility of the Eco-san toilet or urine diversion toilet at the interpersonal level. The school's role and responsibility were crucial for using and maintaining UDT. In this study helpers are more responsible for the cleanliness and storage of urine in the reserve tank. All school stakeholders should be liable for operating and keeping the toilet clean and applying urine fertiliser in the Eco-garden (Karakaya et al., 2014).

In contrast, a study conducted in Bangladesh on assessing the acceptability and feasibility of child potties for safe child faeces disposal in rural Bangladesh under the contextual factor of the IBM-WASH model found that mothers were fully responsible without family members' support (Hussain et al., 2017). A systematic review of what factors affect sustained adoption of safe water, sanitation and hygiene technologies by (Dreibelbis et al., 2013a) suggests contextual factors that gender role, socioeconomic status of the family, and educational status of individuals are determining factors for sustainable adoption of WASH behaviour. The same study further mentioned that WASH infrastructures, access to the market, the role of the individual in household situations, and weather and climatic condition of the place were also the determinant factors for sustainable adoption.

Psychosocial factors. A study in Bangladesh mentions caregivers' self-efficacy in training their children to potty and aspirations of forming good patterns of not defecating in open spaces in the future by their children (Hussain et al., 2017). Another qualitative study in Bangladesh found that disgust is a barrier to using trace beans inside the toilets. The respondents from both sexes feel disgusted about disposing the menstrual pads and condoms without wrapping them in communal toilets. This is related to the psychosocial factors in the individual level of the IBM-WASH model (Yeasmin et al., 2017). A study in Burundi on the influence of contextual and psychosocial factors on handwashing reveals that caregivers' self-efficacy in handwashing at a critical time was high. Their practices were also increased simultaneously (Seimetz et al., 2016).

Technological factors. A study on explaining low rates of sustained use of siphon water filter: evidence from follow-up of a randomised controlled trial in Bangladesh under technology factor at the individual level and habitual level of IBM-WASH found that motivation towards the use of siphon filter has health benefits, most (86%) of the respondents reported that frequency of illness was decreased after use of siphon filter whilst the frequency of their children ill with diarrhoea, dysentery, jaundice and vomiting was high earlier when they did not use the filters (Najnin et al., 2015). Similarly, a systematic review found that the cost of materials (soap) and perceived value (extraneous expense) of the technology play a vital role in adopting soap used for handwashing. Soap was available in their household for other domestic use, whereas managing soap for handwashing was an extraneous expense (Hulland et al., 2015). Another systematic review of technological factors found that affordability of prescribed WASH technology, durability, availability in the local market within people access, and ease of technology from the operation and maintenance point of view is also considered important factors (Hussain et al., 2017). Another study (Paasche, 2017) shows that chlorine was found unfavourable as a water treatment agent under technology factors, whilst bio-sand filters were accepted as a more favourable water treatment process due to chemical-free technology.

Except for the IBM-WASH model, other models and theories are also helpful in changing the health behaviour of individuals and communities. The trans-theoretical model (TTM) is an influential and seminal model for positive health behaviour change. It has six stages: pre-contemplation, contemplation, preparation, action, maintenance, and termination as the behaviour change process, although it may not always be linear. This model effectively supports to quit smoking, drinking, and overeating individuals (Glanz et al., 2008). The health belief model (HBM) is another feasible model for health behaviour change, creating fear of unhealthy habits. Close to the psychosocial factors of the IBM-WASH model, it has four constructs: perceived susceptibility, perceived severity, perceived benefit, and perceived barrier; basically, perceived susceptibility and perceived severity are responsible for creating fear through an individual's belief system toward poor health behaviour (Rosenstock, 1974). Similarly, the ecological model of health behaviour change, communication theory, social cognitive theory, precaution adoption process model, theory of reasoned action and theory of planned behaviour (Glanz et al., 2008) are some appropriate health behaviour-changing models, including WASH.

The behavioural outcomes are influenced by the contextual, psychological and technological factors that operate at school, individual and habitual levels. Multidimensional determinants like available facilities, the awareness level of the stakeholders, culture, and tradition are related to changing the students' health behaviour in school. This study mainly focused on behavioural outcomes through participatory hand hygiene and ecological sanitation interventions. Therefore, the IBM-WASH model is found to be most appropriate to discuss the findings of this study.

Sanitation and Hygiene Approaches

In 1953, WHO and Regional Water and Sanitation Group for East and Southern Africa (RWSG-ESA) initiated the PHAST approach to address the sanitation and hygiene behaviour change (Dumba et al., 2013). A participatory approach encourages people to analyse situations, identify critical problems, and decide what needs improvement. In addition, PHAST directs the need-based activities by making an appropriate plan and acting (Dumba et al., 2013). It also helps promote sanitation and hygiene behaviour among students and the community. Sanitation and hygiene promotion are crucial in changing collective and individual behaviours and fostering ownership and sustainable use of sanitation and hygiene knowledge, practice and praxis (Dumba et al., 2013).To promote sanitation and hygiene, the management and use of the technology and services of the systems must be implemented correctly (World Health Organization, 1996). The sanitation and hygiene technology comes with “educational” to ensure behaviour change since behaviour change is critical to improving access to and practices around sanitation and hygiene (World Health Organization, 1996). The PHAST approaches are intended to help academics, policymakers, sanitation and hygiene practitioners, and other concerned individuals and organisations to accelerate their progress towards achieving the Sustainable Development Goals (SDGs), especially goal 6 (Ensure availability and sustainable management of water and sanitation for all) (German WASH Network, 2017). This approach developed principles to promote sanitation and hygiene behaviour (World Health Organization, 1998) and it works on the premises of school and community to develop awareness of water, sanitation and hygiene through participatory activities by developing and carrying out a plan to improve the situation (Dumba et al., 2013).

In this study, the installation of technological components of the study, such as UDT, source separation of solid-liquid, Eco-garden and handwashing stations with soap management in the school, was supported by NORAD funded the NORHED/ *Rupantaran* project. Additionally, the implementation included a behaviour change approach called Participatory Sanitation and Hygiene Transformation - PHAST (Almazan, 2014) that deals with the outcome of the behaviour change process. The most important ones are the output of behaviours with an intention and need little cognitive effort. Starting habits are the most important since the aim is to achieve long-term behaviour (De Buck et al., 2017).

The PHAST approach introduced by the World Health Organization (WHO) is based on learning and planning methodology through participatory activities. Learning communities are empowered to develop and carry out plans to improve their situation and embrace sustainable behaviour changes. The goal of demonstrating the routes between sanitation and hygiene is to improve hygiene and reduce faeces-to-oral diseases. PHAST aims at enhancing the management of water and sanitation services in the society, where one key is believed to come with an understanding of the situation. Therefore, information is believed to be an incentive to change behaviour (World Health Organization, 1996). The communities engaged in the developing process by analysing their hygienic behaviour and participating in the planning process, giving them the self-esteem to operate and own the facilities. The approach consists of six participatory steps: i) assessing their knowledge base, ii) investigating their environmental situation, iii) visualising a future scenario, iv) analysing constraints to change, v) planning for change, and vi) finally implementing change. Also, they developed a toolbox to perform these steps.

Participatory decision-making means that the people closest to the problem are also involved in making decisions that affect their problems and being since they are the experts in their situation. The co-researchers are experts, and their involvement and dedication become more robust and sustainable than external decisions.

The exchange of information increased to resolve a problem; they expected to look for the necessary information and discover new things (World Health Organization, 1998). Helping and supporting people can learn from each other, recognise their knowledge, and find gaps. With activity-based learning, the school can more easily choose to take the initiative for development. WHO (1996) argues that presenting several benefits of a solution might be good because the connection between poor sanitation and disease can be challenging to understand and not sufficiently motivating to change behaviour. There can also be solid social norms, traditions, beliefs, or religious motives that challenge a behaviour change. Understanding the project's main objective does not need to be the objective that motivates the most (World Health Organization, 1996).

Another model of behaviour changes is The Child to Child (CTC) approach which was formally established in 1987 and has been based at the University of London's Institute of Education since 1978 (Peal et al., 2010). The CTC approach was implemented to promote health education and behaviour change in over 70 countries globally. Since its inception, the CTC approach has contributed to crucial health behaviour change activities in hygiene, water and sanitation and disease prevention. In this approach particular thematic areas have also been identified where the process is seen to have a tremendous and lasting impact (Babul, 2002 p. 12), such as (i) Health Education and Promotion in Schools; (ii) Early Childhood Development; (iii) Children in communities affected by hygiene-related diseases, and (iv) Participatory, practical education. It is a rights-based approach to children's hygiene promotion and development. As a result, children's personal, social, emotional, moral, and intellectual/ cognitive development are enhanced (Peal et al., 2010). CTC facilitates children's understanding of development issues and explains why healthy behaviours are essential and then encourages them to take ownership and identify health and development priorities relevant to themselves and their communities. Likewise, it develops children's decision-making and problem-solving abilities to take action on identified priorities (Bhutta & Sylva, 2015).

Curriculum Review of Sanitation and Hygiene Education in Nepal

Structured teaching of health education practices is relatively new in Nepal. Education system of Nepal could be discussed into four broad stages viz: (i) Beginning from the takeover by the Rana regime in 1847 until is was overthrown in 1951 and characterised by restriction and control of mass education (ii) From 1951 to 1971 characterised by unplanned expansion, greater opportunity of involvement and limited state engagement (iii) Beginning of national education system plan (NESP) in

1971 with high state involvement, centralisation and standardisation and (iv) beginning with the restoration of democracy in 1990 characterising high government involvement in school reform, high expansion of primary schools and government commitment to decentralisation of education (Carney et al., 2007).

Similarly, health education under the education system in Nepal has started from (a) *Rastriya Sikchhya Samitee* (National Education committee) (1954), including science and health education in the secondary level curriculum (b) Health and Physical education included in secondary level as a separate subject from 1971, national education system plan (NESP), (c) Health and Physical education included in the primary and lower secondary level with 50 full marks since 1998 (Government of Nepal, 2007).

Health Education in schools is one of the most effective ways of promoting health in a society. It helps build students' knowledge, skills, and positive attitudes about health and healthy behaviour. It motivates students to improve and maintain their health, prevent disease, and reduce risky behaviours (World Health Organization, 1996). Health Education curricula and institutions help students learn skills to make healthy choices throughout their lifetime. Effective curricula result in positive changes in behaviour that lower students' risks. It promotes learning in other subjects as well. Evidence shows that reading and obtained scores of basic level students who received comprehensive health awareness were significantly higher than those who did not (Hausman & Ruzek, 1995). The overarching goal of health education in Nepal is to improve living conditions and the overall health status of individuals and societies with skills, attitudes and functional knowledge that support physical, emotional and social well-being (Centre for Curriculum Development, 2007).

Over the five years of the Early Grade Reading Program (EGRP), the Curriculum Development Centre (CDC) has revised the current curricula of grades 1-3, to focus more on fundamental reading, writing, and comprehension skills. Current requirements of subject-specific knowledge have been merged by integrating different learning needs into one curricular package, focusing on learning the necessities. The Fourteenth Plan (2073/074- 2076/076) stated that an integrated curriculum was developed in early grades (1-3), tested, and implemented accordingly.

The integrated curriculum, 2076, was framed based on interdisciplinary, multi-disciplinary, problem-based and theme-based approaches. There are some health-related contents like handwashing before a meal, toilet use, use of clean and safe water, cleanliness of the surrounding of toilet and tap, healthy behaviour and disease prevention under the Social Study subject called *Hamro Serophero.* However, it does not go beyond the basics such as use of Eco-san toilet, application of human waste as agricultural fertiliser and handwashing with soap.

In the latest National Curriculum Framework Nepal, 2076, out of seven subjects, sanitation and hygiene education-related contents are incorporated in Health, Physical and Creative Art curricula of Grades four and five, three credit hours with an overall of 96 hours have been allocated for an academic session. This framework includes environment-related content, including life and non-life things, causes of environmental pollution, waste management, use of the toilet, personal hygiene. Emphasis has been laid on student-centred activities at basic level. A teacher must play the role of facilitator to activate students' mind. Generally, the methods used in teaching are group discussion, brainstorming, role play, buzz session, game and simulation, debate, project work, field trip, case study, demonstration and discovery.

The contents of environmental sanitation, causes of environmental pollution, segregation and proper management of solid waste, types of toilets and their good use, etc., are included in science and technology. In contrast, the health and physical education curriculum includes personal hygiene, especially handwashing with soap, games and sports, and many others.

Similarly, the National Curriculum Framework of School Education (Grade 6-8), 2076 aims to raise health awareness by developing knowledge, attitudes, and skills related to Health and Physical Education among basic-level students. The interrelationship between human beings and the environment, the effects of environmental pollution on human health, the use and importance of toilets, the structure and use of pit toilets, solid waste management and menstruation hygiene management are included in this curriculum framework. However, the curriculum framework does not mention any participatory teaching-learning activities and nor does it indicate the use of Eco-san toilet in a school setting and urine fertiliser application in the school garden.

Policy Review of Sanitation and Hygiene in Nepal

Nepal has made considerable progress in fundamental sanitation administration, with inclusion multiplying to 62% in 2011 (Adhikari et al., 2015) from 30% in 2001. Nepal has seen social energy and improvement in sanitation, with many villages and schools being declared open-defecation-free. Coverage of basic sanitation facilities has now reached 81% of the population (ESDMS/DWSS, 2015). To accelerate the implementation of SDG 3 (Good health and well-being) and 6 (water and sanitation) to consolidate the country's far-reaching changes, Nepal has gained sanitation coverage to 99 %, targeted at 86.5 by 2019. The proportion of latrines users has increased from 67.6 % in 2015 to 85 % in 2019 (National Planning Commission, 2020).

Sustainable Development Goal No-6 is dedicated to water and sanitation. The UN General Assembly has agreed that the goals have been decided, and work continues to focus on defining the indicators and monitoring framework. The SDG emphasises universal and equitable coverage, necessitating the WASH sector to work for the sanitation and hygiene system. Targeting to fulfil SDG 6, the challenge to the government is ensuring equal access to WASH facilities for high and low-income households and addressing the disparity between different provinces and regions. However, the sanitation and hygiene sector in the school setting is still not strong enough to ensure healthy behaviour among children though the Ministry of Health and Population and Ministry of Education have developed a strategic plan to take care of WASH facilities at the school and health facilities(National Planning Commission, 2020)

Nepal has significantly reduced the under-five child mortality rate from 47 in 2010 to 30.8 in 2019 per 1000 live births (Government of Nepal, 2019/20). Still, if we look at the cause of deaths, sanitation and hygiene-related diseases are the leading cause of morbidity. Hygiene is being gradually mainstreamed as a critical component for maximising public health outcomes, keeping people and their environment clean, preventing the spread of diseases, and improving the status and well-being of the people.

Access to safe water, sanitation and hygiene is a fundamental right of human beings. The constitution of Nepal – 2015 mentions in Article 35 (4) Right to Health: Every citizen shall have the right to access safe sanitation and hygiene. Article 30, Right to clean environment: 1) Every person shall have the right to live in a healthy and clean environment; 2) The victim of environmental pollution and degradation shall have the right to be compensated by the pollutant as provided by law. Some policy-level efforts have also been made to expand Nepal's Eco-san and School Sanitation and Hygiene Education (SSHE) program.

The Eighth Plan (1992-1996) focused on the integrated implementation of drinking water and sanitation programs, involvement of user committees (UCs), training on latrine construction, promotion of sanitation education and expansion of sewerage and drainage systems in urban areas. In 1992, the Environmental Sanitation Section (ESS) was created at DWSS as a focal unit to help formulate policy, plan, and program for sanitation promotion. Nepal National Sanitation Policy and Guidelines for Planning and Implementation of Sanitation Program 1994 formed a sanitation policy, coordinated with concerned agencies and budgetary provisions and encouraged gender and social inclusion. From 1992 to 1997, The Third Rural Water Supply and Sanitation Sector Project were implemented in the Far-Western and Eastern Development Regions (WAN, 2008). In 1994, the Nepal National Sanitation Policy and Guidelines for Planning and Implementation were implemented. UNICEF took the initiative to implement the School Sanitation Program in 1997 based on the child-to-child approach. The development and implementation of the Basic Sanitation Package commenced in 1999 to reinforce community sanitation.

The Ninth Plan (1997-2002) made a shift from the traditional role of the government as a provider or implementer to that of a supporter or facilitator by making users more accountable and involved with the initiation, implementation and operation and maintenance of water supply and sanitation project (Pyakuryal, 1998). Following a country-level assessment of the school sanitation program in 1999, UNICEF introduced the School Sanitation and Hygiene Education Program in 2000 in partnership with DWSS. The National Sanitation Week was launched in 2000 for broader advocacy, awareness and political commitments. In 2004, the Rural Water Supply and Sanitation National Policy and Strategy and the Sectoral Action Plan were formulated.

In the Three-Year Interim –Plan (2010/2011- 2012/2013), government introduced the concept of one-household-one toilet through the budget speech of 2066/67. It reinforced the government's commitment towards total sanitation. After the International Year of Sanitation- 2008, the sanitation movement in the country has accelerated, causing a significant increase in coverage.

Sanitation and Hygiene Master Plan 2011 was formulated to streamline the sanitation sector activities with a broader sectoral vision, innovative strategic orientation, multi-stakeholder collaboration and locally managed financing modality to improve sanitation and hygiene. The Master Plan has given thrust to resolve institutional, behavioural, cultural and socio-economic barriers and synergise efforts to achieve open defecation-free conditions and promote sustainable hygiene behaviours.

The Government of Nepal has developed the School Sector Development Plan (SSDP) for 2016-2023 to continue its efforts and ensure equitable access to quality education. SSDP aims to improve technical and vocational education using collaboration with health sectors, community organizations and other concerned institutions and organizations. Strategically SSDP expects to empower schools by providing health services, including school toilets and handwashing facilities (GON, 2016; GON/MOEST, 2018). The GON targets to promote sanitation facilities that are environmentally sound and user-friendly for school children through SSDP. SSDP

(2016) incorporate school sanitation agendas to promote healthful school living, health services and skill-based health education in collaboration with MOHP, MOEST and various subordinate bodies. It also seeks to change the health behaviour of school children by adhering to the WASH procedure and the school sanitation and hygiene standards it sets (GON, 2016). At the same time, WASH Procedures 2018 focuses on improving the condition of school sanitation by mobilising not only government organizations but also empowering and mobilise student clubs (Eco-club, child club, Nepal Junior Red Cross) in school (GON, 2016)

School Sanitation and Hygiene Programs were implemented in Nepal in the late 1980s. In 1997, UNICEF took the initiative to implement school sanitation and hygiene in collaboration with Nepal Red Cross Society (NRCS) and Nepal Water and Health (NEWAH) based on the Child to Child (C-to-C) approach. The School Sanitation and Hygiene Education (SSHE) program were then piloted in Nepal in 2000 as a global initiative of UNICEF and the International Water and Sanitation Centre (IRC) (UNICEF, 2006).

Ministry of Health and Population, Government of Nepal has set the targets to achieve SDG 3: Health (ensure healthy lives and promote well-being) for all at all ages) and SDG 6: WASH (ensuring availability and sustainable management of water and sanitation for all) and programs are planned and they are incorporated in 'National Standards for WASH in Health Care Facilities 2018' (Government of Nepal, 2018). It has a provision of improving toilets for males and females and maintain them in health care facilities. Likewise, a basin with soap and alcohol hand rub or hand hygiene materials were available in the toilets. Over the years, Government of Nepal has created several initiatives for the WASH sector. The significant initiations of the SSHE program in Nepal are mentioned in Table 2.2.

Table 2.2: *Major Initiatives on SSHE in Nepal*

Date	Initiation
1980	School sanitation was implemented on a small scale.
1997	Initiation of SSHE applying the C-to-C approach by UNICEF
1999	UNICEF carried out the country-level assessment on school sanitation
2000	UNICEF piloted SSHE with the collaboration of IRC
2000	DWSS and UNICEF developed guidelines on SSHE, and it was piloted in 4 districts of Nepal
2001	SSHE was scaled up in 15 districts of Nepal
2002	IRC and UNICEF enhanced life skills-based hygiene education in public schools
2004	Rural Water Supply and Sanitation National Policy and National Strategy have recognised SSHE
2005	DWSS and UNICEF carried out SSHE participatory assessment in 71 public schools in 7 districts
2005	Nepal participated in the global workshop held in the Netherlands for SSHE participatory assessment
2006	DWSS and UNICEF developed the guidelines on SLTS
2007	UNICEF piloted School WASH Education
2010	Nepal participated in the international workshop on SLTS and children’s involvement in CLTS held in Nairobi
2011	Sanitation and Hygiene Master Plan 2011 has recognised School sanitation program by a total sanitation campaign. The plan outlines the basics of sanitation and hygiene behaviour

	change at school and emphasises leadership selection, stimulating children to promote sanitation and hygiene behaviour change
2012	DWSS has prioritised the school WASH program
2014	National Water Supply and Sanitation Sector Policy 2014
2015	Policy planning regarding water and sanitation (improved sanitation) has been optimal (DWSS, 2015).
2016	Nepal Water Supply, Sanitation and Hygiene Sector Development Plan (2016-2030).
2018	School Sector Development Plan 2016/17-2022/23
2018	National Standard for WASH in Health Care Facilities 2018
2018	School WASH Procedures, 2018
2021	Education Sector Plan (ESP), 2021-2030

Methodological Review. Participatory Action Research (PAR) involves participants and researchers (Whyte et al., 1991) as collaborators in the research process. PAR refers to an inquiry where the people who are the target group of the investigations are involved in the inquiry process (Reason P. & Bradbury H., 2008). "*Participation in participatory action research entails that participants are co-creators in the knowledge development phase and interpretation of result"* (Kindon et al., 2007). Participatory action research was introduced in education in 1940s -1950s (Pine, 2008). Conventional research in education has had less impact on changing people's sanitation and hygiene behaviours (Bennett et al., 2018; Mara et al., 2010). PAR was used in this research to establish healthy hygiene and sanitation behaviour among the students. Incorporating the PAR knowledge in the Nepalese context, NORHED/*Rupantaran* project, funded by Norad, decided to conduct a research based on behavioural change and sustainability through collaborative research and activities with classroom teaching and direct involvement of students, teachers, parents and other stakeholders. This study was conducted to improve the students' sanitation and hygiene behaviour through UDT and sanitation and hygiene education. The researcher facilitated collaborative learning and capacity building in this research, which desired health-promoting behaviour outcomes.

PAR draws heavily on Freire's concept of praxis, whereby action and reflection are intertwined (Baum et al., 2006). It is a democratic process concerned with developing practical knowledge to pursue worthwhile human purposes, grounded in a participatory worldview (Whyte et al., 1991). PAR has a double mission. First, it provides knowledge through reflective inquiry, which results in an action to improve practice or situations in which students find themselves and want to change. The activity was evaluated iteratively, and further action was collaboratively decided upon the repeated cycle if necessary. Secondly, it brings about change relevant to the context and culturally acceptable (Baum et al., 2006). Basic level students and their teachers joined as participants in the research bring personal experiences using different intervention activities.

Teachers contributed with expert knowledge of hygiene and Eco-san and an understanding of their schools' needs and regulations. PAR is used as training and the person-to-person observation assumes that knowledge is contextual. It is based on the student's values and interests (Baskerville, 1999; Pilemalm & Timpka, 2008). Furthermore, involving students and teachers in the teaching-learning process increases engagement, fosters ownership, and builds students' capacity to develop hygiene behaviour after the intervention (Hetherington et al., 2017). PAR became a tool for achieving health promotion behaviour, empowering the individuals, enabling them to establish healthy habits and capacity-building goals (Baskerville, 1999; Whyte et al., 1991).

According to Reason P. & Bradbury H. (2008), communicative spaces should be the first step in PAR. "*PAR spaces and structures for intervention based on democratic rules of participation where participants feel safe, free and pleasant to share ideas, which is a prerequisite for achieving the kind of interaction that will result in learning and empowerment*" (Kindon et al., 2007 p.112). Therefore, within the study, it was imperative to adopt a research design that was facilitated and flexible enough to accommodate change as the next course of action that depends on knowledge transformation. I facilitated the transfer of knowledge to the students, teachers, SMC/PAR committee members and child-club members and contributed to participants' capacity building by providing technical support (Byrne & Alexander, 2006).

In this study, research participants were not the subjects but collaborators The PAR methodology is pluralistic. The practices conducted within it are varied and not prescribed; they all hold the same principle of participating in research to emancipate populations and improve their well-being through methods of reflection upon their situation, knowledge and capabilities and use these to take meaningful action (Balakrishnan & Claiborne, 2017; Baldwin, 2012). *"PAR means the research work brought together the problem, design and solution and implemented change"* (Reason & Bradbury, 2008 p.78). The PAR approach views the school's practical sanitation and hygiene problems as the starting point of investigation and assumes that potential solutions reside in local wisdom (Brydon-Miller, 1997; Chevalier & Buckles, 2019).

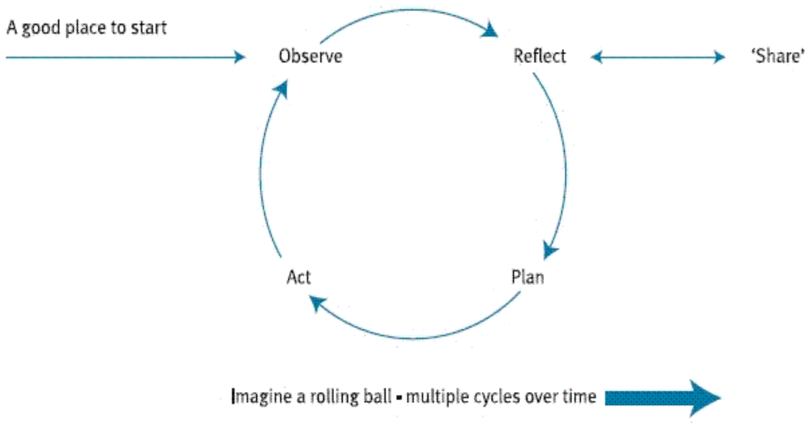

Figure 2.3 Participatory Action Research Cycle, Source: Ozanne & Satcioglu, 2008.

The research followed the multilevel stakeholder engagement strategy by applying the above phases of the PAR cycle. I employed the following phases in conducting the research:

Phase I: Observing. Observation is generally made through direct observation, transect-walk and collecting data. Participants (students, teachers, SMC, PAR committee, local leaders, child clubs, eco-clubs, Junior Red Cross, etc.) were engaged to identify the context and constraints of health sanitation and hygiene in the school setting. Hand washing stations, soap management, Eco-san toilet, and human urine supply system were the main technological components. In contrast, sanitation and hygiene education, guidelines for washing hands with soap, using guidelines of Eco-san toilet and application techniques of urine in the crops/school garden were the educational components of this study. The main essence of the study was to identify the knowledge, value and application of the elements above within the learning community, build a relationship, and understand the context in a participatory manner to set the scene for this research.

Phase II: Planning. PAR intends to produce practical knowledge used in the learning communities in their daily lives. This approach involved the learning community as co-researchers to improve professional practices and local situations. This study was deeply rooted into the in-depth engagement of myself and the co-researchers collaboratively. In PAR, the co-creation of knowledge gives a prominent planning theme. Under this phase, due care was given on participation, acknowledging and sharing power, building relationships, establishing open communication and developing strategies for personal and social transformation. The planning of this study was contextual and flexible as per the situation's demand rather than being prescriptive in advance. Major components of this study were the sensitisation classes regarding sanitation and hygiene, the application of human urine as agricultural fertiliser, and HWWS to change the sanitation and hygiene behaviour of the students.

Phase III: Acting. During the third phase, participants take action, deciding what to do and how to carry it out. The action is the outcome of the action; the group must reflect carefully on the process and its outcomes. After the third phase, there is a reflection phase.

The entire PAR team worked together to achieve the optimum learning outcomes. Members of the PAR team were involved in sensitisation activities regarding HWWS and Eco-san toilet through classroom teaching and learning and students were engaged in hands-on activities for learning. Strategies included improvisation of instructional materials, conducting workshops and training for the teachers, engagement of SMC/PAR committee, inviting child club to maintain HWWS, and Eco-san technology. Classroom pedagogy emphasises interactive, practical, collaborative, and participatory dimensions to encourage the spirit of creative and critical inquiry to enhance learning outcomes. Cross-cutting issues such as focusing on gender, equity, and ICT use in classroom delivery were given due importance. Recruiting and training female teachers and child club members for role modelling and capacity building were also conducted.

Finally, in the third cycle of this PAR, similar methods and tools were used to the first cycle to identify the pedagogical and behavioural achievements resulting from the participatory interventions. Moreover, the effectiveness of using the UDT and urine fertiliser in the school garden was assessed.

Phase IV: Reflecting. Based on the theoretical underpinning of student learning, reflection is viewed as a cognitive, affective and psycho-motor process (Bahati et al., 2018). During the reflective cycle, the PAR practitioner acknowledges the growth in wisdom accumulating through every cycle. In this study, PAR brought a significant change in sanitation and hygiene behaviour through SHE and it was a strong start within one academic year's intervention. The PAR team worked together based on the field reflection and realities during the year. The relevance of the reflections established the validity of the participants' subjective lived experiences.

Review of the Empirical Literature

Every child has the right to a safe and healthy learning environment, including adequate WASH. WASH in schools significantly reduces hygiene-related diseases, increases student attendance, and contributes to dignity and gender equality (UNICEF, 2013). WASH in schools is increasingly recognised as a critical component of sustainable development. Twenty-seven per cent of the global population (1.9 billion people) used private sanitation facilities connected to sewers from which wastewater is treated. Several studies have been carried out in this sector and some of them related to this research have been reviewed here to update myself in research knowledge and identify the research gap in the literature.

Sanitation and hygiene education. Sanitation and hygiene education are all activities based on classroom teaching that improve and sustain hygiene to raise the quality of life and an individual's health (UNICEF, 2018). The USA's National Sanitation Foundation (NSF) defines sanitation education as a way of life. The quality of living is expressed in a clean school, home, farm, business, and community. Sanitation covers the whole field of environmental control to prevent disease and promote health (K. Park & J. Park, 2015). Similarly, hygiene is known as cleanliness or conditions promoting or preserving health. Improved housing, nutrition, and hygiene with access to safe water, sanitation and good hygiene are the war against infectious diseases and bases for a clean environment, socio-economic development, and sound public health (Greene et al., 2012).

Improving drinking water conditions and sanitation facilities remains a major concern globally (Joshi et al., 2014). Significant progress has been made in the Water, Sanitation and Hygiene (WASH) sector since 1990, the MDG baseline year. However, 748 million people still rely on unimproved drinking water sources. Almost a quarter rely on untreated and surface water, 2.5 billion people don't have access to better sanitation, and one billion urinate openly (UNICEF, 2011). Basic handwashing facilities with soap and water coverage varied from 15 % in sub-Saharan Africa to 76 % in Western Asia and Northern Africa. In developing countries, 27 % of the population had basic handwashing facilities with soap and water, while 26 % had handwashing facilities lacking soap or water. The remaining 47 % had no facility. A third of the global population (38%), a quarter of the urban population (29%), and half of the rural population (48%) are using an improved sanitation system such as septic tanks or improved latrines where excreta is stored on-site in pits or tanks (Curtis et al., 2009).

Many of the world's illness and death is attributed to infectious diseases. Sixty-two per cent and 31% of all the deaths in Africa and Southeast Asia, respectively, are caused by infectious diseases. This trend is especially alarming in developing countries where acute respiratory and intestinal infections are the primary causes of morbidity and mortality among young children. *Inadequate sanitary conditions and poor hygiene practices play a significant role in developing countries' increased burden of communicable diseases* (Mills & Cumming, 2016 p.34). Previous hand hygiene studies have indicated that children with proper handwashing practices are less likely to report gastrointestinal and respiratory symptoms. Handwashing with soap has been reported to have reduced diarrheal morbidity by 44 % and respiratory infections by 23 %. However, globally, the rates at which hands are washed with soap range from 0-34 % (Vivas et al., 2010).

Diarrheal disease is one of the leading causes of morbidity and mortality in less developed countries, especially children under 5 years. Over one billion people have gained access to improved sanitation and drinking water services since 1990. Nonetheless, 2.6 billion people- over half of the developing world population- do not have improved sanitation facilities, and 1.1 billion still use water from unimproved sources. Barely one-third of the people of South Asia operate improved sanitation facilities (Thanh Xuan & Hoat, 2013).

Most of the problems mentioned above are preventable with improved sanitation, water quality and hygiene practices (GON, 2016). A review entitled 'Impact of WASH on improving health outcomes among school children' indicated that good practices of WASH reduced school absenteeism, diarrhoea and acute respiratory infection (ARI) (Joshi & Amadi, 2013). Another review entitled 'The impact of WASH on crucial health and social outcomes' claimed that school absenteeism and academic achievement are directly related to good WASH in school. Absenteeism results in poor academic performance, more dropouts and slow intellectual development (Shaw et al., 2015). It shows that if the WASH, including the toilet facility, is available at school, it helps reduce absenteeism and increases the students' academic performance (UNICEF, 2018).

The evidence mentioned above indicates that good sanitation and hygiene education and Eco-san innovations are important in promoting hygiene and behaviour. Likewise, skill-based hygiene education teaches children about sanitation and hygiene-related behaviour. Children understand and think together about their situation and practices. They can plan and act to prevent diseases at present and in the future (UNICEF, 2015). A study in Bangladesh found that 77.7 per cent of the respondents reported ash and water as handwashing materials after toilet use. The intervention focused on soap instead of ash/mud. After the intervention, it was found that 62 per cent of the respondents used soap and water as handwashing agents after cleansing the bottom. So, health and hygiene education through school education is crucial to promoting hygiene behaviour (Rabbi & Dey, 2013).

Ecological sanitation (Eco-san) toilet. Sanitation component of this study is the Eco-san system, especially the Eco-san toilet/ urine diversion toilet. It is a new sanitation paradigm that treats household wastewater and human excrement as recoverable and usable "resources" rather than "waste." It is based on three fundamental principles (Winblad & Simpson-Hébert, 2004 p. 32): i) preventing pollution, which includes soil and water pollution, as opposed to controlling it later; ii) sanitizing the faeces and urine; iii) treating the faeces as resources and making safe products into fertilizers for use in agriculture.

Eco-san is often promoted as an environmentally, economically, and ecologically viable idea. It improves the health situation of the end-users (Lienert, 2011). It provides an alternative to conventional flush and discharge systems, necessitating extensive water consumption for flushing. Since they are decentralized, these flush and discharge systems have significantly invested in treatment plants and pipe networks. These pipes originate in individual homes and collect and treat sewage from kitchens, bathrooms, sinks, and toilets as a homogeneous mixture. Occasionally, particularly in Kathmandu, untreated sewage enters the rivers and pollutes them. Eco-san safely returns human faeces to the plants by closing the sanitation loop. It saves a lot of money, which is often an issue in replacing chemical fertiliser. Eco-san refers to a philosophy of closing the sanitation loop rather than a specific technology. Human excrement (both urine and faeces) is separated from the beginning, as in a UDT, or mixed and then separated later using a filter, in various technologies that differ in functionality or design.

The UDT is a dry toilet with a urine diverter that can provide affordable, secure sanitation in a variety of settings all over the world (Devkota et al., 2019; Rieck C Münch v & Hoffman H, 2012 p.1). Numerous advantages, including odour-free operation and pathogen reduction through drying, can be realized through the separate collection of faeces and urine without flush water. At the same time, urine harvested from Eco-san can be routinely used in agriculture as a soil amender and nutrient-rich fertiliser. This practice is also known as the reuse of manure in agriculture. Many Eco-san toilet installations do not use any recovery scheme (Rosemarin et al., 2012). The Eco-san toilet is a technology that has the potential to create a sustainable sanitation system. The dry excreta management system is an alternative to pit latrines and flush toilets, especially where water is scarce.

Connection to a sewer system and centralised wastewater treatment plant is not feasible or desired, fertilisers and soil conditioners are needed for agriculture, and groundwater pollution should be minimised.

There are several types of Eco-san toilets. The single vault type has only one faeces vault—the double vault type with two faeces vaults used alternately. A variation of the single-vaulted Eco-san toilet, the mobile or portable Eco-san toilet can be made commercially or by hand from simple materials. An Eco-san toilet can be set up as a sitting toilet with a pedestal or bench that diverts urine or as a squatting toilet (Von Munch & Winker, 2011). The Eco-san toilet's most important design features are its waterless operation, source separation of urine and faeces, and ventilated vaults, also known as chambers or removable containers for storage and treatment. If water is used for anal cleansing (i.e., the users are washers rather than wipers), the water must be drained separately and cannot enter the faeces vault.

Nepal's ecosystem is influenced by the effects of the current global trend of urbanization. Approximately 15% of its total population resides in 58 designated urban areas and it is likely to increase in the coming years because the urban population is growing at 6.6% annually. This is because more people are moving to towns to escape rural poverty, conflict, and the reclassification of new towns from villages to municipalities (WHO/UNICEF (JMP), 2021). Despite improvements in sanitation, only 46% of Nepal’s population has access to some form of toilet. In many parts of the country, the built toilets often do not meet the standards for cleanliness. The challenge is to increase the number of toilets and making them accessible by deepening community understanding of how to keep people using them and practising good hygiene. A toilet must be affordable, safe, hygienic, and environmentally friendly (WHO/UNICEF (JMP), 2021).

Evolution of Eco-san toilet. The Eco-san toilet / UDT evolution review has been carried out from eight countries worldwide. These eight countries were purposefully selected; four from low, and middle-income countries (LMICs) and four from high-income countries (HICs) based on World Bank's (WB's) income-specific classification. The purpose of reviewing the evolution of Eco-san toilet/ UDT in this study is to integrate global experiences from Eco-san toilet/UDT concerning its perception, promotion, participation/practice and praxis (4Ps).

Evolution of Eco-san toilet in LMICs. The eco-san toilet is a means of sanitation improvement and a reliable source of promoting livelihood through organic vegetable and grain production using urine fertiliser. The evolution of Eco-san is reviewed in four selected LMICs.

Nepal. Nepal is one of the LMICs in South Asia, with China in the north and India in the south, east and west. Majority of the Nepalese (80%) depend on agriculture and chemical fertilizers are used in most agricultural products **(**Kabir Rajbhandari, 2008**;** Sharda & Shinjo, 2017).

The evolution of the Eco-san toilet in Nepal started in 2000 (K Rajbhandari, 2008). Government of Nepal, Department of Water Supply and Sewerage (DWSS), attended a conference in Eco-san in Germany in 2001 (Environment and Public Health Organization, 2006). In Nepal, the Eco-san toilet concept was first introduced in 2002/2003 by Environment and Public Health Organization (ENPHO) under the support of Water Aid Nepal in Khokana, Lalitpur. ENPHO constructed 10 Eco-san units in Khokana of Lalitpur district as a part of the pilot program. In the same year, the DWSS, under the support of WHO, also built 10 Eco-san units as the next pilot project in Siddhipur of Lalitpur district. Due to the traditional practice of using faeces and urine as fertilisers, adopting new technology with a similar usage concept was not new to the locals of Khokana and Sidhhipur. Hence both programs in these communities were thriving and this system was well-received locally. After the success of these pilot projects, the Eco-san concept was extensively expanded to other peri-urban areas of Kathmandu by ENPHO, Lumanti and the Centre for Integrated Urban Development (CIUD) and the project was funded by Water Aid, UN-HABITAT and WHO. This initiation ignited Eco-san in Nepal (ESDMS/DWSS, 2015).

Despite a few obstacles, both programs were well-received and admired by the community. They were beneficial for two reasons: first, they served as toilet facilities, and second, the human waste they produced was recyclable and recoverable, providing a priceless resource for agricultural requirements. In Nepal, toilets were connected to prospects for employment and financial gain for the first time. Following the success of the pilot projects, many eminent organisations, including Water Aid Nepal (WAN), gradually promoted the Eco-san latrine technology to various other urban and peri-urban areas of Nepal. These partners included ENPHO, LUMANTI (Support Group for Shelter), CIUD, Nepal Water for Health (NEWAH), and DWSS. The previous Thimi Municipality worked with NEWAH to promote this technology during the pilot period. However, municipal levels are not entirely involved in promoting and developing this technology and they seldom give their support. Municipalities may have been inactive during the period due to the political vacuum in the local government during the political transition in Nepal.

After five years of implementation, a study conducted by ENPHO showed that 97 per cent of Eco-san toilet users used Eco-san correctly, i. e. kept clean and well maintained and subsequently used the compost as fertiliser for their local agricultural fields. As a pilot project of Eco-san, most (92%) of them were constructed within the peri-urban areas of Kathmandu Valley, and as few as 8 per cent were built outside the valley. Some 81 per cent of Eco-san users listed agriculture as their primary occupation, 73 percent owned agricultural land of more than 510 m2, and some 8 per cent owned any land (Environment and Public Health Organization, 2006). Government of Nepal recognised the Eco-san toilet as one of the most essential and inevitable sanitation options available and suggested that Eco-san should be promoted (Environment and Public Health Organization, 2012).

Although human excreta has been used to some extent as agricultural manure at the community level through Eco-san toilets in Nepal, it has not been used pedagogically or practically at any other school except at a few public schools in Nepal (WAN, 2008). Therefore, this study was planned to carry out research in school setting. A community secondary school was purposively taken as an intervention school. This school is located in Khaireni Municipality Ward no 02 Chainpur, Chitwan, with easy access to the Ratnanagar, Tandi and Chitwan areas.

India. In India, a demonstration area has been built in Kerala with a toilet separating urine and the water used for anal cleaning into evapotranspiration. The introduction of ‘toilets for the deprived population’ and ‘public toilets’ as a business model was created in 1970 by Bindeshwar Pathak, a young sociology student and a follower of Mahatma Gandhi. His objective can be summed up as follows: "To restore human rights and dignity to scavengers by stopping the practice of manually handling human excreta". Pathak saw his mission to improve sanitary conditions go beyond introducing new technology. For him, it was a veritable movement to fight against casteism and the employment of millions of members of the scavenger caste in cleaning traditional latrines by sweeping out human refuse. He fought against the occupation of people in cleaning out human excreta manually by introducing a toilet model that could maintain automatically without the need for a scavenger. Pathak was also the first person to break the myth that the government must provide public restrooms as a merit good, i.e., the public merited. It has led to sub-optimal maintenance of public toilets in India. He insisted that a public toilet must also be supported by a robust business model that permits 83 accessibility while generating enough (Talat et al., 2020).

Applying a socially and culturally acceptable, sustainable and hygienic concept that helps healthy behaviour change, Eco-san/ UDT system was established in India (Calvert, 2001). So far, basic schools in some districts (Dhandhuka Taluka, Ahmedabad, Limbdi Taluka, Patan, Surendranagar) in India have established Eco-san/UDT in school setting. Construction of Eco-san/UDT was done in two stages; first, it began with classroom teaching and learning or classroom pedagogy to make students aware of this type of toilet. Secondly, the construction of such toilets on school premises for school use. In the beginning, an Eco-friendly demonstration toilet was established in Bangalore. After completing the first toilet, it was learned that UDT was expected to be innovative in the community. Then, the planning of the Eco-friendly sanitation concept for the school started in 2004, the construction of the UDT in 2005, and the inauguration of the first UDT at the primary school in Rayka village in 2006. Sanitation facilities at the private schools in Katariya village had an operation in 2006 (Werner et al., 2009).

Although UDT construction is available in school, it took only minor technological changes like anal cleansing habits, squinting slabs, and less water use. After gaining that experience, a slightly modified pan (prefabricated squinting pans) with three holes system was constructed. Daily deposits are made from the toilets into the processing chambers below the squinting slabs using UDT. The back hole of the

Figure 2.4: Eco-san Pan in Vietnam

slabs/pans was used for faecal matter, where the first hole for urination was joined with separate chambers to supply urine. After collecting human urine for 15-20 days in separate chambers, it was used as fertiliser in crops/ vegetables. Likewise, a different collection system was provided for the greywater discharge (GTZ, 2006 p.35). In this way, the Eco san system has been used and scaled up to the other schools, and now it is used in India's school and community settings.

Vietnam. In Vietnam, various dry latrines (double-vault and bucket latrines) with urine separation are used, although without complete utilisation of urine (Austin et al., 2005b). These had been promoted since 1956, followed by a health education programme to ensure the safe reuse of faeces. The Vietnam example is a double-chamber toilet built above ground, with drop-holes, footrests for squatting and a channel for conducting urine to a container. Wastes are dropped into one of the chambers while the other is kept closed. The faeces are covered with kitchen ash, absorbing moisture and disinfecting them. The paper used for personal cleansing is put into a bucket and later burnt, while the dehydrated faecal material is used as a soil conditioner (Wohlsager et al., 2010). The Vietnamese double-vault toilet originated in the 1950s when peasants using human excreta as manure found that composting reduced the smell and improved its fertiliser value. It became the critical component of a rural sanitation programme for disease prevention and increased food production in North Vietnam in 1956. They have traditionally used human urine as an agricultural fertiliser in household gardens and croplands to increase yields and save on expensive inorganic fertilisers (Phuc et al., 2006). Urine fertiliser was common in Vietnam (Jensen et al., 2005). Approximately 75% of Vietnamese have cultivated land, causing high demand for fertiliser. In 2003, 4 billion kg of nitrogen, phosphorus and potassium (NPK) fertiliser were imported into Vietnam (Dasgupta et al., 2007). To reduce fertiliser imports and fulfil the need for agricultural fertiliser, they separated human urine using UDT, then treated and used it as fertiliser (Jönsson et al., 2004). A decentralised sanitation and re-use system which integrates source separation of urine and faeces with separate collection chambers for treatment of human waste was installed (Wohlsager et al., 2010). A recent study on urine collecting systems and their constraints found that their blockages are caused by the precipitation of inorganic compounds in pipes and storage tanks (Alemayehu et al., 2020). Despite having some constraints, the experience with Eco-san/ UDT system in Vietnam suggests that dry sanitation practices are effective.

South Africa. Single and double vault types are used in South Africa, and prefabricated superstructures have appeared. One of the most important aspects is the incorporation of toilets as part of the dwellings. However, poor quality craft has been a feature of many UD projects, and it appears in some instances as if not much has been learned from overseas developments.

Since 1997, when South Africa’s first urine-diversion sanitation project was implemented in three rural villages near Umtata in the Eastern Cape, thousands of these toilets have been installed in various parts of the country. The Umtata pilot project consisted of 30 units built for research and development. They are single-vault brick structures with concrete floor slabs and zinc roofs. The pedestals are made of rotationally moulded plastic obtained commercially. Urinals were included for the menfolk. Faeces are collected in separate wooden or plastic containers in the chamber beneath the pedestal and are rotated when packed (the toilet vaults are large enough to hold two containers). While aware of the fertilising properties of excreta, the villagers do not actively use it but dispose of the dehydrated faeces in their cornfields without working it into the soil. At the same time, the urine is led into shallow soak pits (Austin et al., 2005a).

Numerous cultural values, beliefs, and discourses are associated with the use of human excrement as fertilizer, all of which have the potential to be beneficial and accepted in communities. Yet it also encounters some difficulties. Aside from non-mineral components like carbon, hydrogen, and oxygen, categorised as either macronutrients or micronutrients depending on the amount of absorption, plants need vital nutrients. The first is used about 100 times more than the second (Jönsson et al., 2004). The macronutrients—nitrogen, phosphorus, potassium, sulphate, calcium, and magnesium—are absorbed by the plant through its roots in their ionic form.

Boron, copper, iron, chloride, manganese, molybdenum, and zinc, among other micronutrients, are typically accessible in sufficient quantities through organic matter mineralization. Chemical fertilizers contain nitrogen, phosphorus, and potassium, the primary nutrients plants require. Even so, the cost of these fertilizers rises since they come from limited resource pools. It is becoming increasingly difficult to acquire the materials required for these fertilizers. Cost recovery of these nutrients further emphasizes the necessity of closing the sanitation loop. For plant growth, nitrogen demand is frequently the most restricting nutrient. Typically, it exceeds all other nutrients' total demand (Andersson et al., 2011). The toilet’s main guiding principle is ecological sanitation, which views human excrement as a resource rather than a waste. In order to complete the nutrient cycle and close the sanitation loop, it emphasizes the necessity of recycling these "resources" and utilizing the recycled sanitized human urine and faeces by returning them to the soil. Sanitizing these resources before they are used as fertilizer is very important because human excrement contains numerous harmful pathogens if discarded in the open without prior treatment.

The countries mentioned above in the world with a historical background of urine diversion toilets are connected under the Eco-san system to develop their livelihood by taking human urine as a resource. The principle of storage and use instead of drop and flush is reviewed concerning the historical development of UDT and urine fertiliser.

Evolution of Eco-san toilet in HICs setting. The evolution of Eco-san toilets has been reviewed in four HICs: China, Japan, Finland and Sweden, as mentioned in the following paragraphs.

China. In China, the old tradition of using human excreta in agriculture is still practised, and new toilets that separate urine from faeces are also being introduced on a large scale. In China, many models of Eco-san toilets have been built: (i) double-vault, (ii) ventilated urine-diversion toilets, (iii) urine diversion toilets, and (iv) three vaults with fibreglass squatting pans which were mainly funded by the Swedish International Development Cooperation Agency (Sida) and are now produced in a factory in the city of Nanning (L M Austin, 2005). The first pilot project in China started in 1997 by the Ministry of Health with the Guanxi Public Health Campaign Committee, the Institute of Environmental Health and Engineering (IEHE). After one year of the first initiation in 1998, 10,000 UDTs in 2000 Eco-villages had been built. Within five years from 1997, the number grew to more than 6,85,000 in seventeen provinces of China (Jurga et al., 2005). This rapid expansion was mainly due to putting sanitation and Eco-san on the national agenda. Now Eco-san is an integral part to china’s sanitation development and poverty reduction agenda. As a result, about 40 million households have Eco-san toilets in China (Cheng et al., 2018). The Chinese government has introduced Eco-san related contents on local television, radio, and newspapers, community visits to model villages, and village health and hygiene education.

Japan. The eco-san toilet has been used in Japan since 12th century, and they have used recycling human urine for agricultural purposes since that time ((Kitanou et al., 2017). Japan's urine recycling/disinfection system is slightly differed from human urine as fertiliser in other parts of the world, even in Nepal. The human urine for agricultural use was collected from eco-toilets and stored for about two months at 7· Degree Celsius. The application is made along undulations of 10-20cm seedlings followed by copious irrigation or supply of more than enough without excessive (Kitanou et al., 2017). Then seedlings lines are covered with soil. They apply three parameters for human urine application as fertiliser i) the application method: is to avoid direct application and comply with food safety regulations; ii) The application rate: urine added depending on the needs of soil nutrient composition; iii) The application time: the amount of urine thus determined is divided in time to meet the needs of the plants at different stages and to get an idea of the assimilation of nutrient by plants. Also, the Japanese practice of night soil recovery from urban areas separated urine and faeces since urine was regarded as a valuable fertiliser (Ferguson, 2014). Use of eco-san / UDT and application of human urine to agricultural manure.

Finland. In Finland, dry toilets are frequently used. Since no additional water treatment facilities are required, the dry toilet is the most common choice. Finland uses sewage sludge for agricultural purposes (Heinonen-Tanski & van Wijk-Sijbesma, 2005). In cases where human faeces and urine differ greatly from animal manure, Finnish law does not differentiate between Eco-san or human faeces and urine. The owners of dry toilets have been instructed to divert urine into their gardens and use them as compost, but commercial use is prohibited (Viskari et al., 2018). Like with sewage sludge, careful testing and commercialization of the fertiliser product would be necessary for widespread use (Nagy & Zseni, 2017).

People are becoming more interested in the environmentally friendly alternative of dry toilets and the recycling of nutrients as the Finnish government's legislation on rural wastewater treatment becomes more difficult. It would be necessary for the law to follow this development, but it has not changed. Additionally, as more people use dry toilets, logistics and services are required to transport waste for further treatment via composting or incineration. When installing a dry toilet and handling human waste, several acts and decrees in Finnish law must be considered. Finland has adhered to EU regulations regarding using sewage sludge in agriculture. Finnish law does not distinguish between ecological sanitation and EU directives. The use of human faeces and urine is interpreted in various ways, from following the same guidelines for animal manure to completely banning it. It has been instructed that dry toilet owners use their compost and diverted urine in their gardens, but using them on commercial crops is against the law (Heinonen-Tanski & van Wijk-Sijbesma, 2005). Like sewage sludge, careful testing and commercialization of the fertiliser product would be necessary for widespread use (Viskari et al., 2018).

The law only provides one option regarding agriculture and using human waste as fertilizer. According to these guidelines, sludge on cultivated fields may be permitted under certain conditions. In order to reduce the number of pathogens and unpleasant odours in agricultural sludge, it was treated by stabilizing the waste through digestion, composting, or other wastewater treatment practices. On the other hand, Eco-san produces composted faeces and sterile urine separately, while sludge is household wastewater (Nagy & Zseni, 2017).

Sweden. The evolution of UDT began when latrine contents were collected in buckets from each household in Swedish cities; urine was often collected separately and poured into the drain to avoid smells and prevent the latrine from filling too quickly (Kirchmann & Pettersson, 1994a). In Sweden, urine has been used to smear wounds and dry skin and, to some extent, to drink as therapy (Kirchmann & Pettersson, 1994a).

Sweden is probably the country with the most advanced collection and re-use of human urine, where farmers practise it on a large scale. Several Eco-villages in Sweden have Eco-san systems with UDTs (Martin et al., 2020). The modern urine-diversion sanitation systems with pedestals are made of porcelain in dry and flushing versions in Sweden. The flushing version is often found in high-density residential apartments or cluster housing. The urine is collected and stored in underground vaults, from where it is managed by farmers, while the faeces are flushed into a conventional waterborne sewerage system for further treatment (Martin et al., 2020). Due to the exclusion of nitrogen and phosphorus found in the urine, this sewage's reduced nutrient load reduces the treatment cost. The front compartment of the bowl, used for urine collection, is flushed with a spray. There is approximately 200 mℓ water from a nozzle in the bowl, while the rear compartment is flushed from a conventional toilet reservoir. However, this type of flushing toilet is not considered an ecological sanitation system, even if the urine is diverted (Martin et al., 2020).

Reflection from the review of Eco-san toilet evolution. Eco-san practices have shown that human excreta are a resource, and they make use of human urine as agricultural fertiliser. Similarly, several scholars (Alemayehu et al., 2020; Austin et al., 2005b; Huussiru, 2017; Langergraber & Muellegger, 2005; Prithvi Simha & Mahesh Ganesapillai, 2017) have stated that the Eco-san toilet is the best sanitation option where the toilet content, both urine and faeces, is used as agricultural fertilizer.

The perception, participation of intended beneficiaries, promotional efforts on Eco-san, practices in the Eco-san toilet or the practical application of any branch of learning regarding Eco-san found in China, South Africa and Sweden. The Government of China, South Africa, and Sweden provide a subsidy to the community people to construct Eco-san toilets. These countries play the role models or as agents of change in Eco-san advocacy. China and South Africa have exemplified large-scale Eco-san diffusion in the world. Nepal has also followed the pattern of China, South Africa and Sweden regarding the construction and use of Eco-san toilets. It is also prioritised using urine fertiliser in the crops and vegetables in Nepal. However, Eco-san toilets do not exist on a large scale as a sanitation option and this technology has not been connected to classroom teaching in schools or academic settings in Nepal.

India, Japan, Finland, and Vietnam have limited Eco-san diffusion and no practice of providing subsidies for constructing Eco-san toilets for the community. There is no mass media advocacy about eco-san technology and its utility in these countries. But even in these countries, NGOs and INGOs have been advocating for Eco-san technology.

Nutrient Value of Human Urine

"Human urine is generally pathogen-free and contains the required nutrients of nitrogen, phosphorus and potassium, which are essential for crop growth" (Esray, 2002). Eighty-eight percent of the excreted nitrogen (N), 67% of the excreted phosphorus (P), and 73% of the excreted potassium (K) are found in the faeces. From waterless urinals like those in the toilet complex, undiluted urine creates a harsher environment for microorganisms, prevents mosquito breeding, and accelerates pathogen destruction (Winblad & Simpson-Hébert, 2004 p. 32). When the urine is applied and harvested, it must be stored at temperatures between 4 and 20 degrees Celsius for the recommended time (Winblad & Simpson-Hébert, 2004 p. 32).

If all of a person's urine were used as liquid fertilizer on farmland, it would contain enough nutrients to grow 300-400 m2 of crops annually (Wilhelm et al., 2004). This demonstrates how crucial recycling this "resource" is for providing crops with a low-cost, readily available, and environmentally friendly source of nutrients. Each person excretes approximately 5 kg of elemental nitrogen (N), phosphorus (P), and potassium (K), or the generalized form N-P-K, annually (4 kg in the urine and 1 kg in the faeces) (Shi et al., 2018). Compared to chemical fertilizers, it has also been discovered that the concentrations of heavy metals in urine are deficient (Winker et al., 2009). Thus, the studies mentioned above, and practical examples have proven that urine application is beneficial in multiple ways.

Before planting the crops, undiluted urine can be applied to the soil. Depending on the crop being grown, it can be diluted or undiluted (Jönsson et al., 2004). Usually, two to five parts of water are added to one part of the urine. While creating an eco-san system, the urine can be combined with the faeces or diverted into manure at the source. According to a study done in Chile, the toilet complex has waterless urinals available. This led to the collection of pure urine, which was then physically placed into a drum and used on the farmlands after being stored for a long enough period (Calderón et al., 2020).

My study connects Eco-san toilet with education in school setting. , There is very little research into the school's Eco-gardening for changing sanitation and hygiene behaviour in a public school setting in Nepal so far. There have been many global studies on using human waste for human welfare by converting it into a resource, but its uses are still insufficient in Nepal. In China, South Africa and Sweden, human waste is considered the leading resource of agricultural fertilizer but in Nepal, it is used in very few areas. Likewise, Nepal government has not provided any incentive such as providing subsidies for constructing Eco-san toilets / UDT. The eco-san system, eco-farming, and urine diversion toilets have not been used extensively in any education setting in Nepal. In some schools, Eco-san has been applied in the initiation of NGOs and INGOs but no curricular contents related to the Eco-san system, Eco-san toilet use and application of humanure have been incorporated in the mainstream national curriculum of Nepal. Therefore, considering the need for the Eco-san system, participatory action research has been carried out to change students' sanitation and hygiene behaviour through Eco-san toilets and apply urine fertiliser in the school’s Eco-garden to produce organic vegetables.

Conceptual Framework of the Study

A conceptual framework is the researcher's understanding of how the research problem is explored (Leshem & Trafford, 2007). I have sketched a conceptual framework for this research (Figure 2.5) following the PAR approach, theoretically inspired by the transformative learning perspectives of Freire (1970) and Taylor (2009).

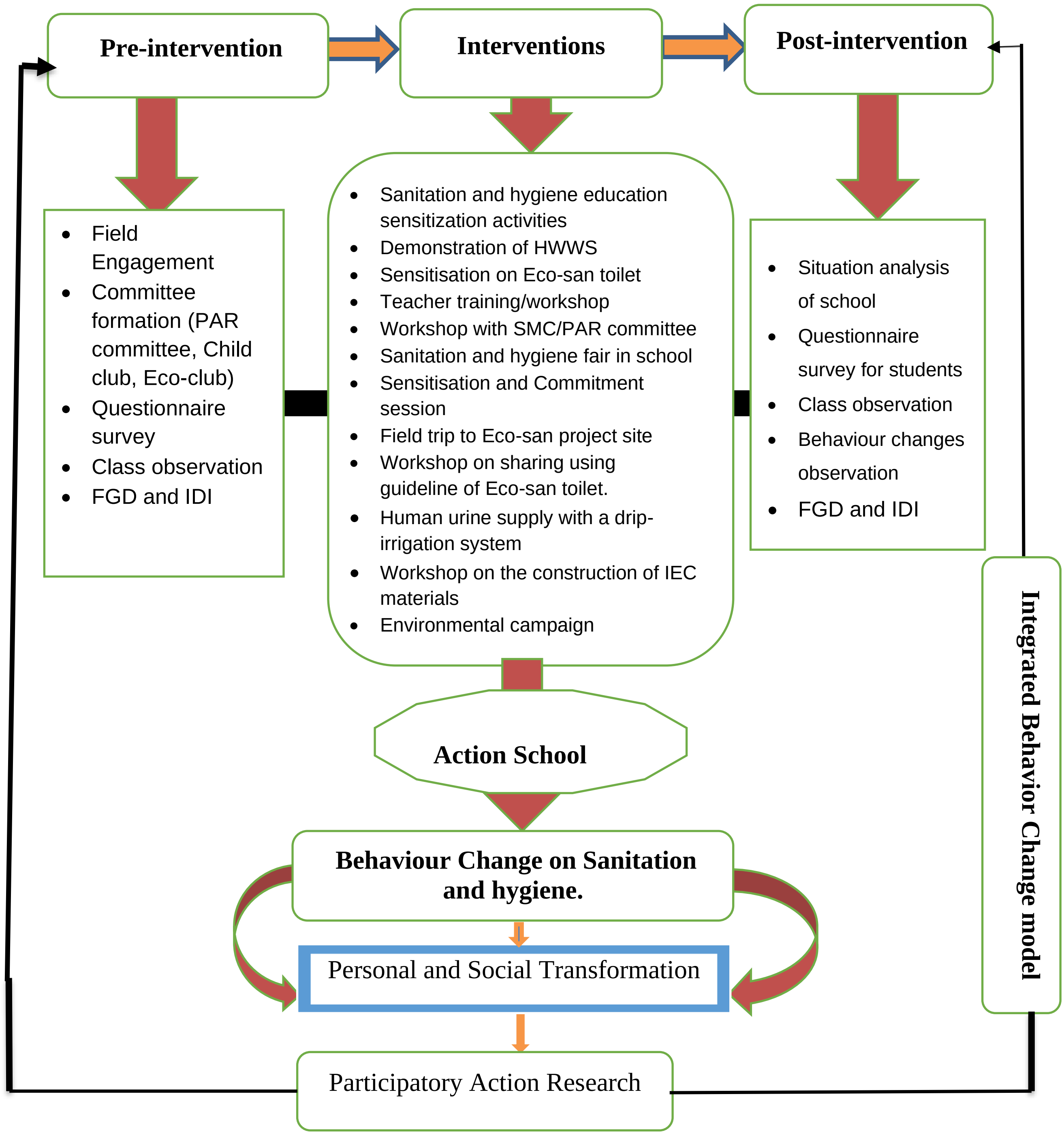

Figure 2.5. Conceptual Framework of the Study

The Conceptual framework (Figure 2.5) shows that the research has three phases with different PAR cycles. The first phase of the PAR consists of starting the ocular field visit (pilot survey), school selection, interaction with school family (teachers, students, school administration, school management committee, Parents Teachers' Association - PTA) and local government officials. During the interaction meetings, the objectives of the visit were explained. Then we formed a Participatory Action Research Committee consisting of 21 members from different professionals and groups. Similarly, students' clubs were also developed to make participatory activities effective and transformative. Then we planned to conduct a participatory needs assessment (PNA) using several tools and methods, i) record review, ii) questionnaire survey, participants' observation of classroom teaching, iii) in-depth interview with the headteacher, iv) observation of hand washing practices, and v) focus group discussion on the perception of using Eco-san toilet/UDT and application of urine fertiliser in the school kitchen garden.

The interventions were conducted through a participatory approach consisting of educational and technological-based activities based on the needs assessment results. Eleven sessions, including 22 activities performed in the second PAR phase, are called the intervention phase. Finally, more of the less similar methods used in needs assessment were followed to conduct the PAR's post-intervention (evaluation) phase. The ecological IBM-WASH framework (Dreibelbis et al., 2013) was used in the study.

Chapter Summary

PAR methodology is based on a solid theoretical foundation of behaviour change through sanitation and hygiene education in school. The reviewed data may help replicate similar initiatives in other schools like institutional schools and community schools. The literature review supported that PAR is effective in behaviour change and teacher performance when the Integrated Behavioural Model scaffolds it -WASH (IBM-WASH) and Diffusion of Innovation (DOI) theories.

Empirical research on the use of Eco-san toilet, hand hygiene promotion and application of human urine as agricultural fertiliser explored the contributions of Eco-san toilet concept in behaviour change of the students. The review also indicated that human urine is not a waste but a resource if we gently use it in our crops/vegetables. Also, reviewing the school curriculum of Health subject and policy implementation regarding sanitation and hygiene in Nepal suggested incorporating more content related to sanitation and hygiene, especially on HWWS and Eco-san toilets, using a participatory approach.

Chapter 3. Research Methodology

Overview of the Chapter

This research used PAR methodology, including multi-phase mixed methods, to bring together the empirical data both qualitative and quantitative. This chapter presents the methodology that I used to research the educational, technological (use of Eco-san toilet and handwashing with soap) and behavioural interventions in changing the sanitation and hygiene behaviour of the students at basic level in a public school in Nepal. This chapter discusses the research design, study area, population, sample size, sampling strategy, tools, and data collection and analysis methods. Finally, this chapter concludes by discussing methodological issues, constraints, potential biases, ethical considerations, and the impact of COVID-19 on the PAR.

Philosophical Underpinnings of PAR

In research, the term "*Paradigm' refers to basic belief systems that represent a particular worldview of the researcher based upon ontological, epistemological, and methodological assumptions"* (Denzin & Lincoln, 2011; Guba & Lincoln, 1994). Here, 'worldview' denotes the synonym for paradigm, described as "*a way of thinking about and making sense of the complexities of the real world"* (Patton, 2014, p. 69). PAR is multi-facated and it tends not to rely on a single paradigm. Many scholars acknowledge that it has been derived mainly from critical theory, constructivism, or pragmatism (Israel et al., 1998; Kim, 2016; Reason, 2006). There are worldview or philosophical underpinnings of PAR by answering three philosophical questions, particularly in terms of ontology (what is the nature of knowledge or my perspective of reality?), epistemology (What is the nature of the relationship between the knower and the known or how do I know?), and axiology (what I value as knowledge?)

(Creswell, 2014b; Jorgensen, 2019). These three components are the key for determining a research methodology. Two paradigms or models claim superiority over the rest; positivist/post-positivist and constructivist. The former paradigm is characterised by objectivity or quantification (quantitative interpretation), while the latter focuses on subjective worldviews (Guba & Lincoln, 1988; Moon, 2005). T*he positivist paradigm is primarily deductive, while the constructivist paradigm is inductive* (Guba & Lincoln, 1994 ; Tashakori & Teddlie, 1998). The positivist method is based on quantification and objectivity, while the constructivist method believes in individual and social constructs. The latter is also known as a qualitative method. Structural surveys, structural observation, case-control studies and experimental methods are quantitative, while in-depth interviews, focus group discussions, ethnomethodological observations, and discourse analysis are qualitative. Qualitative methods capture life as it is lived (Kirk et al., 1986). This perspective focuses on the reality and experiences of the stakeholders, service providers, decision and policymakers, leaders and laypeople. It provides the framework to analyse their discourses. This study has drawn extensively on participants' perceptions that yield significant insights into how they describe eco-san toilets and the application of human urine as fertiliser and hand hygiene regarding their health promotion.

A third model that claims to be a pragmatist model states that polarisation between the two paradigms is inappropriate (Greene et al., 1989; Morgan, 1998). It combines positivist and constructivist approaches, popularly known as the mixed-methods approach. Mixed methods research has been a third methodological movement over the past twenty years, complementing quantitative and qualitative activities (Tashakkori, 2003; Teddlie & Tashakkori, 2009). The paradigm problem for mixed methods arises from the so-called paradigm wars of the 1970s and 80s. The positivists' quantitative research paradigm was attacked by notable scientists supporting qualitative research and proposing constructivism as an alternative paradigm (Reichardt & Rallis, 1994). A worldview consists of stances adopted on each element (Creswell & Tashakkori, 2007) or dimensions of contrasts (Teddlie & Tashakkori, 2009) comprising ontology, epistemology, axiology and methodology.

None of the paradigms is free from limitations. There are conflicting opinions on combining the research methods. Some researchers (Bourdieu & Wacquant, 1992; Hughes, 1984; King et al., 1994) have contested the mixed-methods paradigm claiming that the "*paradigms are incompatible"*(Tashakori & Teddlie, 1998). Brewer and Hunter (1989) suggest that *"the multi-method approach allows the investigator to attack a research problem with an arsenal of methods in addition to their complementary strengths"* (p.17).

Ontology. Ontology is the branch of philosophy studies the concepts of existence, being, becoming, and reality. Ontologically, PAR assumes the interactions between subjective and objective facts (Baum et al., 2006). Generally, the ontological perspective of PAR is similar to constructivist viewpoints because PAR researchers believe that multiple realities exist in people's minds (Reza, 2007). However, they recognise that subjectivity cannot be separated from objectivity (Heron & Reason, 1997; Löfman et al., 2004). In other words, the *"world' (objectivity) and individuals (subjectivity) don't exist separated from one another, and they exist in steady connection"*(Freire, 1970, p. 50). People's perception of their realities is affected by the objective world where they live, but the objective world is also reconstructed simultaneously by individual consciousness. PAR focuses on understanding how particular actors define their present situations from subjective and objective dualism.

Epistemology. It means theories and assumptions about knowledge creation or concerns the nature and forms of knowledge (Guba & Lincoln, 1994 ; Scotland, 2012). Epistemological assumptions are concerned with creating understanding, acquiring and communicating, in other words, "*what it means to know"* (Guba & Lincoln, 1994). Epistemology asks about the relationship between the knower and what can be known. For participatory action researchers and co-researchers, epistemology is the key to understanding possibilities and conditions for creating new knowledge in a world (Kaushik & Walsh, 2019; Mack, 2010). Researchers and co-researchers in PAR simultaneously find themselves objectified and existential concerning the field of practice (Edwards-Groves & Kemmis, 2016).

Participatory action researchers often characterise the knowledge creation process as a joint venture. PAR epistemology brings together the researchers and co-researchers in the field to develop a shared horizon of behaviour change. Creating new knowledge is an ongoing dialogue about implementing participatory actions (Guba & Lincoln, 1994). The criteria for creating new knowledge are not only a question of measuring collected data from the field but generating more questions and creating experiences which can potentially change, modify and contextualize all participants' values and beliefs in the same process. The participatory action researchers and co-researchers have different roles; however, they are all players in the same game and shared values, but generalised knowledge becomes possible. Similarly, PAR shares with critical theorists the assumption that generating knowledge is not neutral and value-free but political and value-based (Brydon-Miller, 1997). Therefore, participatory action researchers critically examine power structures in knowledge production (Ozanne & Saatcioglu, 2008).

The methodological or axiological question in PAR. It is how can the inquirer/known determine what they believe can be learned? The phenomenon under this study is interpreted within a context through direct interaction and collaborative activities among the researchers and co-researchers (Morgan, 1998). Based on the epistemology of PAR, participatory action researchers stress the role of dialogues as their primary methodological strategy (Reason, 2006). As a PAR researcher, I stressed dialogue as the main methodological strategy. Other methods like surveys, focus group discussion, behavioural observation, classroom teaching and situation analysis were also encouraged. The value of this research affects how the research is done through the collaboration of teachers, students and PAR committee members. In PAR, the dialogue critically analyses individual and social problems from participants' experiences to raise sanitation and hygiene behaviour change and critical consciousness (Park, 1993; Reason, 2006). This PAR emphasised the collaborative partnership between researchers and co-researchers in implementing participatory actions/ interventions.

Moreover, this PAR involved a circular process with flexible methods and activities. This emphasis is based on the premises that pragmatic approaches are beneficial for discovering the best practices for personal and social change (Reason, 2006). The basic procedures included observation or need assessment, planning for addressing an identified need, implementation/action and reflection, and further observing, planning, acting and reflecting.

Research Design and Methods

As guided by pragmatist views, this research design included qualitative and quantitative data with PAR approaches. However, the PAR approach shaped the procedure to confirm the research framework. As the PAR approach used within mixed methods (qualitative and quantitative) has become popular over two decades (Patton, 2002), I used the PAR approach to challenge the traditional top-down approach for a bottom-up one (Mikkelsen, 2005). The focus of PAR as an ongoing iterative process involves an engaged spirit, intellect, emotions, and physicality of human beings that complement the research process (Macmillian, 2009) developed in this study. I employed PAR as a methodology that raised inherent competencies with the active participation of co-researchers.

Multi-phase mixed methods (QUAL-Quan) research design with the PAR approach (Whyte et al., 1991) provides an overarching methodological framework to a multi-layer study that calls for multiple phases to develop an overall program for this research or evaluation of the given intervention (Subedi, 2016). In this respect, multi-phase design with necessary flexibility was governed by the research aim or objectives that employed different worldviews and assumptions (Subedi, 2016). The intervention was envisioned as a collaborative process by mobilising a child club, Eco-club, teachers, head-teacher, and community concerning health-promoting communication, especially on WASH and Eco-san. Students, teachers, parents and the researcher were involved from conceptualisation to dissemination. Thus, it was applied a flexible model. The study was carried out in three phases under the health-promoting communication and behaviour change process (Dunlop et al., 2010), which entails analysis, intervention design, implementation and evaluation of the process and outcome.

The mixed-methods approaches generate numerical and narrative data that answer similar questions (Creswell & Tashakkori, 2007). Four different methods are used under the mixed methods approach: (a) convergent method; (b) explanatory sequential method; (c) exploratory sequential; and (d) transformative, embedded or multi-phase method (Creswell, 2014, p. 47). I used multi-phase mixed methods. I conducted semi-structured interviews with the headteacher and focus group discussions with teachers, the school management committee, PAR committee members, and child club members. Likewise, observation of handwashing with soap and a survey with basic level students (quantitative) was conducted. Moreover, I also reviewed school records to assess the physical and human resources of the school and the educational performance/results of students. Figure 3.1 shows the research designs and methods used in this study.

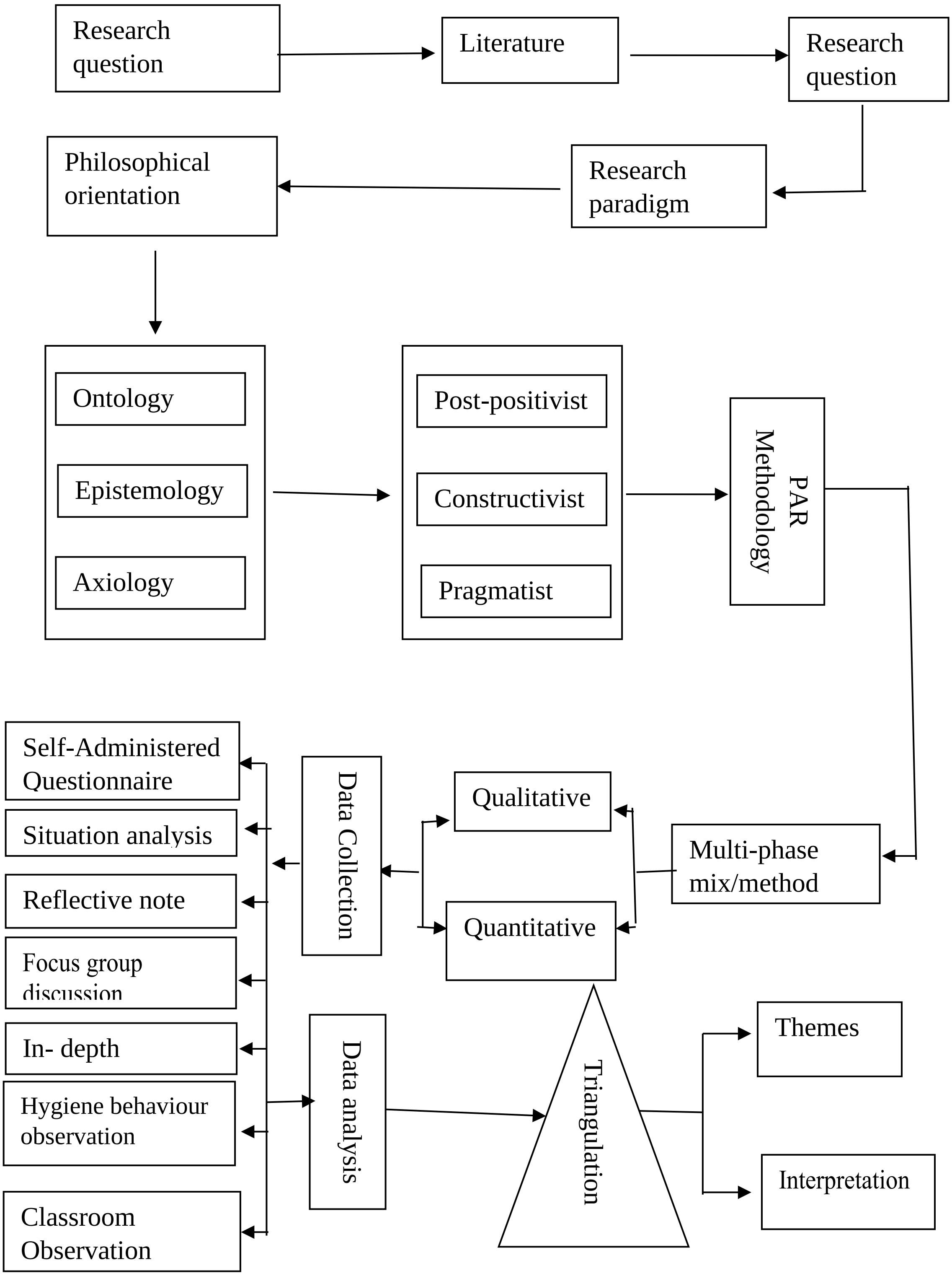

Figure 3.1. Research Design and Methods

The study was conducted over the spane of three years timeline and it included three phases (i) pre-implementation (needs assessment), (ii) Implementation and (iii) post-implementation (evaluation phase) and study has met all the five characteristics of a mixed-methods approach (i) a triangulation (convergence, corroboration and correspondence of results from different methods); (ii) complementarities (seeking elaboration, enhancement, illustration and clarification of the results from one method to another; (iii) development (seek to use the results of one method to help, infirm another method); (iv)initiation (seek the discovery of paradox and contradiction, new perspective of the framework, the recasting of question or result from one method); and (v) explanation (seek to extend the breadth and range of inquiry by using different inquiry components) (Greene et al., 1989).

IBM-WASH was used to guide the development of the intervention and the interpretation of the findings because it is relevant to the study, which identified three dimensions (contextual, psychological and technological) and different levels, including behavioural, personal and interpersonal (Dreibelbis et al., 2013a). It was attempted to guide behaviour change interventions related to sanitation and hygiene. The design and evaluation of such interventions would benefit from synthesising this integrated theory informing sanitation and hygiene behavioural patterns. In evaluating behaviour change, information on the organisation of behavioural determinants like handwashing with soap (HWWS) at critical times, especially before a meal and after toilet use. Proper techniques of handwashing, Eco-san toilet use, and avoiding open defecation/ urination were assessed through behavioural change guiding components of IBM-WASH. Though different factors such as contextual factors (gender, educational status, age, personal preferences), psychological factors (culture, beliefs, attitudes, and perception of Eco-san system and application of humanure), technological factors (construction of Eco-san toilet, urine diversion, drip-irrigation, urine dilution, hand washing techniques with soap and water etc.), intervention activities were guided and launched based on the principles of IBM-WASH. The PAR cycles applied to receiving continuous feedback, and dialogues were carried out among the study participants, thus, enabling learning and subsequent design refinements of the prototype. This process is referred to as 'rapid prototyping in the PAR Paradigm.

Study Site and Its Justification

This study occurred in a South Asian country i.e. Nepal, officially the Federal Republic of Nepal. India and China border this landlocked nation. The Constitution of Nepal 2015 defines Nepal as a federal democratic republic with the provision of three tiers of government: local, provincial and federal. Since the last democratic election in November 2017, Nepal has 753 local governments, seven provincial governments, and one federal/central government. Chitwan district is one of the 77 districts of Nepal and is located in the southwestern part of Bagmati Province. It covers 2238.39km^2 and has 579984 (279087 male and 300897 female) (Government of Nepal, 2011a). It lies in the Terai region. It was originally a dense forest with animals. The second-largest city of Nepal, Bharatpur, has a 77.3% literacy rate and comprises multi-ethnic composition consisting of Brahmin, Chhetri, Tharu, Newar, Darai, Gurung, Magar, Tamang, Chepang, Pariyar and many other castes (Government of Nepal, 2011a).

Figure 3.2: Map of Chitwan District

Of these, 70.1% speak Nepali, 10.25 Tharu, 4.9% Tamang, 3.7% Chepang, 2.8% Gurung, 1.7 Bhojpuri, 1.6% Magar, 1.6% Newari, 1.1 % Darai, 0.6% Maithili, and 0.5% Hindi as their first language, of the population, 27.3% in the district spoke Nepali as their second language. The district consists of seven municipalities, out of which one is a metropolitan city, five are urban municipalities, and one is a rural municipality named i) Bharatpur Metropolitan City, ii) Ratnanagar Municipality, iii) Khairahani Municipality, iv) Madi Municipality v) Rapti Municipality, vi) Kalika Municipality and vii) Ichchhakamana Rural Municipality. This study was conducted in one public school in Chitwan district, Kharahani Municipality wards 2, Chainpur, Nepal. This school was purposively selected based on the selection criteria (see Appendices P) formed by NORHED/ Rupantaran Project, Tribhuvan University, Nepal.

Research Participants and Selection Procedures

This study was conducted in a public secondary school that is in a semi-urban setting. The school was purposively selected to include socio-economically diverse catchment areas. The research participants were all the basic level students (4-8 graders), teachers, parents, School Management Committee (SMC), Participatory Action Research (PAR) committee, and child-club members from a selected school. This study used purposive convenient sampling techniques to determine the research participants, especially for qualitative inquiry. In contrast, the census method or all population members were studied for the quantitative survey (Sharp et al., 2012).

When this action research cycle was conducted, the school consisted of 632 students, ages 6-18 years, residing in the adjoining communities of the school, 26 teachers and three supporting staff. Hence, all the basic level students (n=209), excluding grades one, two and three, were taken as the research participants using the census method of this study. A survey and a school record review regarding the number of students, annual class upgrading results, physical facilities, teachers' profiles and other records maintained in the school were used to obtain quantitative data. The purposive sampling technique with voluntary participation per the PAR protocol was employed to select the teachers, SMC/PAR committee members, child-club members, students for the FGD session, and headteacher for IDI of the qualitative study.

Qualitative data were collected from focus group discussions, in-depth interviews, reflective notes, transect walks, and participatory observation, as not all the research could be obtained from the survey alone. The focus group discussions were carried out with student-teachers teaching at the basic level, SMC/PAR committee members, and child-club members.

Table 3.1: *FGD Participants (May-June 2018 Need Assessment)*

FGD No	Participants	FGDs Male	Female	Total
1	Girl students (senior graders, 6-8)	-	11	11
2	Girl students (junior graders, 4-5)	-	10	10
3	Boy students (senior graders, 6-8)	10	-	10
4	Boy students (junior graders, 4-5)	11	-	11
5	Teachers	5	5	10
6	SMC/PAR	7	4	11
7	Child-club/ Eco club members	5	6	11
Total		38	36	74

I selected them using a purposive convenient sampling method from the selected school. The criteria for their selection were familiarity with school children's sanitation and hygiene problem, collaborative engagement in PAR, especially in hand hygiene sessions and Eco-san toilet use, and their willingness and consent to participate in the study. The study samples of this study were selected based on mutual discussion and participation.

Although this study focuses on the sanitation and hygiene behaviour change of basic-level students, it did not choose the children of grades one, two and three for the sample as they could not participate in the discussion. As the study population of this study was basic-level students, students from grades nine and above were excluded from this study. Since the sample was selected from the participants in the PAR, the emphasis was on the quality of information rather than the volume of data. Patton (1990) stated, "*There are no rules for sample size in qualitative inquiry*". He again said, "*Sample size depends on what the investigator wants to know, the purpose of the inquiry, what's at stake, what will be useful, what will have credibility, and what can* *be done with available time and resources"* (pp. 22-25). The qualitative inquiry focuses on relatively small samples in-depth, and the type of data chosen depends on the research questions to be answered.

This study also observed students' handwashing with soap or hand hygiene behaviour. Fifty handwashing events were observed, especially before midday meal (*khaja)*, and after toilet use. Fieldwork was carried out in vegetable production activities or teaching-learning with garden pedagogy, including human urine application as an agricultural fertiliser in the school garden. A purposive convenient sampling technique was employed to select handwashing behaviour observation throughout the week. Observation mainly focused on the availability of soap at handwashing stations, soap used to wash hands, hand washing skills and time is taken to wash their hands. While selecting handwashing visits, an equal number of boys and girls (25 boys and 25 girls) were observed. Similarly, ocular visits, transect walks, record review (situation analysis), discussion with research participants, in-depth interviews with school administration, questionnaire survey, reflexive notes and diary were also applied in the study.

Methods and Tools of Data Collection

Pragmatists' research philosophy guided this study and it was completed in 3 phases: needs assessment, intervention, and follow-up. This study aims to catch a better and deeper understanding of the combination of different methods. Though multiphase designs may be massive and complex, they will cover vast information not explored using other research designs by weaving several mixed approaches under one identified problem (Creswell & Clark, 2017). Moreover, it brings strong credibility to the analysis results (Brevik & Buchholtz, 2022). I used multiphase mixed methods in this study since drawing a holistic picture through many methods was necessary. Data collection relied on qualitative and quantitative data. Both types of data were collected concurrently. Data collection procedures or instruments in this PAR were determined through mutual consultation between the researcher and co-researchers. Self-administered questionnaires, in-depth interviews, focus group discussions, hygiene behaviour observation, and record reviews. Moreover, "*emergent data collection techniques/methods"* (Creswell, 2014, p. 47) were used in this study. These were peer and self-reflection worksheets for class observation and compare-contrast matrices between pre- and post-intervention.

Methods of the Study

Two methods were used for quantitative data, while five sources were used to collect qualitative data. Qualitative data were gathered from the following sources:

Direct observation and transect walk. Observation is the main technique in selecting research problems, which provides an extensive understanding of the context. However, *any form of observation remains time-consuming* (Gillham, 2000 p. 47) and requires the development of specific skills. In this study, observation of the study site and problem was a supplementary technique that helped select better intervention schools. As a researcher, I observed the study site through unstructured and informal observation and developed subjective and objective context illustrations. I did not have a fixed format and guidelines for questions, timebound and seating arrangement in the transect walk. When I was in the village, I got an opportunity to ask questions about handwashing habits with soap, the perception of using Eco-san toilets, and applying human urine as agricultural fertilisers in their crops with community people. The contextual questions I raised with them were what I saw. I had just asked questions on the road or on their home premises. The objectives of this study were explained in a natural setting, asking questions to the community people on the transect walks. During the transect walks, I invited key informants from farmers, teachers, local leaders, parents, local government members and health personnel. I noted down everything the participants shared—in addition to making a map and taking photos/ videos of the participants as required.

Focus group discussions (FGDs). FGDs with teachers, students, SMC and PAR Committee members, and child-club members were administered at pre-intervention or at-needs assessment and post-intervention or evaluation phases. The FGDs method was selected since it efficiently collects views and thoughts among various research participants. It is a suitable method in PAR, especially in school settings (Green & Thorogood, 2018). Seven FGDs in the needs assessment phase and the same number of FGDs in the post-intervention phases were conducted. Different participants: students, teachers, SMC/PAR committee members, and child club members were invited to represent a definite group of participants who were willing to share their views. The FGD guidelines were developed collaboratively. The guideline consisted of the lessons on sanitation and hygiene education, content coverage on hand hygiene and eco-san toilet, time allocation in classroom teaching, student participation during indoor and outdoor teaching-learning activities, and perception of hand hygiene and eco-san toilet use (see appendix V-VII).

In-depth interview. The in-depth interview guide was also used twice (pre and post-intervention) with the headteacher of the intervention school. This guide contained open-ended interview questions (see Appendix IV). This in-depth interview guide was also developed collaboratively. This tool mainly incorporated teaching methods and contents regarding sanitation and hygiene issues, soap management alternatives in school, sustainability measures on HWWS and Eco san toilet use, perception of Eco san toilet use, and application of human urine as an example of agricultural fertiliser in the school garden.

Hand hygiene behaviour observation. As mentioned in the introduction section, the immediate goal of this study was to explore hand hygiene (HWWS) practice among basic-level students in public schools. The observation schedule was made to observe students' hand hygiene behaviour, especially handwashing practice at critical times (before midday meals, after toilet use and after work in the field). This tool was also collaboratively developed. It incorporated students either washing their hands or not at critical times, hand washing with or without soap, time taken for hand washing and techniques applied to wash their hands with or without soap. It was conducted two times (before and after interventions). I (researcher) observed the HWWS behaviour of basic level students during tiffin break, both before and immediately after health education intervention sessions.

Participants' observation of classroom teaching. Peer observation tool was used to collect information in terms of teaching methods, content coverage regarding HWWS, Eco-san toilet use, application of human urine as agricultural fertiliser (perception and practice), students' participation in indoor and outdoor teaching-learning activities, time allocation for teaching sanitation and hygiene issues and so many other pedagogical matters. Classroom observation using participatory techniques of participating teachers in sanitation and hygiene/ health education was made in collaboration. This tool was also developed collaboratively with co-researchers (students, teachers, headteacher, SMC/PAR committee members, students club and expert communities). It is also applied before and after the intervention.

Classroom observation data was also used to compare the changes in teaching pedagogy and content coverage before and after intervention conducted in the intervention school.

Reflective field note. During the need assessment phase, all sessions of the interventions phase and finally, the evaluation (post-intervention phase), every participant, including me (as a researcher), had their reflection. Reflection is essential at every step of PAR. It begins when participants engage in intrapersonal and interpersonal communication. Dewey (1933) stressed that thinking about an issue in the classroom or school environment was an initial reflection step. In all forms of PAR, reflection is tied to action. At each stage of the PAR process, the researcher and co-researchers reflect before, during, or after a move (Areguy, 2017). In this study, as a researcher, I reflected on my beliefs, values, assumptions, and biases to learn more about a contextual problem and interpersonal experiences and explore contributions made toward outcomes in a PAR.

The four stages of PAR cycles (observe, plan, act, reflect) were used for this study. Every research participant (PAR team) engaged in the intervention to evaluate Health Education sensitisation sessions and related PAR activities. Even though PAR participants made reflection notes essential to fostering hygiene behaviour of students, using Eco-san toilet and applying human urine as an agricultural fertiliser in the school garden.

Quantitative data were collected from the following sources:

Survey. All the students from grades 4-8 were the survey participants. At the beginning of this study, the participants' knowledge and practices regarding hand hygiene, Eco-san toilet use, and human urine application as agricultural fertiliser were collected from the self-administered questionnaire which contained 33 questions (see Appendix III). It was pre-tested in a public school in Kathmandu, for validation. It covered socio-demographic characteristics (age, sex, caste/ethnicity, education level/grades), handwashing with soap/hand hygiene practice, toilet use/sanitation knowledge, practice, and application of human urine as an agricultural fertiliser in the school garden. enduring the process, suggestions were also invited from the learning community/ students. The questionnaire was thematized after a review of the literature and in consultation with the supervisors in learning communities. The questionnaire included a consent form detailing the researchers' purpose to maintain the research participants' confidentiality. I received ethical approval for this PhD research from the Nepal Health Research Council (NHRC) (see appendix IX) and obtained informed consent from the parents of each research participant. The participant survey (student survey) was conducted twice, beginning and ending the PAR cycle.

Situation analysis. Record review was another tool/method for collecting quantitative data in this study. Observed records maintained by the school administration, especially on school physical facilities like school buildings, classrooms, toilets, drinking water, hand washing stations, school garden, soap management facilities, furniture, school canteen, waste management facilities/ waste segregation, etc., before and after intervention conducted by NORHED/Rupantaran project.

Table 3.2: *Data Collection Methods and Tools*

Steps	Tools/methods (for both phases or pre-and post-intervention)	Data types	Data sources
01	Review of literature: Journal articles (database searches), reports, records, working papers, newspaper clips, books	QUAL/Quan	Secondary
02	The researcher's direct observation and transect walk	QUAL/Quan	Primary
03	A self-administered questionnaire for students (n=209)	Quan	Primary
04	In-depth interview with the head teacher (n=1)	QUAL	Primary
05	Focus group discussion: girl students (n= 02), boy students (n=02), Child club (n=01), teachers (n=01), SMC/PAR committee (n= 01)	QUAL	Primary
06	Hand washing practice observation (n=50)	QUAL	Primary
07	Situation analysis	QUAL/Quan	P & S
08	Session notes	QUAL	Prima
09	Reflective note	QUAL	Primary
10	Audio recording, videos and photos (artefact)	QUAL	P & S

QUAL: Qualitative, Quan: Quantitative, P: Primary, and S: Secondary

Field Procedures

I have briefly described the field study procedures under the pilot study process and the data collection process.

Pilot study. Immediately after defending my research proposal and its approval from the Graduate School of Education (GSE), Faculty of Education (FOE), Tribhuvan University, I went to this PhD project site in Chitwan. Then I proposed with SMC and teachers to form PAR Committee and finally formed 21 members PAR committee following the inclusive principles in the intervention school. I explained in detail about the study and I also conducted meetings with teachers, PAR/SMC members, students and the child club. We discussed the tentative research areas and prepared draft tools for needs assessment /baseline study. After a week, I consulted with experts in Nepal and from the Norwegian University of Life Sciences, Norway, to finalise the needs assessment tools.

A pilot study is necessary for testing the appropriateness of the methods and tools for a study (Arain et al., 2010). Pilot studies help to i) develop and test the adequacy of the research instrument, ii) assess the feasibility of the study, iii) design the research protocol, iv) assess whether the research protocol is realistic and workable, v) identify logistical problems that might occur using the proposed methods, vi) collect preliminary data, vii) train researchers in as many elements of the research process as possible viii) determine what resources (man, money and materials) are needed for the planned study, and ix) assess the proposed data analysis techniques to uncover potential problems (Van Teijlingen & Hundley, 2001).

This study's tools and methods were developed and finalized collaboratively by discussing with co-researchers /learning communities of the intervening school, Chitwan. The preliminary tools and techniques for need assessment or baseline study were again rechecked by experts' teams in Nepal and Norway and then pretested in the basic public school located nearby the intervention school in Chitwan. The study tools were revised by incorporating the findings and feedback from the piloting. Moreover, the suggestions of my PhD supervisors on the pretested tools were also included. Finally, the modified tools were translated into both Nepali and English language.

Data collection (Needs Assessment May-July 2018 and Impact Evaluation April-June 2021)**.** The data collection for the study involved several steps, incorporating participatory action research process. The initial data about the participants’ knowledge, perceptions, and practices regarding their ability to use the Eco-san toilet in transforming students' sanitation and hygiene behaviour were collected from teachers. Then we moved to the students, SMC/PAR committee members and Child club members using focus group discussion, self-administered questionnaires, interviews, hygiene behaviour observations, record review and class observation collaboratively. The need assessment/ baseline study data were coded, organised, and presented with general sanitation and hygiene education sources, including indoor and outdoor teaching-learning activities.

The information on study participants' knowledge, perception, and practices in the initial phase was essential for effective planning and design of the interventions. It helped identify the factual scenario regarding students' knowledge gaps, cultural beliefs, or behavioural patterns, especially on sanitation and handwashing with soap at critical times on school premises. Similarly, based on their collaborative analysis of the initial data, participating students and teachers then identified common difficulties most exhibited in sanitation and hygiene education in their classes. We used this information to discuss possible instructional changes that address school sanitation and hygiene problems.

The research participants were recruited purposively after preparing data collection tools incorporating pre-test findings. These included: i) students from grades 4-8, ii) teachers who teach at the Basic level, iii) SMC/PAR committee members, and iv) child club members.

After initial inquiries, potential participants were first introduced to some documents; i) A copy of the consent and assent form, ii) A copy of the study proposal, in brief, iii) A letter from NORHED/*Rupantaran* project, iv) An ethical approval letter from Nepal Health Research Council (NHRC), and v) A copy of research tools. Then scheduling of the date and time was prepared according to the collective wishes of the research participants. After confirming and re-confirming the participants in data collection, the data collection started within different groups, in different milieus and guidelines. But the data collection procedure in the post-intervention (evaluation) phase rather than in the need assessment (initial) phase was a bit easier because the participants were more convinced, owned the achievement, and had well-understood content and conditions that had changed behaviour. The process of data collection tools and methods within a different group of participants were discussed here:

Survey. This survey was conducted among basic-level students, mainly grades 4-8. This was done with the support and coordination of the PAR committee. Two days before conducting this survey, the consent form was sent to the parents of all the students in grades 4-8. After receiving the consent form, the questionnaire was distributed to the students with the sign/ fingerprint of the respected parents and oral consent of the concerned students from their parents. Before filling up the questionnaire, it was briefly oriented by PAR committee members, including me, about its main essence and how to fill it. Although one hour was allotted for filling out the questionnaire, half an hour was added as some students could not fill in the allotted time. Thus, 209 students filled in the questionnaire and collected it. The questionnaire used a code without the student's name for confidentiality.

In-depth interview guidelines. An in-depth interview with the intervention school's headteacher was conducted during the second data collection step. A semi-structured interview approach was adopted. It adhered well to the PAR of flexibility and responsiveness (Kemmis & McTaggart, 1988) and offered the liberty and option to explore, clarify and elaborate on responses (Dawson, 2009).

This interview was recorded with the consent of the interviewee. This was done to primarily be an active member, be involved in the discussion, and elicit more profound responses. The interview would also help clarify, assess and reflect upon the effectiveness of implementing interventions in sanitation and hygiene education, Eco-san toilet as a resource of humanure and hygiene promotion of students with apply handwashing with soap in school.

This interview was done twice (Needs assessment: June -July 2018 and Impact evaluation: February- March 2021). Internal validity is thus relying on both times and interview transcripts to triangulate. The questions, responses and reflections of the first interview were compared to the second or last interview to identify the achievement of this PAR project.

Focus group discussion. FGDs adopted in this PAR provided opportunities for participants to join in activities through forms of communication other than writing. FGD is often used because of its ease of use, financial benefit, high face validity, and quick results. Participants can better relate to the topic under discussion without being influenced by groupthink, thanks to FGD's ability to provide the enlightening and conceptual tools they need. It encourages participants to generate ideas by suggesting various dimensions and nuances of the actual issues to one another. The group discussion sometimes leads to a deeper comprehension of a problem (Boateng, 2012).

After completing the essential part of the preparatory phase (developing FGD guidelines), the participants were invited to represent a specific group in the school. We paid particular attention to participants' homogeneity to overcome self-perceived inferior positions. This proved to be practical and encouraging enough to participate in the discussion. The selection of participants also considered the balance of gender and ethnic group. The data collected depended on the participants, so the group composition was essential.

Figure 3.3: Teachers' FGD at Needs Assessment Phase

Written consent was requested and obtained from all participants. In students' cases, consent was also obtained from their respective parents. Similarly, consent from all participants was obtained for audio and video recording. In this PAR, video recording was needed to analyse interpersonal interaction and non-verbal communication.

All FGDs in the pre-implementation (need assessment) phase and impact evaluation or follow-up phase of this study was conducted in the school premises that offered a quiet, separate, and comfortable environment for participants and an observation bench with audio, visual, and other technical support. Including gender-sensitive issues in this study, female FGD was conducted with the facilitation of 2 female freelancer field researchers and female students from senior graders to make the analysis easier and more gender-friendly. Similarly, handwashing behaviour observation was done based on hand washing in the handwashing station. The handwashing station is about 35 meters away from the toilets. Group consent was obtained by going to the classroom before collecting data on handwashing behaviour. Data collection from this method was also conducted with the help and participation of senior grader students.

One of the PAR committee members of this study took comprehensive notes during the discussion. After the FGD had concluded (usually 1.30 -2.00 hours), the notetakers and I met to discuss the pertinent findings and planned for the next FGD with another target group. The information collected during the FGD was transcribed and translated. I have tried to keep to the language and sentence structure used by the research participants during the discussion.

Observation of handwashing with soap behaviour. Though handwashing with soap in school and its measurement is challenging, this study applied PAR methodology with collaborative activities to address this complexity. HWWS behaviour was observed during tiffin breaks before and immediately after health education intervention sessions. I observed the students' toilet use and handwashing behaviour from 30 meters and handwashing alone from ten meters. Students' Hand Washing with Soap (HWWS) was recorded in the observation checklist during the short- and mid-day snack breaks. Fifty observations were recorded between April 10 and 17, 2018 (in seven days). A similar observation was made immediately after the intervention (May 7-14, 2019). The spot checks were made on structural elements at handwashing stations in school to determine handwashing behaviours, particularly soap. The key indicators used to determine the handwashing behaviour of basic-level students were soap for washing hands, effective or dedicated handwashing stations, following WHO's recommended six steps of handwashing skills, and time taken to wash hands. These indicators were used to collect information on hygiene behaviour and practice.

Data Processing and Analysis Procedures

Shin et al. (2009) pointed out several methods to analyse qualitative data. The analysis procedures and descriptions were conducted in different ways, which vary by the authors and the study objectives (Taylor & Bogdan, 1984). Categorising all collected data allowed the researcher to make assertions. Data processing and analysis were conducted during and after conducting the PAR activities. "*A concurrent participatory in multi-phase data collection*" (Creswell, 2014, p. 47) allows the researcher to gain a valuable perspective on the effectiveness of the PAR. Analysis of the achievement on students' health/hygiene behaviour change, achievement of the class performance of teachers and perception on Eco-san toilet use and application of human urine as agricultural fertilisers in all learning communities was conducted collaboratively.

The framework analysis was a matrix-based method that used a thematic framework to classify and organise data according to key themes and concepts sub-divided by the successions of related sub-themes (e.g., (Benner, 1985; Taylor & Bogdan, 1984). The thematic approach allows themes to develop from both the research questions and the narratives of the research participants.

I first transcribed the interview, and FGD notes into Nepali and then translated them into English. I followed the steps suggested for the framework analysis (Pope, Ziebland & Mays, (2000), Ritchie & Spencer, 1994): (i) Familiarisation: it involves reading transcripts, and field notes several times. The aim was to immerse me in the details and get a sense of the interview before breaking it into central themes. In this process, I noted down the recurrent themes. (ii) Identifying a thematic framework: I wrote memos in the margin of the text in the form of short phrases to identify themes. I have identified the descriptive statements and analysed the data following the interview and FGD guide. (iii) Indexing: I gave numerical codes to the textual data at this stage, highlighted and sorted out quotes, and made comparisons. While doing so, the original research objectives, interview guidelines, and FGD guidelines were considered, (iv) Charting involved comparing and contrasting data and cutting and pasting similar verbatim together in the new chart. Indexing and charting is a kind of data management. It is helpful in data reduction (Green & Thorogood, 2018) (v) Mapping and interpretation: the themes and sub-themes that emerge from charting are mapped and interpreted based on the research objectives and questions, nature of, and links between themes to generate descriptions for the finding.

The data obtained from the teacher participants' classroom observation or lesson taught was based on the notations in their observation tools. Peer teachers' comments were read, and similar notes in different categories were colour-coded and highlighted. A summary chart of all notations was created, and common themes were identified. Finally, the compare-contrast matrix was constructed, incorporating all revealed similarities and differences between pre and post-sensitisation/demonstration sessions conducted in school as interventions.

I established the process link between different discourses and meaning accordingly. The emerging themes and the interrelationships between categories were described in the existing literature. Krueger (2014) suggested I use the criteria for interpreting coded words: internal consistency, frequency and extensiveness of comments, specificity of comments, the intensity of comments, and big ideas.

As far as the quantitative data analysis is concerned, after collecting the data from the self-administered questionnaire from students, they were carefully checked, edited and cleaned. After cleaning and processing the data, they were entered by developing a codebook into the SPSS version 25. Meanwhile, I checked both variable and data view sheets in case of missing data. A dummy table was developed as per the nature of the variables to be explained. Univariate analyses such as frequency, mean, median and standard deviation were used to describe the background characteristics of the respondents.

In the same way, a bivariate analysis such as a chi-square test was also used to examine the association between the independent and dependent variables by pre and post-interventions. Likewise, simple tables, cross tables, and graphs were constructed to present the data. The data was interpreted as per the research objectives. The study variables can be seen in Table 3.3.

Table 3.3: *Study Variables*

Independent variables	Dependent variables
Gender: male, female	Perceived need for handwashing
Age	Perceived need for handwashing with soap (HWWS)
Education /Grade	Perceived advantages of HWWS
Caste/ethnicity	The place to wash at school
Religion	Condition of handwashing stations (HWS) at school
Occupation of father	Availability of enough water at HWS in school
Occupation of mother	Availability of soap at HWS in school
Membership in the child club	Time is taken to wash hands
	Feel comfortable/uncomfortable washing hands at HWS in school
	Sources of information to wash hands with soap is good for health
	Place of defecation/urination at school during school hours
	Feeling of privacy in school toilet
	Queue while going to the toilet
	Duration to stay queue
	Status of school toilet
	Perceived reason of school toilet is not child-friendly
	Heard or not heard about Urine Diverting Dry (UDD) toilet
	Sources of hearing Eco-san/UDT
	Provision of diverting faeces and urine in school toilet
	Perceived benefits of UDT
	Application of human urine as fertiliser in their crops

Then, I triangulated the study methods (QUAL-Quan.), data sources and data. Triangulation involves various qualitative and quantitative methods and incorporates multiple perspectives (CRESWELL, 2014a; Creswell & Clark, 2017; Terrell, 2012).

Triangulation aims to obtain different but complementary data on the same topic to understand best the research problem (Creswell & Tashakkori, 2007). Denzin and Lincoln (2018) distinguished four types of triangulations, i) data triangulation (the use of the data from various sources), ii) researcher triangulation (involvement of several different researchers or evaluators), iii) theory triangulation (employment of multiple perspectives to interpret a single set of data) and iv) a methodological triangulation (use of numerous methods to study a single problem). Besides researcher triangulation, I applied all these approaches in this research. It triangulated the findings obtained from PAR learning communities/ stakeholders, then married theory and secondary data.

Validity, Reliability, and Trustworthiness

A core motivation of PAR is to help solve problems, improve social conditions, and enable stakeholders to participate in research and development research processes. The characteristics of this participatory action research are knowledge creation into praxis-oriented and constructed and reconstructed situations to realise human goods and trustworthiness in achieving human ends. In a praxis orientation, transformations are inherent in knowledge and inquiry as competent activities (Denzin and Lincoln, 2018).

Validity and reliability are other issues in PAR using mixed methods that must be appropriately addressed. It denotes the reality preceded by the truthfulness and credibility of the study (Slevin & Sines, 1999). I maintained reliability and validity in the study by establishing a logical link between the research objectives and several methods (survey, FGD, IDI, participatory classroom observation, handwashing observation, situation analysis, transect walks and reflexive notes).

In quantitative research, validity expresses the degree of measurement it intends to measure' (Leavy, 2017 p.111). A research tool is valid if it estimates what is expected to measure. Validity can be determined by comparing the test with verified validity tests. Qualitative research is expressed in different ways but with similar meanings. Singh (2007) described validity as the quality of the conclusions and the processes through which these were reached. However, he argues that the exact meaning of validity depends on the particular criterion of truth adopted.

The term 'reliability' interpretation varies in quantitative and qualitative methods and tools. The measurement's consistency, predictability, or accuracy is known as reliability (Hafsa & Linguistics, 2019). It can be estimated by correlating the scores obtained by the same individuals in different PAR phases with different sets of comparable items.

In qualitative research, reliability focuses on identifying and documenting recurrent, accurate, consistent, or inconsistent features such as patterns, themes, values and worldviews, experiences, and other phenomena confirmed in a similar or different context (Krefting, 1991).

The traditional concepts of reliability and validity used in quantitative methods are appropriate to 'trustworthiness in qualitative research and fit in participatory action research (Murphy & Yielder, 2010). Trustworthiness is a circular and dynamic process comprising credibility, dependability, conformability, and transferability. However, these four stages are not direct, enabling the researcher to measure their research process throughout the study.

Table 3.4: *Components and Measures Used for Trustworthiness*

QUAL	QUAN		Measures employed in the research
Credibility/ Authenticity	Internal validity	Reflexivity	Data consistency checks by the researcher and supervisor, prolonged involvement in the field, debriefing to the learning community, member checking, triangulation of data and cross-checking with published literature
Transferability/ Fittingness	External validity		Findings are not generalised; all recurrent and less recurrent views are presented as lived experiences.
Dependability	Reliability		Establish linkages within the methodology, data analyses and discussion through the audit trail
Conformability	Objectivity		Researcher's awareness and precautions to minimise possible biases, the supervisor checks for data coding and analysis (audit trail)

Source: (Lennie, 2006).

Prospective of Trustworthiness in the PAR. This research is wholly based on PAR methodology. The PAR methodology is rigorous, where the knowledge generated is valid and generalised. In PAR, 'truth' is not seen as objective and can be generalised but is embedded in a particular context of a learning community or locality (Lindhult, 2019). It was jointly developed understandings amongst participants generated by trying particular strategies and watching the results. In this PAR, rather than pursue rigour in the scientific sense, we (the PAR team) maximised real needs or trustworthy insights and actions. Well understanding in the context of the students' sanitation and hygiene behaviour change (basic level) was expected to change. PAR involves asking questions in a particular context and gaining trustworthiness.

Table 3.5. *Perspectives of Trustworthiness in PAR*

Dimensions	Activity outcomes
Orientation	Pragmatic orientation in PAR methodology
Value (relevance)	Advancement of knowledge in a field of study, application of findings and dissemination
	Innovation of product/process, new understanding, new alternatives, self-development
Validity	Valid theories, data and knowledge claims
	Workable, efficient solutions and praxis
	Moral-political transformation/rationalization
Reliability	The reproducible and accountable research process
	Robust solution, stable praxis
	Sustainability of transformation
	Self-reflection, self-realisation and identity formation
Action/practice	Application and quality test of knowledge claims
	Instrumental for change
	Implementation and dissemination of solutions struggle for emancipation and realising values/ideals.
	Owned achievement

Trustworthiness in Participatory Action Research. The trustworthiness of this PAR was stepping: i) Participation of those most affected by, and closet to, the situation being investigated in ways that develop mutual trust and open communication, (ii) Direct observation and transect walk, (iii) Formation of the participatory action research committee and child club, (iv) Using multiple theories and methodologies, numerous sources of data, and various methods of data collection, (v) Using rigorous documenting, data analysis and reporting processes, (vi)

Transparency in process, (vii) Ongoing meta-analysis and critical reflection, (viii) participants' review of the study, impact assessment and reports, (ix) Multiple cycles to fine-tune and confirm insights and actions, (x) Developed rich contextualised answer to questions, and (xi) Critically assessed the intended or unintended impacts of this PAR using relevant theoretical models (Elo et al., 2014; Feldman, 2007; Kornbluh, 2015; Lennie, 2006; McTaggart, 1998)**.**

Challenges of the PAR

Relational challenges. Mutual trust between the researchers and participants is important for successful PAR outcomes (Ford et al., 2012). If participants do not trust and respect each other, they hesitate to collaborate with the researcher. Throughout the PAR, all research participants' trustful relationships and efforts are required (Balakrishnan & Claiborne, 2017). Though the students were equally interested in participating in this study, they engaged in classroom study and could not attend all the PAR sessions.

Similarly, students sometimes dominate and feel inferior to participating in session activities due to unequal power relationships among teachers, SMC chairperson, head-teacher, and students (Visser & Kreemers, 2020). Furthermore, the insufficient research skills of students caused teachers to take more control over the research process, especially in fieldwork. For example, when trying to cheat on toilet cleanliness when soap and water do not wash hands thoroughly, at various critical times, when soap is not put in the soap case, when garbage is thrown indiscriminately, when the urinal hole is closed, and urine fertilizer is applied in the kitchen garden, we had to control students. However, comprehensive cooperation and coordination in PAR activities were not inadequate. But I negotiated with them that it was possible even in their regular classroom teaching if participatory sanitation and hygiene pedagogies are connected. After a series of discourses, teachers gradually realised that SHE could be instrumental in developing students' healthy sanitation and hygiene behaviour. Having discoursed with teachers, as explained by Mezirow (1997) in transformative learning theory, we reflected that a dialectical discourse could bring change in the metacognitive process of teachers.

Methodological challenges. PAR has been increasingly considered an effective strategy to improve students' sanitation and hygiene behaviour. The methodological aspects of this research are more rigorous, time-consuming, and challenging. The research methods of this study were decided by mutual agreement between the PhD student I and co-researchers. Despite the vital role of all the strategies adopted in this study, junior grade students did not participate in some methods (questionnaire survey, FGD, Reflective note). Therefore, this study has not included their views and reflections. Additionally, this study demanded a more iterative and cyclical process, which took time and tremendous commitment from the research participants. Moreover, it is also challenging to triangulate data from different data sources, theories, and methodologies.

Ethical challenges. Another challenge in this study in terms of ethical issues was identified. It was not free from a breach of confidentiality, given that it engaged more research participants, especially in the implementation phase of this study. Examples of incomplete violations include a lack of confidence in maintaining the facts of work done, lack of equal participation in PAR activities, the occasional practice of not washing hands even after toilet use and before eating, and not collaborating with friends. However, the collaborative works conducted in this study are relatively open, increasing the risk of exposing participants' identities. As this study period is long and there are many groups, there is no vital confidentiality.

Challenges in aligning timeframe. The next challenge we faced in this study was the planning timeframe. The PAR method of this study was time and resource-intensive and involved a high degree of personal collaboration on behalf of the researcher. The researcher must develop a close working relationship with co-researchers conducive to sharing ownership. As a PAR researcher, much of the work I coordinated of multiple activities facilitated dialogue and knowledge exchange among participants. Similarly, we encountered delays in the planning schedule, especially in the construction phase (e.g., construction of Eco-san/ UD toilet, hand washing stations, drip-irrigation system, and Eco-garden). Though we have contingency alternatives, ongoing consultation with experts, flexible study design, and the sheer determination of the PAR team minimised the risk to the study, such changes in the external circumstances beyond the researcher's control can be anticipated but were unavoidable.

Biases

Peer debriefing bias. The researcher did not collect and analyse the data alone. A team of academic partners and co-researchers collected the data. The team was able to help me develop tools, which occurred potential bias and needed to be controlled from my side.

Triangulation bias. Triangulation is a popular strategy divided into four kinds (Olsen, 2004). They are i) Methodological triangulation involving the mixing of qualitative and quantitative approaches to which can be added the participatory approach (Mayoux, 2006), ii) Data triangulation using data from various sources, involving several tools in collecting and analyses data, iii) Observer triangulation, involved several researchers to analyses the data, and iv) Theory triangulation involved the selected theories of investigation.

Responses and social desirability bias. The research participants did not equally respond to their views/perceptions. Especially in junior graders, students and junior teachers seemed to have an inferior complex during group discussions. The FGDs were led mainly by knowledgeable participants, where small students and teachers were the only spectators. In addition to schooling, the study also looked at social desirability bias (Grimm, 2010), such as employing students in agriculture instead of classroom reading and writing. Likewise, using Eco toilets instead of pit toilets and attempting to adopt a system that uses human urine is considered a disgusting subject as agricultural fertilizer even though it's not their choice.

Methodological Limitations

There are several methodological limitations to this study. The study was limited to voluntary participation by the students, teachers, SMC/PAR committee members and child-club members. It was limited to gender, caste, education/grades, and teaching level. This study was as easy to conduct in the first phase as it was challenging in the second phase due to the COVID-19 pandemic effects. Prolonged school closure due to COVID-19 hindered students' hygiene behaviour, Eco-san toilet use, urine collection, and urine fertiliser application in the school's Eco garden. Students could not engage in activities due to regular classes or time constraints.

Due to the many methods and procedures adopted in this study, the data were somewhat overlapping. Respondents have repeatedly been presented due to multiple data sources for cross-validation. Even the students in all practical classes were exposed daily to the same educational interventions. Multiple homogenous and heterogeneous groups of co-researchers have participated in different PAR activities.

Ethical Considerations

There were a variety of ethical issues that must be taken into consideration. The ethical issues are morally and practically central to the research process because the quality of findings will depend on relations with research participants (Mayoux, 2006). Many of these involved negotiating the relationships between the researcher and co-researchers in this PAR. Provisions were made to protect the privacy and confidentiality of the study participants and the information they provided. These provisions included storing paper-based information in locked cabins and password protection for folders storing electronic-based information. Similarly, using pseudonyms in reports and any published work or ensuring that information is presented prevents the readers from learning anything personal about the study participants. No names were collected or recorded, as each respondent could only be assigned a unique number.

Participants were required to give their verbal informed consent before participating in the study. For the case of teachers and SMC/PAR committee members, an oral consent form was developed for the participants that stipulated their participation in the study would be voluntary. But for the students' case, written consent was taken from their parents. The firm also specified that they could refuse to respond to questions they might not be comfortable with and have the space to withdraw from the study if they wished; the data recorder was attached as a witness for verbal consent.

In-depth interviews and focus group discussions were conducted in an open environment to avoid suspicion but private enough to avoid any possible interference from other curious onlookers. No monitory incentive was provided to individuals for participating in the study. Confidentiality and storage of the data was explained to the participants. The answers provided during the task would be treated with the utmost confidentiality and used only for research purposes. Furthermore, the study participants were also assured that when the researchers published the study results in reports and journals, it would be in a way that would prevent the readers from learning anything personal about the study participants, and no participants were identified by name. The ethical approval for the study A Participatory Action Research in Transforming Hygiene Behaviour of Students through Ecological Sanitation Toilet has been received from Nepal Health Research Council (NHRC), agreement number 2016Q2A04 Ministry of Health and Population, Government of Nepal (Appendix IX).

Chapter Summary

This chapter summarized the PAR methodology and approaches to gathering data for my PhD research. It also described the study setting, justification, research participants and sampling strategies. It outlined the design and implementation of the different quantitative and qualitative research instruments and methods and identified the employed data management and analysis strategy. It also comprised the philosophy within the methodology, such as ontology, epistemology, axiology, and the theoretical basis of PAR. Methods of achieving trustworthiness, validity and reliability were also explored in this chapter. Finally, this chapter summarised the ethical, practical, and theoretical considerations of research biases and challenges.

Chapter 4. A Journey through the PAR Process

Overview of the Chapter

This section presents the research process that we (researcher and co-researchers) followed to explore the students' sanitation and hygiene behaviours, especially related to handwashing with soap and implementing Eco-san/UD toilets at a public school in the Chitwan district of Nepal. It sets the scene by describing the context of the participatory action research (PAR) activities. PAR is geared towards planning and conducting the research process with the participants whose practical actions are included in the study (Baldwin, 2012). Likewise, several steps of the PAR process, i) developing collegiality with co-researchers, ii) building trust and relationship with them, strategic steps of the PAR process, iii) setting agendas and priorities for the intervention, iv) exploring interests and capacities of co-researchers, v) developing a detailed plan of action, vi) organising meetings, and vii) dialogue conferences and workshops were conducted. In the best case, both sides (researchers and co-researchers) benefited from the research process. PAR is an essential process that evolves when action and practice comprehend each other. The PAR approach stresses the importance of the authentic participation of co-researchers in all phases of the inquiry. It involves a collaborative process of knowledge co-production that leads to insights into the sculpture of both researchers and practitioners. Therefore, the two

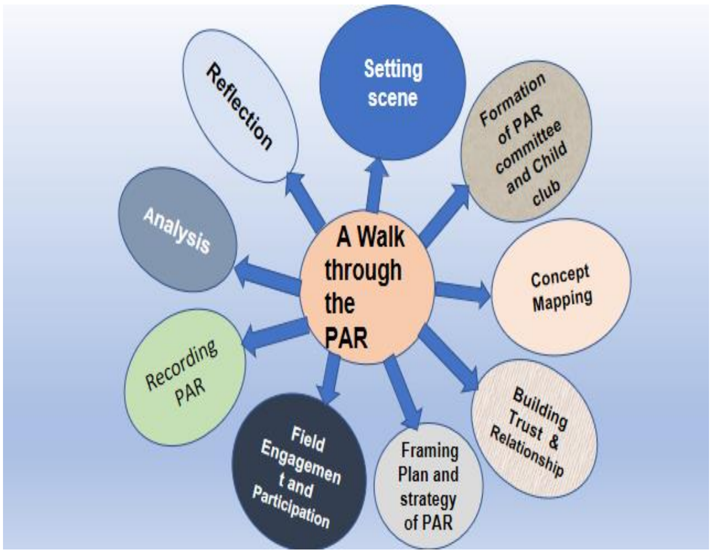

Figure 4.1: Participatory action research process

sides (co-researchers and the researcher) should have a conducive and democratic relationship. At the beginning of this field engagement, I felt unsure whether PAR is possible in school. But while working with the school family, I started to think that the school setting is suitable for PAR. Then we were involved in making an action plan. In this PAR journey, we moved forward, applying different steps and strategies for conducting activities to co-create knowledge. This chapter describes the details of the PAR journey including the PAR activities, strategies, components, and methods.

Setting the Scene and Informal Talks

Since the NORHED/*Rupantaran* project has its site in Chitwan and Nawalparasi districts, I was interested in researching sanitation and hygiene among school children and in the schools of the same districts. It is believed that PAR in a school setting is helpful to all stakeholders/research participants in all collaborative actions (Pine, 2008). Pine explored that school is an ideal site for social and individual change efforts and that PAR is central to the struggle. He also contends that the classroom is a radical space of possibility.

Further, Pine states that schools are "Research Goldmines" regarding the variety and richness of data, essential issues, and potential PAR research (Pine, 2008). He further stressed that schools influence students' sanitation and hygiene behaviour change through academic or classroom exercises. He also stated that PAR is a "*mental disposition - a way of being in the classroom and school*" (Pine, 2008, p.1). This dynamic moves from an insider view of schools and classrooms toward a knowledge generation. Stakeholders collaborate to discover, learn, and understand (Pine, 2008). PAR within school recognises that teachers and students are in a position of power and privilege. Any community has fundamental value and local knowledge (Salomaa, 2018). Along with creating new knowledge, PAR initiatives can assist schools and their constituents in advancing change (Pine, 2008). So, we (the PAR team) expect schools can become centres for change rather than targets for change.

When I decided to carry out this research, I was committed to transform the sanitation and hygiene behaviour of students through classroom teaching and learning. I had PAR in my mind and it requires a great willingness among those involved to share and exchange views of the existing sanitation and hygiene situation, opinions, and experiences. Thus, I engaged in field visits with colleagues and seniors and organized open discussions with the co-researchers (teachers, students, parents, and school management committee members) to identify the existing problems, especially on sanitation and hygiene in school settings.

In the conversations with the teachers, students, parents, and SMC members, we tried to understand the urgent problems faced by the school. Open discussions, formal and informal talks programmes, and workshops were conducted weekly with the research participants/co-researchers. To understand more about the community people, transect walks help know the situation (Lorenzo & Motau, 2014). This process was helpful to build relationships among the community, parents, local farmers, and leaders to motivate them towards the proposed activities and stimulate parents for Eco-san initiatives and hygiene promotion in school. We talked and collected photos/videos of the toilet, hand washing stations, water management systems, and soap management

Figure 4.2. Toilet Situation (Before Implementation of PAR)

available in the schools. We made many such visits in the name of transect walks to explore the existing situation. After those visits, schools with critical sanitation and hygiene-related problems were selected based on priority needs.

Four of the five selected schools are from Chitwan, and the remaining one is from the Nawalparasi district. Similarly, 4 out of 5 chosen schools were categorised as reference schools and one as an action school. Action school is a public secondary school that initially had hygiene and Eco-san-related activities such as teacher training, sensitisation and demonstration sessions, installed a model Eco-san/UD toilet with urine-diverting mode, and Eco-garden. After the achievement evaluation of these intervention activities that happened in the action school, it was replicated using the train-the-trainer model by mobilising the teachers and students from the action school to other schools (reference schools) based on their needs. Finally, the intervention school was selected and finalized.   The first Memorandum of Understanding (MoU) was signed on November 14, 2017, with Shree Jana Jiwan secondary school, Chainpur, Chitwan, as the action school and the other four reference schools. Then, the signing of MOU was followed by a mass meeting, discussion, dialogue conference, and other demanding activities with students, teachers, SMC/PAR committee members, and local government officials to determine the PAR plan, strategy, and overall problem.

Formation PAR Committee and Child Club

Participatory action follows democratic principles of justice and equality. It is an inclusive research practice defined by participation and determination to produce personal and social change (Ozanne & Saatcioglu, 2008). The members provide a process that can assist in achieving the targeted goals.

Figure 4.3. Formation of PAR Committee

Enabling actual participation is about creating access and building trust. So, a 21 member PAR committee was formed as the first step of PAR in Jana Jiwan secondary school with the proper representation of various groups like farmers, health personnel, social leader, security person, school management committee, the ward chair (local government member), the reform committee (Toll Sudhar Committee), the headteacher of the neighbour schools, and the president of the Kankali community forest, farmers, and parents, teachers, students and school administration in the presence of 110 participants in the discussion meeting. The PAR committee's primary purpose was to efficiently carry out the activities during the research, increase participation of everyone, and take ownership of its achievements.

In this school-based PAR, collaboration with the students, teachers, SMC/PAR committee members, and local government representatives was ensured through collaborative methodology in baseline and follow-up phases: hygiene behaviour observation, focus group discussion, questionnaire survey, participants' classroom observation, record review, and reflective notes/diary. PAR as a theoretical standpoint and collaborative methodology was helpful in this process to ensure the voice of students targeted to change agents (Langhout & Thomas, 2010). For the same reason, a thirteen-member child club was formed and mobilised during the whole process of the PAR.

From the beginning of the PAR journey, I was engaged mainly with students, teachers, and SMC/PAR committee members to identify the school's ground reality or actual needs. I also contacted the schoolteachers and discussed their engagement in school sanitation. After I understood the school's situation, especially on sanitation and hygiene, especially Ecological Sanitation (Eco-san) and hand hygiene, we worked collaboratively in all research activities.

Formation of Eco-club and child-club. We formulated Eco-club and class-based committees in the PAR study and activities, allowing children to lead activities and monitor their progress. To effectively carry out sanitation activities, including eco-san, exchange information among all co-researchers, and operate urine supply and cultivation activities in the Eco-garden, we formed 13 Eco-club members (five boys and six girls). Also, assigning children to an Eco-committee helped create peer influence to adopt good hygiene behaviours. Groups were formed by age (mixed ages) and gender appropriate.

Power Dynamics and Relationship with Co-researchers

It is essential to focus on power dynamics to conduct participatory actions systematically and achieve the objectives. Headteacher, parents, SMC/PAR committee chair, SMC members, ward chair, teachers and students must work together. So, the feelings of the elite and those with less power need to be discouraged in PAR. From the beginning of the PAR, we tried to minimise the power between researcher and co-researcher since power neutralisation through collaboration was the main objective of field engagement. We realised that power neutralisation is the fundamental step of the PAR process (Jacobs, 2016). The power neutralisation process in the PAR was facilitated by regular group conversation, establishing new levels of intimacy and collaboration with co-researchers in every step of the research process and encouraging participation in every activity (Wallerstein et al., 2017). Likewise, we researchers and co-researchers work as colleagues, combining our different skills in mutual learning, making it possible to neutralise the power.

Further, the literature suggests that sharing expertise between the researcher and co-researcher is helpful to neutralise the power. Power discrepancies between teacher and students, headteacher and other teachers, SMC chair and other members must be discouraged (Hooks, 2000). Rather than power discrepancy, Hooks advocates for acknowledging this power dynamic and suggests using this power in non-coercive ways to enhance the PAR process. Power dynamics between teachers and students normally refer to simply teaching content, ranking students to be engaged in behaviour change based on their performance and collaborating in-class engagement. We learn from the literature that researcher needs to take responsibility for collaborative attainment rather than attempting power over the junior researchers (Koch & Kralik, 2009). Therefore, a PAR researcher must be acquainted with their judgment and expectations about the level of participation and how these could result in an imbalance of power between researcher and co-researchers and anyone else (Koch & Kralik, 2009). PAR initiatives allow the research participants without inferior complexity. Similarly, Kindon et al. (2007) state that a PAR can reduce the hierarchical scaling of events and offer processes to proceed practically and be participatory.

Building Trust and Relationship

Trust forms the basis of every relationship (Kindon et al., 2007). It plays a vital role in research collaboration. Building trust is essential. Learning communities can accept what they say about the researcher and co-researchers and their aims. Motivation is impossible without mutual trust between the researcher and the co-researchers (Lind, 2008). Trust impacts vital social functions, including cooperation, coordination, and performance (Park & Lahman, 2003). We applied different strategies to develop trust and relationships in this PAR process. As a researcher, after entering the field, as mentioned previously, I conducted informal talks, dialogue conferences, and workshops every week with the research participants/ co-researchers.

In this PAR, structures for collaboration and processes for communication, the creation of shared goals and implementation were established. However, as a PAR researcher and in-field experience, I realised that gaining trust in PAR is difficult. Relationships require many mental and emotional efforts to establish mutual trust and be together in diversity and difference despite adversity (Bergum, 2002). Regarding sanitation and hygiene, relational knowledge in PAR was co-created based on the mutual expectation between researcher and co-researchers and worked out to fulfil the expected needs like handwashing with soap, using Eco-san toilet/ UDT and application of human urine as agricultural fertiliser through participatory teaching and learning. Relational understanding between teachers and students, teachers and headteachers, teacher and SMC/PAR committee, a child club and children converted into reflective knowledge. The reflective ability included sharing, experiencing everyday events and demonstrating what we got from this study. Then relational learning finally changed to reflective knowledge, which was possible through collaboration. All co-researchers achievements were made during these participatory action research activities. Although those achievements are not easily achieved, knowledge co-creation occurs through a democratic, participatory process. Then we were involved in participatory activities in the classroom and the field. Finally, it was possible to transform personal and social behaviour, especially in HWWS and Eco-san innovations. In this PAR process, I sometimes became a facilitator, sometimes, co-researchers and assisted the research participants or learning communities in developing friendly relations and conducting PAR. As a facilitator, I became a team-building coach, sometimes a bridge to establish connections rather than an expert. As a result, researchers and co-researchers have co-owned the achievement.

Framing Plan and Strategy of Participatory Action Research

Participatory action research implies that the researcher and co-researcher collaborate with individuals, groups or communicate who have decided stakeholders in the program, development strategy or any other entity (Brown et al., 2003). Based on the priorities identified from the needs assessment, the PAR project was implemented collaboratively, including observation, planning, acting, and reflecting with stakeholders. In addition, a regular spot of stakeholders' meetings and reframing the strategies. Figure 5 shows (McNiff & Whitehead, 2011) the overall process of PAR that we applied in the study.

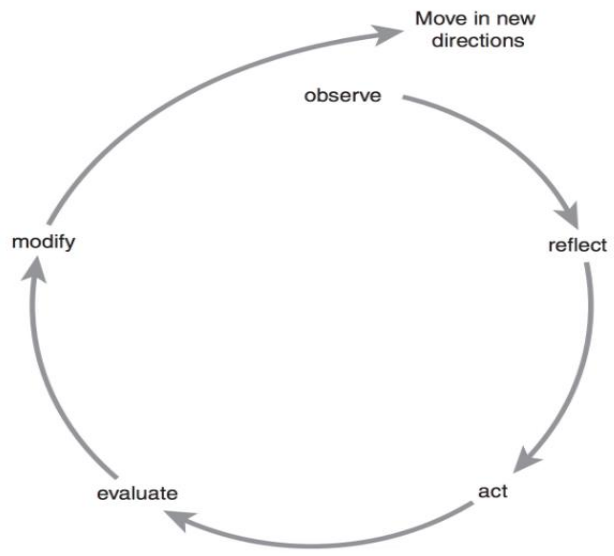

Figure 4.4. The participatory Action Research Process

In this PAR, all stakeholders/coresearchers worked together on school sanitation and hygiene education and the Eco-san project. The collaboration of stakeholders was culturally responsive and acknowledged local wisdom. An example of how vegetables produced using human excrement as fertiliser smelled bad is compared with no bad smell on the vegetables that we used animal dung as fertilisers. Researchers and co-researchers are involved in the iterative cycles of observing, planning, acting, and reflecting (Heslop et al., 2017). It is often called an action-reflection cycle (Kemmis & McTaggart, 1988).

The study involved middle school students from fourth to eighth grade, teachers teaching at the same level, school administration and management committee members, child club members, PAR committee members and Eco club members, and co-researchers. This study followed strategic steps (Table 4.1), making the PAR comfortable and practical.

Table 4.1: *Participatory Action Research Strategy*

SN	Strategic Steps of the PAR process
01	Set agendas (bottom-up policy)
02	Bridging workshop/ meetings with PAR team and experts' community
03	Explore interests and capacity
04	Develop a plan of action
05	Identified ethical consideration
06	Documented the critical issues on hand sanitation and hygiene
07	Capacity build-up
08	Group work with a specific focus
09	Field engagement with PHAST (Participatory Sanitation and hygiene Transformation) and CTC (Child to Child) approach
10	Record keeping
11	Articulate different positions, power and different understanding
12	Establish reflection
13	Publications

Setting the agendas. Setting the agendas in PAR is a process of outlining activities in the coming days in consultation with stakeholders during PAR (Koontz & Newig, 2014). There were frequent meetings and interactions in the presence of the PAR committee, child's clubs, students and teachers. The workshop discussed the results obtained from the needs assessment and it served an outline of activities that could be implemented. Collaborative approaches address challenging sanitation and hygiene problems in the school. Multiple stakeholders such as teachers, SMC/PAR committee members, a child club and eco-club members, students and representatives of local government sources of information emphasise local wisdom in setting agendas and PAR activities in school. We discussed sanitation and hygiene issues and prioritised them related to classroom teaching, teaching methods, and the teacher's materials. This practice at PAR provided all the roles to the community by discouraging the top-down policy implementation approach. The bottom-up implementation perspective emphasised that the work done is sustainable and the community-owned experience of that achievement.

Bridging workshop with PAR team and experts' community. In fact, in completing the PAR process, a clear and comprehensive discussion of the various activities in the school outlined the future activities (Maguire, 1987). The gaps between the real needs of the school, cultural practices, available resources and the scope of research were also discussed extensively. The bridging workshop also explored the gap between the problems encountered during the superficial visit to the school and the problems faced by the school in real life. Based on all these gaps and needs, the scope and arena of this PAR was determined. Then the PAR process established relationships among researchers, coresearchers and the expert community from the beginning of the field entry. The success of any PAR project depends on the depth of relationship building, a discussion on the agendas, and their importance (Brydon-Miller, 1997).

Different learning communities participated as co-researchers after starting this study. Students of grades 4 to 8, teachers, SMC/PAR committee members, local government authorities (ward chair) and student clubs actively participated and collaborated. A participatory approach empowers the co-researchers to prioritise the research problems and envisage the action plans (Chambers, 2008). With this in mind, we emphasised the importance of collaboration among all co-researchers (Pine, 2008) and we included all stakeholders in all aspects of the research process (Brydon-Miller et al., 2011; Cook, 2012; Young, 2013), including while making a detailed action plan.

Figure 4.5: Commitments on PAR Activities

After the needs assessment, a two-day bridging workshop was held with all stakeholders, including SMC/PAR committee members, students, teachers, the local body, and students' clubs to prioritising needs, selecting intervention activities to address them, and preparing a detailed action plan. However, while doing the exercises, other meetings and seminars were held repeatedly to make necessary changes according to the context. Some issues like pedagogy, urine supply system and development of Information Education and Communication (IEC) materials became more specific and discussed in a different group and implemented. A joint agreement among all participants involved in PAR was established based on the priority needs.

The bridging workshop/meeting enabled all the research participants to consolidate and put their reflections. Also, the research participants brought new insights regarding sanitation and hygiene education from their cultural and social grounds. They also generated local knowledge integrated into scientific knowledge on handwashing with soap and Eco-san toilet use. Discussion in the workshop also concentrated on the availability of human capital, including feasibility like land for Eco-garden, water management and time allocation in the school premises. The role, responsibilities, and commitment of researchers, co-researchers, and the expert community were determined. In most PAR phases, students were encouraged to involve as co-researchers. They received indoor and outdoor activities and, most importantly, the opportunity to acquire skills of HWWS and apply human urine as an agricultural fertiliser in the school garden drip-irrigation system. Finally, a bridging workshop was held among the researcher, co-researchers and expert community with a shared consensus and commitment to a practical PAR project.

Exploring the interests and capacities. The iterative cycles of the four stages: observing, planning, acting, and reflecting, allowed PAR group members to collectively identify sanitation and hygiene issues that impact students' health. Then all the research participants participated in specific changes in their behaviour as a part of the transformative journey. In the first phase of PAR, it is essential to identify the problems in the target area and the people's capacity and interest to work on them (Whyte et al., 1991). The study was conducted with the primary goal of improving the sanitation and hygiene behaviour of basic school students through the practice of handwashing with soap and the use of Eco-san toilet and also aimed to promote the health of the students by developing knowledge and skills using human urine as an agricultural fertiliser in the school garden, producing organic vegetables, cooking it in the school canteen and incorporating it in the student's midday meal. A comprehensive assessment of the current school curriculum, its specified content and teaching methods, skilled teachers and physical facilities of the school was done. Due to inadequate content in the school curriculum about hand hygiene, ecological sanitation, eco-san toilet, urine fertiliser, a drip-irrigation system plant and school garden, the tailor-made course (see Appendix XII) was made and sensitised the students using that course. In addition, subject expert, teacher and researcher, I also conducted several workshops and orientation classes on these issues. Also, we assessed adequate water for handwashing, land for Eco-garden and suitable space for eco-san toilet construction.

The priority needs determined intervention mapping or activities with all the co-researchers participation throughout the study. After an in-depth discussion with students from classes 4-8, teachers, school administration, SMC members and local government authorities, intervention activities were identified as: i) hygiene awareness sessions for students, ii) demonstration sessions of HWWS, iii) sessions of preparing information education communication (IEC) material to make classroom teaching and learning effective, iv) introductory sessions about the Eco-san system and using guidelines of Eco-san toilets, v) sensitisation on disinfection and dilution of human urine to be used as an agricultural fertiliser in the school garden, and vi) application of human urine as agricultural fertiliser.

Likewise, we also mobilised child clubs, Eco-club, and Junior Red Cross while developing the action plan. The child club and junior red cross were active before the study began, and the PAR committee and eco-club were formed. Since the behaviour and activities of such club members affect the younger students, intervention activities were conducted primarily by mobilising them. Almost implementation events were carried out with the coordination and collaboration of senior students and club members: i) role modelling by senior students, ii) sharing HWWS and Eco-san knowledge among the junior graders, iii) demonstrating six steps of HWWS skills as guided by WHO to the junior graders' iv) awareness programme in the family, school and community, vi) sanitation and hygiene message through school assembly and wall magazine, and vii) participatory hygiene behaviour observation of colleagues.

In addition, necessary meetings, collaboration, and coordination were held with the teachers even though they were already overloaded with their classroom teaching, checking students' classwork, homework, and extracurricular activities. These interventional activities were designed as a result of engagement with teachers during tiffin time, before and school time, and even on holidays: i) awareness and commitment sessions among students, ii) sensitisation and demonstration session of HWWS, iii) preparation of IEC materials and tailor-made course on sanitation and hygiene, iv) soap management and repair of handwashing stations, water tap and soap case, v) preparation of using guidelines of Eco-san toilet and its cleanliness vi) orientation regarding disinfecting human urine, drip-irrigation system, dilution ratio of human urine and water and vii) seedling and application of human urine in Eco-garden.

Organising a dialogue conference. Furthermore, aligning with Freire (2000) empowerment model, I used 'dialogue conference' as a discursive tool to get deeper insights into resolving the prioritised needs. Dialogue conferences are the primary techniques for collaboration and trust-building with the research participants in participatory action research (Knowles & Cole, 2008; Wright, 2015). The conference was structured as a multi-stakeholder and cross-sectoral discussion involving local government officials, the health facility in charge, farmers, teachers, student representatives, SMC/PAR committee members and mother group members. In addition, the dialogue also welcomed social interpreters and academia and discussed the issue of sustainable sanitation and hygiene at school. Through a dialogue conference, we established democratic norms, which received each participant's opinions and ideas (Ahmad et al., 2016). The dialogue conference was organised based on Engelstad (1996) three-stage procedure: i) short briefings about the theme of conversation, group formation modality, and dialogue procedures; ii) norms for intra-group discussion; and iii) presentation followed by inter-group discussion.

Four hours long dialogue conference suggested micro (intrapersonal) to macro (organisational policy) level interventional activities: i) awareness and motivation sessions among students, teachers, parents, school leaders, and community people, ii) behavioural-centric sanitation and hygiene education, iii) preparation of application of sanitation and hygiene-related IEC materials and tailor-made course, iv) construction of a model eco-san or urine diversion toilet in school, v) preparation of Eco-garden and supply diluted human urine through the drip-irrigation system, vi) supervision of students' hygiene behaviours, viii) maintenance of handwashing stations (HWSs) and regularly managing soap and soap cases at HWSs and toilets.

All co-researchers (students, teachers, SMC and PAR committee members, Eco-club and child-club members) engaged from the planning to implementation phase. It helped improve students' sanitation and hygiene and accepted Eco-san/ urine diversion toilet (UDT) and urine application as an agricultural fertiliser in the school garden. Regular engagement and continuous dialogue with stakeholders contributed to address the issues in a timely manner and participants clearly understood the proper use of HWWS and UDT.

Table 4.2: *Details of an Action Plan* (October 2018- March 2021)

Step	Major Actions	Activities
Step I	Forming a collaborative action group	Field entry Engaging a diverse group in the school community Developing the inquiry study Framing the research question Designing the PAR Establish collegiality among co-researchers Reflecting on the group process
Step II	Conducting needs assessment	Conducting a needs assessment survey Realising and prioritising the needs Negotiation with different stakeholders Bridging the gap workshop with stakeholders Agreeing on a constitution for collaboration Keeping reflective records of the needs assessment stage
Step III	Intervention mapping	Review of interventions Identify theoretically based methods of behaviour change Develop intervention scope, theme, methods and materials Prepare intervention session/session plan (see chapter vi) Respecting ownership of intervention activities, so kind Celebrating meaningful collaboration Communicating to the public arena/ publication
Step IV	Evaluating the PAR and the PAR Interventions	Preparing structured questionnaire Facilitating dialogue Stakeholders survey Observation: HWWS, cleanliness of UDT, cultivation with urine supply Artefacts analysis: photo, video, audio Documents analysis: reports, policies, curricula, stakeholders' narratives Evaluate both the action and reflection process as a whole

	Evaluating class involvement Evaluating sanitation and hygiene activities Estimation of the progress of academic and functional skills Evaluating social relationship Assessing stakeholders’ satisfaction Assessing stakeholders' perception of Eco-san and urine application Evaluating the most significant changes

Forming a collaborative action group. PAR is a joint effort among research participants with a shared concern (Oh, 2003). Collaboration shares resources, power, and authority to achieve goals that cannot be achieved independently (Mattessich & Monsey, 1992). The researcher and co-researchers in this PAR engaged in improving experiences, particularly in health-promoting behaviour in the school setting for three years in all phases of the research.

Working as a teacher educator in a public campus and having researched as a field researcher in many districts of Nepal, I was aware of the teaching method and sanitation and hygiene behaviour patterns of students in public schools in Nepal. Due to the dogmatic lecture method adopted in most public schools in Nepal, students usually remain in pin-drop silence during the lesson. Due to the state's indifference to issues such as health, sanitation and hygiene related to people's daily lives, schools do not pay much attention to such problems. They do not give adequate time for teaching and learning. Teaching learning based on student participation is almost non-existent, and there is no trend of collaborating with school stakeholders. With a view to bring some change in this scenario, I started my PhD journey and decided to work with public-school stakeholders to initiate participatory teaching-learning and creating healthy living behaviour change. The beginning of this study gradually moved from what was known to what was not known (Reza, 2007). This study started with joint exercise and collaboration. After entering the field with the research agenda, I successfully worked on the sanitation and environment campaign, sanitation fair and fieldwork in Eco- Garden. The themes discussed in the PAR workshop are enlisted in Table 4.3.

Table 4.3. *Issues Discussed in the PAR Workshop*

Step	Themes	Discussion
I	Inform	Information related to the main essence of the study, e.g., participatory teaching on handwashing with soap, Ecological sanitation toilet use, application of human urine as agricultural fertiliser and sustainable sanitation and hygiene in school setting.
II	Consult	Coordination and cooperation among students, teachers, school administration, SMC and PAR committee members, school child clubs, local leaders, health service providers, and parents.
III	Involve	Health education teacher, science teacher, headteacher, SMC/PAR committee members, and student representatives engaged in the workshop and committed to participating actively in PAR.
IV	Collaborate	Workshop participants discussed establishing democratic collaboration between the researcher (s) and co-researchers to fulfil the objectives of the PAR.
V	Empower	The workshop plan is to identify necessary needs related to sanitation and hygiene in the school and discuss how to participate in its improvement actively. There was a discussion about empowering students in particular.

The initial step of the PAR workshop identified native knowledge and readiness to promote sanitation and hygiene components like Eco-san and HWWS in school settings. Participants agreed to participate in every activity that would be implemented in the school and the active engagement and collective wisdom of both researcher and co-researchers led to more meaningful changes in students' sanitation and hygiene behaviour.

In the initial field engagement, spent almost nine months (January to October 2018) establishing relationships among stakeholders of the learning community. It enhanced the capacity to understand research problems, set mutual goals, formulate research questions, and share responsibilities as developing a democratic communication space is essential in PAR (Habermas and Society (1975). Reaching, seating, and talking with stakeholders made it easy to share feelings and opinions. Also, I realised that research participants felt comfortable interacting with their colleagues and me. Moreover, it helped minimise power hierarchy (Ozano & Khatri, 2018; Rajbanshi & Luitel, 2020).

The collaborative interaction with the co-researchers helped me understand local knowledge, cultural and social practices, interests, and desires to increase social sharing. To develop a collaborative teaching-learning environment, I organised two days workshop with the teachers, school administration, SMC/PAR committee members and local government representatives in the school and organized democratic dialogue. Also, I conducted similar discussions with students from grades 4-8, school child- club and Eco-club members. At the end of the session, group-wise leader was requested to present their views. As a researcher, I initiated a plan to engage with a diverse group of co-researchers to change the students' sanitation and hygiene behaviour and implemented the PAR activities simultaneously (Susman & Evered, 1978) in a cyclical manner; observing, action planning, action taking, evaluating/reflecting, and specifying learning. Figure 10 shows the five phases of

PAR based on research in action rather than research about asking (Middel et al., 2006). This study was concerned with creating behavioural change and simultaneously studying the process of working with the learning community and those who experienced the issue directly (Coughlan & Coghlan, 2002).

Conducting needs assessment. Participatory needs assessment of the school's priorities and problems was carried out through collaborative efforts between the researcher and co-researchers (Ledwith, 2020; Salsberg et al., 2012; Şandru, 2014). Needs assessment in this study refers to exploring students' and teachers' knowledge, perception, and practice on hand hygiene, Eco-san and the application of human urine as agricultural fertiliser. The participatory needs assessment (PNA) helped identify the existing condition of the toilets, students' health hygiene status, contextual sanitation and hygiene education pattern of the school, and students' handwashing practice at critical times like before meals and after toilet use. We all were involved in identifying the needs, setting priorities, and developing intervention mapping and action plans (Minkler & Wallerstein, 2011; Şandru, 2014).

Several methods and tools were used to assess the needs, especially on sanitation and hygiene aspects of students and the whole school family. Self-administered structured questionnaire survey was conducted with students of grades four to eight. Altogether 209 students participated in filling out the questionnaire. In addition, some qualitative information was collected using focus group discussion and in-depth interviews with teachers, students, SMC/PAR committee members and school administration to assess their perception of Eco-san toilet use and application of human urine as an agricultural fertiliser in the school garden. Likewise, we did structured observation to identify the handwashing practices of students at critical times, situation analysis or record review to assess the existing situation in school and classroom observation to assess the students' participation and content coverage of sanitation and hygiene education. Chapter V mentions detailed data analysis and participatory needs assessment survey results.

The researcher (I, as a PhD student) adopted a participatory approach to empower co-researchers to prioritise the research problems and envisage the action plans. The process included contacting and obtaining data, becoming knowledgeable about internal and external contextual factors (culture, local knowledge, available structure and resources) and ensuring support from the participants. Before discussing, sorting out prioritised needs, the analysed result of the participatory needs assessment was presented in the workshop in the school's ICT hall. Some co-researchers, especially a science and health teacher, helped me present the needs assessment results. Once the needs assessment results were presented, the bridging workshop sorted out the prioritized needs and possible intervention plans. The detail of priority needs and intervention plans are given in Chapter V.

The overall results of the participatory needs assessment in schools revealed poor hand sanitation and hygiene practice among students. There was insufficient sanitation and hygiene education contents, less participatory teaching and learning methods, and lack of information education communication (IEC) materials. Likewise, the student toilet ratio seemed very high, which created a long queue in toilets. The handwashing stations (HWSs) available in schools were not enough to the number of students, and they were not child-friendly; water taps were placed higher than the height of the students, the taps could not be easily opened and it was overcrowded at the time of short break for toilet and break for a midday meal.

No soap was available in HWSs and even in toilets. The handwashing practice of students at critical times, such as after toilet use and before eating food, seemed very poor. Organic and inorganic waste segregation, drinking water purification and toilet cleanliness were also not found. Discussion with the participants revealed unfamiliar feelings about Eco-san toilet and humanure use as agricultural fertiliser.

Intervention mapping. Intervention mapping in PAR is a stepwise protocol for developing a theory-based and need-based behaviour change action plan (Eldredge et al., 2016). After identifying potential adopters and implementers, the PAR project was established. Based on the priority needs, the requirement for successful implementation was noted. In the bridging workshop, a researcher described the context for the implementation. Here context denotes; i) classroom teaching and learning practice in terms of sanitation and hygiene education, ii) hand hygiene knowledge and practice, iii) urine diversion toilet (UDT) construction and use, iv) process of human urine dilution and installation drip-irrigation system plant and, v) Eco-gardening. Considering the inputs from the bridging workshop expected outcomes for students' sanitation and hygiene behaviour change were stated. Finally, plans were made for participatory evaluation in teaching and learning, hand washing with soap and water after all critical times, construction of UDT and application of human urine as an agricultural fertiliser in Eco-garden. For intervention mapping, rounds of discussions, meetings, workshop dialogue conferences, and bridging workshops were conducted among members of the PAR committee. Several meetings were held on field reflection with the involvement of the expert community, national and international coordinators team, the core team of the NORHED/*Rupantaran* project, and me, a PhD research fellow. Dozens of meetings, workshops, dialogues, and conferences were held during the period of interventions that lasted for three years. Even though I feel that PAR is never-ending and never saturated, I had to reach a stage and do a follow-up study, as I had to prepare a PhD dissertation as a part of my research assignment. The intervention session implemented in the action school is presented in Table 4.4 briefly.

Table 4.4. *Intervention Sessions*

Session	Major Themes	Major activities
I	Sensitisation (health sanitation and hygiene education session)	HWWS (hand hygiene message) Eco-san toilet (Sanitation message) IEC materials (message related to HWWS, Eco-san toilet, Using guidelines of Eco-san toilet, urine dilution and application guidelines, drip-irrigation system plant, Eco-gardening) Draft curriculum/tailer made a course on HWWS, Eco-san toilet, urine application as agricultural fertiliser, Eco-gardening Environmental campaign Sanitation fair Observational tour of the Eco-san project site Surkhet
II	Producing programme components and materials	Develop/finalise IEC materials Develop local curriculum/tailor-made course Develop teacher manual Develop using guidelines of UDT Construct a model UDT Develop urine dilution system plant and Eco-garden Installed drip-irrigation system plant Construct HWSs with soap case
III	Demonstration and actions	Demonstration session on HWWS based on WHO's instruction (see appendix VIII) Sharing workshop on using guidelines of UDT Class demonstration using participatory tailor-made course Demonstration and sharing session on human urine

		storage, dilution and supply system
		Demonstration and sharing of drip-irrigation system plant
		Application of diluted human urine in Eco-garden
		Cultivation experiment using human urine as fertiliser
IV	Participatory evaluation	Define indicators and measures to assess the effect and process evaluation questions
		Specify and complete the evaluation plan
		Observation: HWWS, cleanliness of UDT, cultivation with urine supply
		Artefacts analysis: photo, video, audio
		Documents analysis: reports, policies, curricula, stakeholders' narratives
		Assessing both the action and reflection process as a whole
		Evaluating class involvement
		Evaluating sanitation and hygiene activities
		Evaluation of the progress of academic and functional skills
		Evaluating social relationship
		Evaluating stakeholders’ satisfaction
		Evaluating stakeholders' perception of Eco-san and urine application
		Evaluating the most significant changes

Participatory evaluation. Researchers and coresearchers worked together in PAR to identify problems, design solutions, and implement change (Reason & Bradbury, 2001). Through a series of participatory activities over three years, we explored the transformation and sustainable use of HWWS. Eco-san technology was also implemented through a participatory approach through classroom teaching, learning, and field-based activities. We also worked together to assess the improvement and changes in hygiene practice. We also explored the motivations and changes regarding the classroom teaching and learning practices, the practice of HWWS, UDT use and experiential learning from the Eco-garden using human urine as agricultural fertiliser.

The participatory evaluation was conducted using both quantitative and qualitative methods. Under the quantitative techniques, we used observation of HWWS practice, situation analysis and cultivation experiment. In contrast, FGDs, IDI, session notes, reflexive notes, class observation, and other artefacts (photos, videos) were used under qualitative methods. We also evaluated the challenges encountered throughout the PAR and the alternative solutions.

The PAR was conducted in a formal academic setting that contrasted with more conventional research, mainly based on a pragmatist worldview. It was evaluated with enlisted indicators presented in Table 4.5.

Table 4.5. *Indicators Used in Evaluating the PAR Process*

Theme	Methods	Indicators
Pedagogical implication of the PAR	Classroom observation (Qualitative)	Methods of teaching
		IEC materials used for making teaching and learning effective
		Student participation
		Taking time and classroom involvement
		Content coverage regarding SHE
		Knowledge transformation
SHE awareness	Questionnaire survey (Quantitative)	Materials used to wash hands
		Importance of HWWS
		Critical times to wash hands
		Proper techniques to wash hands with soap and water

		Importance of cleaning the toilet Value of UDT and human urine Materials need to clean UDT Techniques to make UDT clean
Hygiene behaviour change practice or HWWS practice	Observation	Materials used to wash hands Skills followed washing hands with soap and water Key times implied washing hands with soap Soap management at HWS Time taken to wash hands with soap and water
Knowledge perception and use of UDT and human urine	Questionnaire survey, FGD, IDI	Introduction of UDT Using guidelines of UDT Value of human urine Storage and dilution of human urine Drip-irrigation system Supply human urine as an agricultural fertiliser in Eco-garden
Cultivation experiment	Observation and weight measurement	A weight measurement of vegetable Perceived differences in size and taste between the vegetable products produced with and without human urine as a fertiliser
Others		Assess both the action and reflection process as a whole Observe the progress of academic and functional skills Assess social relationship Evaluate stakeholders' satisfaction Evaluate the most significant changes

In PAR, the outcomes regarding sanitation and hygiene were defined collaboratively, especially on HWWS and UDT use. The PAR team of this research developed contextual participatory evaluation where almost all co-researchers and researchers actively participated in data collection and analysis of evaluation data.

Their involvement in the evaluation process helped build a clear understanding and excitement about the value of evaluation.

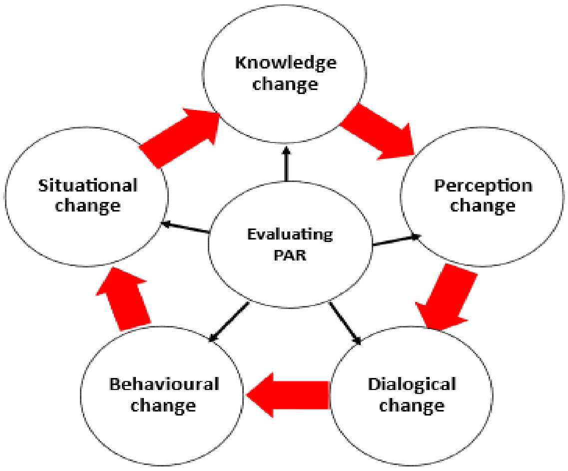

Figure 4.7. Evaluating Participatory Action Research

Several key concepts underpin the evaluation of PAR. Most fundamentals were knowledge or awareness regarding sanitation and hygiene, perception or motivations towards the UDT use and application of human urine as agricultural fertiliser. Another key component was the dialogical or emergent change that broke the distance between the researcher and co-researchers. The dialogical or emergent change also indicates critical reflection, including the biases and assumptions of co-researchers that motivate them to feel ownership of the achievement. Finally, behavioural change was identified in the third phase of this study. The specific changes from the needs assessment to the follow-up phase were identified with particular indicators. Five areas of change were assessed (Figure 4.7).

The classroom observation focused on teaching and learning methods and applying IEC materials in teaching. Similarly, students' participation in learning and content coverage on sanitation and hygiene education were observed. Furthermore, the knowledge regarding handwashing with soap and urine-diverting toilet use was compared with the results from a follow-up study using similar methods and tools. Moreover, a few of the components that I feel critical and contextual to incorporate, like PAR, is the power of change. Some technicalities related to the Eco-san system emerged by contexts, such as storage and dilution of human urine, drip-irrigation system plant and supply of diluted human urine as agricultural fertiliser, have been added as part of knowledge change. Similarly, a cultivation experiment using human urine and animal dung as fertiliser in Eco-garden was also incorporated as the evaluation in the PAR process. Many sessions and activities were conducted as an intervention between this study's first and third phases.

Similarly, this study's next evaluation aspect is dialogical or emergent changes. Here dialogical change denotes a process of knowledge production for change. After implementing different activities as interventions in the PAR, the research participants' knowledge, perception and behavioural change regarding SHE, HWWS, UDT use, and perception change on 'urine as waste' were evaluated. In addition, it also assessed social norms and values regarding the Eco-san system, the collaborative manner in research work, hierarchical scaling in field engagement and learning process, PAR-based social construction and the change of researcher and co-researchers into non-deceptive and non-exploitive. The details of dialogical or emergent change among research participants are elaborated in chapter six.

Structural or situational changes in school-related sanitation and hygiene have also occurred, considering that resources and materials directly or indirectly affect change. Some physical/structural changes during this study period were also appraised. For example, we observed handwashing stations (HWSs), soap management at HWSs and toilets, number of toilets, specifically UDT and IEC materials, to support effective classroom teaching and learning. In addition, a storage tank, urine treatment plant, human urine dilution system plant, drip irrigation system plant and an Eco-garden inside the school compound were also developed to use human urine as an agricultural fertiliser.

Chapter Summary

This chapter describes the participatory action research (PAR) process that begins with the needs assessment to follow-up and evaluation. This study was conducted 'with' participants but not 'on' participants developing collegiality and working collaboratively in the school setting. The nature of the research is cyclical, implementing different activities to address the priority needs regarding sanitation and hygiene education and the Eco-san system in the school. The PAR phase two was collaboratively conducted to develop sensitisation/awareness on sanitation and hygiene education (SHE), handwashing with soap, developing IEC materials and participatory curriculum development and installing an Eco-san system in the action school. The strategies and procedure of participatory evaluation to identify the changes after conducting intervention activities are briefly presented in this chapter. By completing the study and data collection side by side with the group's participation, it was found that the participants felt as if they had received something and not something to be given. The essence of participatory action research is collaborative action, where the reflection after the action is the research findings.

Chapter 5. Participatory Action Research during the Pre-Implementation Phase

Overview of the Chapter

Since the study has been conducted in three phases with 31 field visits to the action and reference schools in Chitwan, the findings of the first phases, mainly obtained from the action school, are presented with the results from the needs assessment. This chapter presents pre-implementation findings derived from analysis of the physical characteristics of the school, survey, classroom observation, focus group discussions (FGDs) and in-depth interviews. It starts with a situation analysis of the action school in 2018. Situation analysis includes the composition of teachers, students and school management committee, physical facilities available in schools and the standard of toilets, water and waste management system in the school. Similarly, the survey results indicated the student participants' demographic profiles and reported handwashing knowledge and practices. The qualitative data related to classroom observation focuses on content coverage of sanitation and hygiene education, teaching methods, and information education communication (IEC) materials. Moreover, the chapter describes the pre-implementation qualitative findings related to the perception of urine diversion toilet (UDT), use and human urine as an agricultural fertiliser in the school's Eco-garden. The data collected in the pre-implementation phase did not involve any intervention or shared ideas about the Eco-san toilet/ UDT, advantages and disadvantages of Eco-san toilet/UDT, using guidelines of UDT and human urine application as agricultural fertiliser.

Situation Analysis of Action School (Before Intervention)

Situation analysis of the action school helped to clearly understand the school's situation and establish a common understanding between the researcher and co-researchers or research participants. Situation analysis within a particular school can be defined as a process of getting involved in a school to assist teachers and students in learning more about their current situation, problems, and needs regarding sanitation and hygiene behaviour change. Strategies and activities to solve these problems may be jointly developed. Issues identified within a school can only become concrete needs once defined (Hatton & Smith, 1995). In this study, situation analysis was seen as a part of the needs assessment. Mainly it focused on handwashing practice with soap and water or water only at critical times, like before a meal and after toilet use.

Similarly, it revolves around using Eco-san toilet/urine diversion toilet and applying human urine as agricultural fertiliser and classroom teaching and learning practice of sanitation and hygiene education (SHE). Content coverage on SHE, drinking water management, waste segregation practice, and sanitation situations before implementation of PAR intervention are also included under the situation analysis of the action school. The situation analysis of this study provided a glimpse of the action school. It guided the development of sanitation and hygiene behaviour change strategies and activities through a participatory action research approach. It also motivated researchers and co-researchers to work together to understand and change a problematic situation for the better.

Figure 5.1. A Transect Walk in the Community

In the study process, we (researcher and co-researchers) first engaged in a transect walk to ensure health education problems in a public-school setting. We identified the necessary pedagogical support for implementing sanitation and hygiene education-related support.

During the ocular survey, we visited 22 public schools in Chitwan and Nawalparasi districts. Out of the 22 schools we visited, we selected five schools in the second step. Finally, one public secondary was selected based on the school nominating guidelines of NORHED/ Rupantaran project Tribhuvan University. As a part of the participatory process, schoolteachers, school management committee members, students club, students and school administration were asked to SHE problems and ways to improve the situation. We identified some visible conditions related to SHE, hand washing with soap and urine diversion toilet and perception regarding human urine as agricultural fertiliser.

Figure 5.2. Action School

Action school is a beautiful school located in Khaireni Municipality Ward no 2 Chainpur, Chitwan, with easy access to the Ratnanagar, Tandi and Chitwan areas. It is the action school of the NORHED/ *Rupantaran* project. It was established in 2016 *Bikram Sambat* (BS) and accredited by the Government of Nepal, Ministry of Education, Science and Technology. It is dedicated to academic excellence, personal attention, and the character-building of the students. It supports parents in raising children and promotes intercultural harmony. The action school is committed to making school life a meaningful and enriching experience. It is located in a residential area with enough space for all the students to assemble at once. The total area of the school is 5.556 acres. School buildings and playgrounds occupy about 1.67 acres within this area, and the rest of the site is estimated to develop into a school garden. There is a child club with 13 members, an Eco club with 13 members, and a Junior Red Cross with 11 members. Similarly, it has a school management committee (SMC) with 13 inclusive members and a functioning Parents Teachers Association (PTA). The action school enrolled 506 students from grades 1 to 10 in 2018.

Table 5.1. Situation Analysis before Intervention

Variables	Before PAR Implementation (2018)
Number of toilets	6
Teacher-student ratio	1: 20
Toilet student ratio	Boys- 1:96 and Girls- 1:139
School buildings	6
Water taps	8 (without soap)
Wash Basins/sinks	2 (without soap case and soap)
Eco-san toilet/ UDT	Not available.
Urine fertilizer use	Not available.
Eco-garden	Not available.

Sanitation situation. A clean and well-maintained toilet is a pathway to healthier schools and healthier, better-performing children (Suryadarma et al., 2006). In the action school, there were only six toilets, where teachers and female students shared two toilets. One was a male urinal, and all students used the remaining three. Unfortunately, the senior girl students had no separate toilets, which was problematic during menstruation. All teacher staff and senior girl students were using the same toilets. The toilet-student ratio for girls was 1:128, and boys was 1:101. While the WHO UNICEF JMP standard suggested that the toilet-student ratio should be 1:22, which is five times greater in this school (WHO UNICEF JMP, 2020). Most of the students (91.4 %) used school latrines for defecation and urination while in school, but the remaining (8.6%) used public toilets adjoining the school compound.

Provision of water supply in the school. A water tap was available inside the school compound. Deep boring (300 feet deep) was the source of water which was installed 20 years ago. There was no water treatment practice in the school, and the water quality from the well was not regularly tested. Regarding the water purification practice, the chairman of the school management committee (SMC) stated:

> I have discussed the water purification process with the headteacher many times. The staff arrive here at 9 am and fill the tank. I suggested putting a few drops of chlorine in the water tanks. However, it is not in practice and wanted has not been tested yet. (SMC chair in the informal talk).

Again, he elaborated:

> I realise it is a fault too because I told him the process 3-4 times but have not followed it.

Other participants also shared similar observations.

Sometimes students bring water from their home for drinking but not for toilet use or handwashing. (Informal speak with the female teacher)

> Sometimes we have scarcity of water at school because of no electricity. (Informal talk with the male teacher)

Similarly, the headteacher of the school reiterated:

> We need to improve the condition of drinking water in the school. It is necessary to construct one water tank and install a water filter. (Informal talk with headteacher)

In addition, there was no waste segregation practice as decomposable (organic) and non-decomposable (inorganic) at the beginning of this study or during the situation observation in 2018. Also, there was no onsite urine treatment practice in the school.

Composition of teachers, students, and school management committee. Based on the analysis conducted in early 2018, 506 students consisting of 228 boys and 278 girls, studied from grades one to ten. Similarly, 25 teachers, including 15 males and ten females and four support staff were working. In addition, the 13-member (male eight and female Five) SMC played an influential role in school management.

Profile of the Co-researchers. The study was carried out with 209 students, 21 participatory action research (PAR) committee members, 25 teachers, 13 child club members, 13 Eco-club members, and 11 Junior Red Cross Circle (JRCC) members. Forty-nine (49%) male and 51% female participants were engaged as co-researchers. Co-researchers from different groups involved in the study are given in table 5.2.

Table 5.2. *Research Participants*

Group of Participants	Male		Female		Total (Column)
	N	%	N	%	N
Students	99	47	110	53	209
Teachers	15	60	10	40	25
PAR committee	11	52	10	48	21
Child-club	6	46	7	54	13
Eco-club	7	54	6	46	13
Junior Red Cross	6	55	5	45	11
Total	144	49	148	51	292

Survey

The needs and gaps were identified from the survey method in areas of hand hygiene, sanitation, Eco-garden-related information, and acceptance of human urine as manure.

Socio-demographic characteristics of the research participants. A total of 209 students from grades 4-8 were involved in the survey. Table 5.3 shows the socio-demographic characteristics of the students. Of the 209 students, females were 110 (53.0%). The mean age of the participants was 12 years (SD= 1.675). The majority (80.0%) of student participants in the survey were from grades 6-8. Seventy-six percent of the students were Hindu, and more than half (53%) belonged to indigenous castes. Most student participants (36%) considered agriculture the primary source of income for the family.

Table 5.3 *Socio-demographic Characteristics of the Participating Students*

Variables	Frequency	Percentage
Sex (n=209),		
Male	99	47.0
Female	110	53.0
Age (n=209) mean age= 12.3 years, Minimum age= 8. Maximum age = 16, SD= 1.675		
≤12	106	51.0
> 12	103	49.0
Grade (n=209)		
4 and 5	42	20.0
6,7 and 8	167	80.0
The religion of the Participants (n=209)		
Hindu	159	76.0
Non-Hindu	50	24.0
Ethnicity of the Participants (n=209)		
Indigenous/ Janajati	112	53.0
Dalit	54	26.0
Brahmin/ Chhetri	43	21.0
Family Income sources (n= 209)		
Agriculture	75	36.0
Business/Trade	28	13.0
Job/ Service	51	25.0
Labour	55	26.0

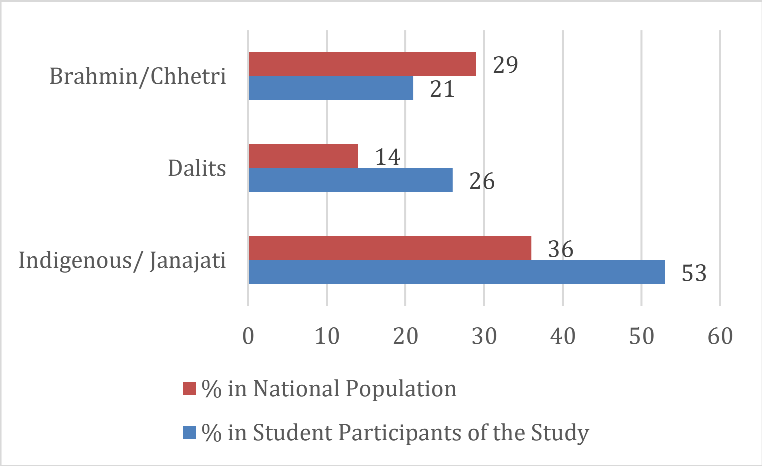

Figure 5.3. Comparison of Ethnic composition between survey participants and national figure

A comparison of the caste ethnic composition of the survey participants (students) with the national demographic composition (Fig.1) shows more *Dalits* (12% increase) were involved in the survey than the total 14% of the national *Dalits* general population. The percentage of *Janajati*/ indigenous was more significant by 17% engaged in the study than their national population share. However, the percentage of Brahmin/Chettri involved in the survey was less by 8.0% than their national population.

Status of sanitation and hygiene facilities (reported). Some of the issues regarding sanitation and hygiene facilities in school were identified through record review and observation visits. At the same time, the broad context was assessed through a survey and other related methods used for the needs assessment. Though policies and targets on sanitation and hygiene in schools are a national priority, the intervention school faced many problems. Some parameters regarding sanitation and hygiene facilities incorporated in the survey and reported results are shown in table 5.4.

Table 5.4. *Sanitation and hygiene Facilities at School*

Parameters of Sanitation and hygiene facilities	Reported Results (%)
Handwashing facilities (HWFs) (n=209)	
Provision of regular running water at HWSs and toilets	90
Inappropriate height of taps at handwashing stations	32
Not comfortable washing hands at handwashing stations	43
Dirty washbasins	56
School toilets facilities	
Feeling a lack of privacy in school toilets.	14
No child-friendly toilet door	36
Overcrowding in the male urinal (n= 99)	45
Open urination (boys only) (n= 99)	13
Queue for toilet	84
Used to go to a public toilet	17
No, disabled-friendly toilets	17
Cleanliness of school toilet	
The faecal matter was found in toilets	40
Poor cleanliness and bad odours	54
Lacking supervision of toilet cleanliness	77
Helper (peon) cleans the toilet	89
Drinking water	
Lack of safe drinking water at school	97
Brought drinking water from their home	7

Table 5.4 above presents that a high majority (90%) of student participants reported regular running water available at HWSs and toilets. But overall, 67 out of 209 (32%) students reported that the height of taps at HWSs was inappropriate. Similarly, nearly three-quarters (72%) and less than half (43%) said being overcrowded and uncomfortable while washing hands at HWSs, respectively. Also, more than half (56%) of students reported dirty basins.

A small percentage (14%) of survey participants stated that they did not feel privacy in the school toilet. Likewise, 36% of the participants said that the toilet door was not child friendly, and 84% said they had to wait in queue for 7-17 minutes to use the toilet. While overall, 45 (45%) out of 99 male students reported overcrowding while going to the male urinal, and 13 % out of 99 boys used open urination. In addition, majority (89%) of them reported that toilet was cleaned only by the helper (peon) and.   77% said that toilet cleanliness practices were not supervised. Not only that, but nearly half (40%) of the survey participants also reported that faecal matter was visible and smelly on the toilet surface. Despite globally recognising that human excreta are not a waste, but a resource, 61% of the survey participants (n=209) were not unknown about it. In the pre-implementation phase, an overwhelming percentage (97%) of the research participants were unknown of Eco-san/ UDT.

Knowledge of sanitation and hand hygiene. This section especially summarizes sanitation and hygiene-related knowledge of basic level students. The key aspects covering knowledge on sanitation and hygiene are: i) sources of information, ii) importance of handwashing, iii) sanitation and hygiene-borne diseases, iv) required materials while washing hands and v) association between demographic variables and sanitation and hygiene.

Major sources of information regarding sanitation and hygiene. Participants were asked the sources of information regarding handwashing through the questionnaire. As table 5.5 shows, nearly three in one per cent of the survey participants (34.9%) reported no source of information, while 31.6% of participants reported the source of information was school/teacher. Similarly, parents, neighbours, friends, and radio/TV were also known sources about handwashing.

Table 5.5. *Sources of Information about Hand Sanitation and hygiene*

Main Information Sources	Responses	
	N	%
School/teacher	66	31.6
Parents	28	13.4
Neighbours	14	6.7
Friends	10	4.8
Radio/TV	18	8.6
No source of information	73	34.9
Total	209	100.0

Knowledge of the importance of handwashing. Knowledge assessment of respondents about the importance of handwashing found that 60.6% of the respondents were aware that handwashing with soap was helping to prevent diseases. In comparison, 22.8% of participants were unaware or did not know why it is important to wash hands with soap.

Table 5.6. *Knowledge of the Importance of Handwashing with Soap*

Indicators	Responses (n= 209)	
	Yes (%)	No (%)
Kill germs	47.4	52.6
Keep clean	47.4	52.6
Prevents diseases	27.3	72.7

*****Multiple responses

Knowledge of sanitation and hygiene-related diseases. Participants were asked whether they knew of any hygiene-related diseases. Infectious diseases are caused by poor hygiene. More than half of survey participants (55.5%) said diarrhoea was caused by poor sanitation and hygiene. In contrast, participants reported malaria, skin diseases, typhoid, and worm infestation were 34%, 34%, 32 %, and 26%, respectively. But most participants in all cases were still unaware of the diseases caused by poor sanitation and hygiene.

Table 5.7. *Knowledge of Hygiene-related Diseases (Pre-intervention))*

Hygiene related	Responses (n=209)	
diseases	Yes (%)	No (%)
Malaria	34.0	66.0
Typhoid	32.1	67.9
Diarrhoea	55.5	44.5
Worm Infestation	26.3	73.7
Skin diseases	34.0	66.0

*****Multiple response

Knowledge of required materials while washing hands. When asked what materials should be used for handwashing, more than half (54%) of the participants answered water only, whereas 46% reported water and soap. However, no one was aware of seven steps handwashing techniques that WHO suggests (Pan et al., 2014).

Table 5.8. *Knowledge Required Materials while Washing Hands*

Handwashing materials	Responses	
	N	%
Water only	113	54.1
Water and Soap	96	45.9
Total	127	100.0

Association between socio-demographic variables and sanitation and hygiene-related knowledge. There was no statistically significant relationship between the demographic variable caste/ ethnicity and HWWS knowledge in terms of advantages of HWWS ($\chi 2$ =5.665, P=.462). The association between socio-demographic variables (caste/ethnicity) and HWWS knowledge regarding the advantages of washing hands with soap is given in Appendices XVI.

However, there was a significant relationship between their level of education (grade/grade) and knowledge of handwashing materials that need to be used ($\chi 2$ =4.750, P- value= 0.22).

Table 5.9 *Association between Grade and knowledge in terms of Hand Washing Materials*

Grade/ grade	HW Materials			χ 2	df	P-Value
	Water and soap (%)	Water only (%)	Total (%)			
4 & 5	13.5	25.7	20.1	4.750	1	.022*
6, 7 & 8	86.5	74.3	79.9			

*p<0.05

Sanitation and hygiene practices. From this study, I learned about different valuable information on the handwashing practices of students in school. This part considered the handwashing behaviours while the students were in school. It mainly focused on the handwashing (HW) place/stations, the timing of HW materials, students' perceptions of HW stations, and the availability of water at HW stations and toilets. HW was evaluated at two critical times: after toilet use and before a midday meal. Table 5.11 shows that out of 209 survey participants a high percentage (93.8%) of them washed their hands at critical times. Of the 196 participants who used to wash hands at school, majority of them (96.9%) washed their hands at HW stations, while 3.1% washed their hands at basins. In response to "when to wash your hands at school", most participants (91.8%) washed their hands both critical times before midday meals and after toilet use.

Basic level students were asked eight related questions in the survey to identify the sanitation practices before providing any sensitisation or intervention programme. In response, an overwhelming majority (91.3%) of the survey participants stated they usually defecate in the school's toilet during school hours, whereas 7.7% of students use the public toilet adjoined to the school compound due to the hassle of queuing in the school's toilet for a long time. Similarly, only one per cent of students near school went to their home toilet when they felt defecating. Out of 209 participants, 86% said the school toilet was private, but 84% reported the tragic situation of waiting in a queue for a maximum of 20 minutes for toilet use, whereas 64% of participants said the school toilets were comfortable. According to 86% of the survey participants, helpers were involved in school toilet cleaning, but 64% said school toilets were not cleaned.

Table 5.10. *Sanitation and hygiene practices of the students at school*

SN	Variables	N	%
Hygiene Practice			
1	Handwashing practice (n= 209)		
	Yes	196	93.8
	No	13	6.2
2	Place of HW at school (n=196))		
	HW stations	190	96.9
	Basin	06	3.1
3	Perceptions of the comfort of washing stations in school (n=196)		
	Comfortable	166	85.0
	Uncomfortable	30	15.0
4	Handwashing timing (n=196))		
	Both after the toilet and before the midday meal	180	91.8
	After toilet only	10	5.1
	Before midday meal only	06	3.1
Sanitation Practice			
5	Place of defecation while students are in school (n=209)		
	School toilet	191	91.2
	Public toilet	16	7.8
	Home toilet	2	1.0
6	Perceived privacy in school toilet (n= 209)		
	Yes	180	86.1
	No	29	13.9
7	Wait in the queue while going to the school toilet		
	Yes	176	84.2
	No	32	15.8
8	Time to wait in the queue (n= 176)		
	Mean (x) time = 4.20		
	Maximum time= 20 minutes		
	Minimum time= 1 minute		
	SD= 2.521		
9	Easy to use school's toilet (n=209)		
	Yes	133	63.6

	No	76	36.4
10	Reasons for feeling uneasy about using school toilet (n=76)		
	Difficult to open the toilet door	13	17.1
	Difficult open water taps in the toilet	30	39.5
	Not appropriate height in the toilet pan	33	43.4
11	Response for cleaning the school toilet (n=209)		
	Sweeper/helper	185	88.5
	Students themselves	13	6.2
	Teacher and students collaboratively	11	5.3
12	Frequency of cleaning school toilet (n= 209)		
	Once a day	28	13.4
	Twice a day	15	7.2
	Once a week	20	9.6
	Twice a week	12	5.7
	Never	134	64.1

Association between demographic variables and sanitation and hygiene practices of the students at school. More than half (63.6%) of survey participants felt the school toilets were comfortable, whereas more than one-third (36.4%), mainly junior graders, reported that they felt uncomfortable in school toilets due to the difficulty in opening the toilet door and the non-functioning of the lock of the toilet's door (13 %).

Figure 5.4. School Toilets before Interventions

Similarly, it was difficult to open the water tap in the toilet (17%) and toilet pan height was inappropriate (40%). It was also found that there was a statistically strong relationship between junior and senior graders of students and comfortable use of school toilets (χ^2 = 91985, df= 1 and P<0.001).

The perceived uncomfortable use of school toilets by caste/ ethnicity was not statistically significant (χ 2=2.399, p= 0.031). Still, there was a strong association between uncomfortable use of the toilet by age ((χ 2=19.758, p<0.001). In contrast, there was no association between uncomfortable use by sex/gender ((χ 2=2.986, p= 0.057).

Table 5.11. *Association between Demographic Variables and Perceived Comfort of School Toilet*

Variables	Comfortable use of school toilet			χ 2	df	P-Value
	Yes %	No %	Total N			
Grade						
4 & 5	0.0	100.0	42	91.985	1	.000***
6- 8	79.6	20.4	167			
Caste/ethnicity						
Dalit	55.6	44.4	54	2.399	2	.301
Janajati/ indigenous	67.9	32.1	112			
Brahmin/Chhetri	62.8	37.2	43			
Age (years)						
≤12	49.1	50.9	106	19.758	1	.000***
>12	78.6	21.4	103			
Sex						
Male	57(57.6)	42(42.4)	99	2.986	1	.057
Female	76(69.1)	34(30.9)	110			
Total	133(63.6)	76(36.4)	209			

***P<0.001

The school administration/headteacher is the main person who is supposed to understand the whole situation of the school well. So, we conducted an in-depth interview (IDI) with the headteacher and discussed the school's sanitation and hygiene situation. The headteacher reported that not washing hands with soap and water at key times (before meal/ tiffin and after toilet use) still prevailed in the school. Soap was not managed at school, both in HWSs and toilets. Managing soap at school was seen as a challenge. Likewise, another challenge was not enough toilet facilities in the school. The number of toilets in the school was far below the toilet-student ratio recommended by WHO (1:20) (Ashu et al., 2021). Likewise, the Government of Nepal, Ministry of Education, Science and Technology (MOEST) emphasized separate toilets for girls and boys and 50:1 student toilet ratio for boys and 30:1 for girls as a minimum standard (GON/MOEST, 2018; Government of Nepal, 2018). However, the school's toilet-student ratio (1:128) was as high as the recommended standard by WHO and MOEST. In addition, students and teachers had not developed a culture of cleaning school toilets. It was done by helping staff (peons) but cleaning the toilet regularly or daily was not customary. The headteacher said that the main reasons for poor cleanliness of toilets were lack of adequate counselling by teachers and school administration, lack of understanding of the importance of toilet cleanliness by students and view of human excreta as the matter of disgust. However, the school toilets were not so bad smelly because of having an adequate and regular supply of water at all toilets and HWSs. In this regard, the headteacher asserted that,

> The school does not have enough resources to buy soaps, and it is not easy to manage. Students themselves also cannot manage soap for their use in school. No funding agency has been supported, especially in the sanitation and hygiene sectors. So, we wash our hands with only water. (IDI, Headteacher)

He further said =,

> There are not enough toilets in the school, and teachers and students do not clean even the existing toilets. Sometimes, helpers/peons clean the toilet. (IDI, Headteacher)

Awareness and Perception of Urine Diversion Toilet (pre-intervention)

Human- urine is the most potent nutrient-abundant part of the domestic waste component and the Eco-san toilet or urine-diversion toilet (UDT) is the best solution to control environmental pollution (Jonsson et al., 2000). It still does not seem to be used sufficiently in Nepal’s school and college settings (KC, 2017; Pradhan and Tanski, 2010). Using Eco-san toilet or UDT, the study changed students’ sanitation and hygiene behaviour and converted human urine into resources or agricultural fertiliser instead of waste. To identify knowledge about Eco-san toilet/UDT, the data were collected and analysed to find out the awareness, perception and potential acceptance of UDT/ Eco-san toilet and the application of human urine as an agricultural fertiliser in the school garden.

Awareness of urine diversion toilet. When asked the survey participants about the eco-san system and urine-diverting toilet, a high majority (97%) of them were not aware of the urine diversion toilet system and the fact that they were unaware of the human excreta that can be used to make agricultural fertiliser while the rest of them (3%) knew Eco-san toilet/ UDT and human excreta would be useful as fertiliser. Sources of information were their parents, neighbours, relatives and online sources (youtube). However, most of the research participants in the focus group discussion (FGD) and in-depth interviews reported knowing the ecological sanitation system, Eco-san toilet/UDT, and applying human urine as agricultural fertiliser. Their relatives, friends, neighbours, radio, and the internet were quoted as the sources of information. Most of the study participants did not know about UDT techniques. They also did not know the storage of human urine properly, the dilution ratio of human urine with water and supplying it with a drip-irrigation system in the Eco-garden. Regarding the knowledge and awareness of Eco-san toilet/ UDT and the application of human urine as agricultural fertiliser, the headteacher of the action school stated:

> Eco-san toilet/ UDT is a human excrement toilet in which human faeces and urine are stored in separate chambers or safety tanks. Human urine can be used in the vegetable garden without being stored or without any treatment, but when making fertiliser from faeces, it needs to be stored in the safety tanks by adding ash, leaves etc. After decomposed leaves and fresh faeces, it can be used as fertiliser. (IDI Headteacher)

During the needs assessment, discussions were held with the students' group about the Eco-san system, Eco-san toilet, UDT, and humanure. The student participants said they did not know much about the Eco-san system, Eco-san toilet or UDT, and human excrement could be used as soil nutrients, but they knew a little differently from parents and neighbours on the internet. They stated,

> We lack knowledge of the Eco-san system, the Eco-san toilet/ UDT and humanure. No school curriculum facilitated us. Similarly, no sensitisation whatsoever from any Non-governmental Organisations (NGOs), International Non- governmental Organisations (INGOs), or Governmental Organizations (GOs) has been done, and there has been no campaign regarding innovative sanitation systems like Eco-san through Eco-san toilet/UDT and application of human urine as agricultural fertiliser. (FGD, male student from grade 8)

There were also knowledge gaps among teachers on the Eco-san system, Eco-san toilet/UDT, application of human urine as fertiliser and no idea regarding Eco-san as the best solution to control environmental pollution. In this regard, some teachers and some PAR committee members were aware, and they reflected the following remarks:

> Eco-san is a way of making sanitation friendly and healthy environment. It is an innovative technology involving human faeces and urine disposal, but it is impossible in the school setting. (FGD, Male teacher)

The above quotation demonstrates that even those who are supposed to spread the message of Eco-san had inadequate understanding of Eco-san. The male teacher added:

> No opportunity we got to know information education communication (IEC) materials, including posters, flyers, booklets, radio programmes, campaigns, film and drama shows, seminars, and workshops in the school and the communities on the Eco-san system. (FGD, Male teacher)

While a few of the participants were not aware of whether the Eco-san toilet/UDT is safe or not, they made the following remarks:

> We lack knowledge of the Eco-san toilet. No related course and information were mentioned in the school curriculum, and no Municipality or wards have given us information on the Eco-san. Even radio programs relating to human urine as fertiliser have not been found. We learned very little about Eco-san from the internet and YouTube. (FGD, Male teacher)
>
> No instruction has been done, and there has been no formal course to promote the Eco-san. (FGD, Female teacher)

The critical informant interviewed acknowledged the common knowledge about the Eco-san system. He attributed it to a lack of resources to promote Eco-san. However, the discussion explored further queries by asking whether the participants had seen an Eco-san toilet/UDT. Most teachers and PAR committee members who participated in the discussion reported hearing about the Eco-san toilet. Still, they had not been sensitised about the technology. Few of the FGD participants from teachers and PAR committee members' group had seen the Eco-san toilet in the same district in Darechowk (an adjoining rural municipality). As they mentioned, the Eco-san toilet of separation of urine has chambers. Likewise, the type of Eco-san toilet reported by the few participants was a compost toilet.

Perceptions and attitudes towards ecological sanitation. Perception regarding the conventional sewage disposal system 'drop and flush' or 'drop and store' is the subject of debate. In the 'drop' and flush system, especially in Nepal's city, the wastewater is discharged directly into the rivers, polluting and spreading water-borne diseases. This drainage management model cannot solve the sanitation needs in school and community settings. As mentioned earlier, the system of disposing of human waste does not mean changing human waste into a resource. Implementing the Eco-san concept would be the best solution to control environmental pollution. Human urine can be used as a resource in agricultural fertiliser. Therefore, efforts should be made to promote the segregation of

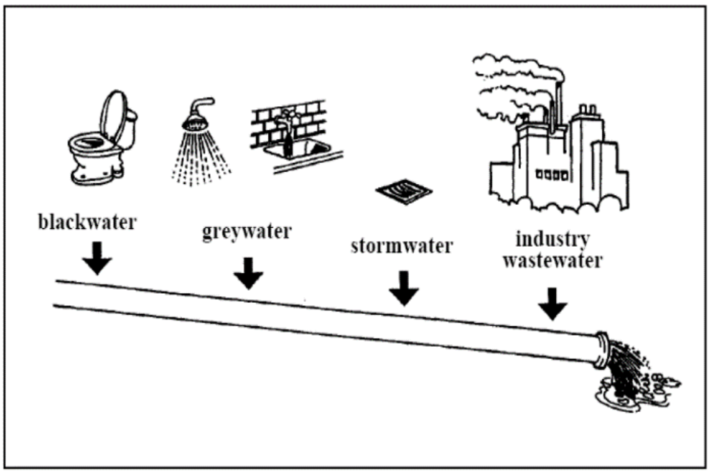

Figure 5.5. The Drainage system, source: (Esrey et al., 2001, p. 10)

human urine and faeces and treat it as agricultural fertiliser. Concerning applying the Eco-san system in urine-diverting mode, some issues were discussed to understand the perception and attitude on Eco-san toilet/UDT use and application of human urine as agricultural fertiliser.

The linearity of the current sanitation system' drop and flush' has made it impossible to recover the valuable plant nutrients released from human excrement. This calls for the need for sanitation to be rethought (Esrey et al.,2001) to make it possible to recover these nutrients for their subsequent use in food production. Regarding the generation of human excrement that starts with food, we raised the issue of converting the nutrients in the excreta back to food through sensitising human urine and applying it as fertiliser.

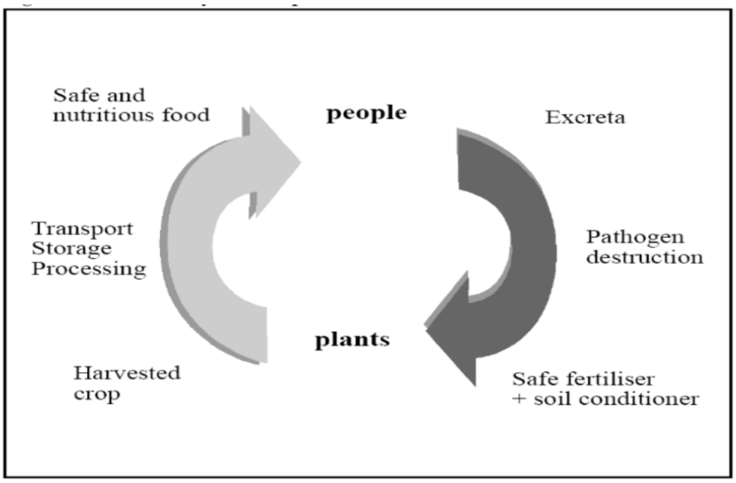

Figure 5.6. The Eco-system Loop (Esrey et al., 2001, p. 12*)*

As a researcher, before going to the field, I was a bit worried about how the participants would feel talking about excrement in groups. The action school's SMC/PAR committee members had said that the subject had been a taboo to discuss earlier. However, none of the co-researchers felt uncomfortable during the discussion. The participants had a gentle attitude during FGD and interview, and the atmosphere was more humorous than stiff. Though the subject was embarrassing, the participants did not dislike sharing sanitation activities, especially Eco-san technology.

Conversely, in the youth group, especially student participants, the atmosphere was not so light, and they were not actively participating in the discussion. While discussing Eco-toilet/ UDT in FGD and the interview, they expressed lack of awareness of Eco-san toilets in schools and communities. Very few participants were aware of Eco-san technology and its benefits.

Eco toilet in terms of sanitation and hygiene. Perceptions of Eco-san toilet /UDT are integral to health practices, especially sanitation and resources such as fertiliser. In the initial phase of the study, research participants had different perceptions about the general adaptation of Eco-san toilet/ UDT, disease transmission and the type of sanitation technology adopted. For instance, the UDT can be thought of as dirty and evil. The discussion among SMC/PAR committee members found that poor sanitation may lead to diseases and illness due to less water use in the Eco-san toilet. This can lead to diseases for water consumers and negatively affect the environment. On the relationship between Eco-san toilet/UDT and risk of diseases, most participants perceived risk of contracting diseases through the handling of urine, unhygienic toilets or poor sanitation. They describe the following quotes:

> Eco-san toilet/UDT is very unclean and always smells; we need to buy chemicals to eliminate the smell. These toilets host a lot of germs and flies. The flush toilet is better because we can use water for cleaning, flushing and hand washing. (FGD, SMC/PAR committee member)

In contrast, another SMC/PAR committee participant addressed the benefits of the Eco-san system, which is seen as a possible and reasonable solution to improve the sanitation situation. He said:

> Diseases caused by poor toilet conditions can be reduced by using Eco-san toilet/UDT. (FGD, SMC/ PAR committee member)

Teacher participants also expressed similar statements, which depicted that poor sanitation in the school premises is a huge problem that uses Eco-san toilet/UDT. He stated:

> The Eco-san system using urine-diverting mode helps avoid diseases caused by poor toilets. (FGD, Teachers)

Gender perspectives on Eco-san toilets. The Eco-toilet, or UDT, according to most female educators, is not gender friendly. They believed blood spots would appear on the Eco-san toilet pan during their period/ menstruation due to the Eco-San toilet's unpleasant seating position and odour. They also said that because females have a shorter distance between their urethra and anus than males, the pan wall separating the faeces and urine into different holes is not good for them. They opined that diverting urine and faeces into different holes was problematic. However, a female teacher who participated in the FGD made the following statements:

> The Eco-san toilet/UDT can improve menstrual hygiene management because there is privacy, better facilities for waste disposal, and handwashing facilities inside. (FGD, Female teacher)

Some other participants went on; using the Eco-san toilet during their menstruation is very uncomfortable. They also claimed that sanitation and hygiene are more critical for women. By nature, they need to urinate more frequently, and holding urine is difficult, especially when menstruating. This shows that the Eco-san toilet is not more valuable and preferable for women and girls, as the quote below expresses.

> The menstrual discharge may clot in the pan of the Eco-san toilet and is a disgusting matter. The design of the Eco-san toilet pan does not provide enough urine diversion for females. Both faeces and urine may go in the same hole. (FGD, Female teacher)

Acceptance of Eco-san toilet or UDT. The pre-implementation results indicate that the study participants anticipate numerous advantages of the Eco-toilet. Regarding valuing and accepting new ideas, some participants emphasize organic manure's economic and sanitary benefits, which are also healthier for people and the environment. As a result, the Eco-san innovation concept appears attainable for use in educational and community settings. However, due to their perception of urine as filthy or impure, a few research participants stated that using the Eco-san toilet and human urine could be problematic. As a result, they did not value its fertilizer application. The teachers' FGD participants were also unsure of the Eco-san toilet's technical capabilities. They could not comprehend how the management of foul odour, the diversion of urine and faeces, the supply of urine to the school garden or fields, and the management of sanitary issues were accomplished.

Even though the participants were less willing to accept the Eco-toilet, a few educators were aware of its potential applications after reading about it in the media. They reported greater awareness about the importance of using such toilets and applying human urine as fertiliser in the school garden and on their crops.

> Using the Eco- toilet is good because human urine can be fertilised with this technology. (FGD, male teacher)

> We do not consider the Eco-san a priority because no one is prepared to empty it and distribute it to the crops. We feel uneasy doing so. (FGD, female teacher)

> Sadly, our school no longer has a garden, and we are not even interested in having them. I do not think students and teachers would apply human urine to their crops. (FGD, Female teacher)

An SMC/PAR committee participant has a tremendously positive attitude towards the Eco-system. During the discussions, the participant said that he visited the Eco-san project site and saw the effect of human urine fertiliser. He stated,

> There is no disadvantage but more advantages of Eco-toilet. I want to apply the human urine fertiliser I have produced myself to my farm. I think that everything at the beginning has a problem, to use human waste on the farm will be difficult, even eating the vegetable will feel bad but as time goes on people will be used to this. (FGD, SMC/PAR committee male member)

Despite the fact that the majority of participants rejected the Eco-toilet, male participants were more favorable. They were more aware of why it was necessary. They frequently compared the Eco-san toilet to the improved pit latrine with a ventilated toilet. According to the statement above, touching human urine is inappropriate in the classroom. Handling human urine and applying it to the school garden was not readily accepted unanimously.

Cultural perspectives on Eco-san toilet. There are cultural beliefs about handling and working with the Eco- toilet. Nepal's norms and traditions dictate that it is unacceptable to take human urine in the edible plants. The research participants believed people should not be exposed to human urine because it is dirty and may lead to illness. So, changing a cultural belief seems to be a challenging task. Those FGD participants opposed the Eco- toilet and said it was incompatible with the local culture and tradition. One participant said:

> Mixing ash with faeces, leaving faeces, and doing pee openly are against our culture. If anyone does so, God will punish them through witches and demons. (FGD, Female teacher)

Another participant in the teacher FGD expressed his fear thus:

> According to our tradition, people don't like eating something grown in our faeces and urine. People feel something terrible. If we go to the market and say that these products are produced using human urine, people will not buy them. (FGD, Male teacher)

> The crops grown will not smell like faeces. It is just a matter of joking. Human urine does not make food smelly, but it is more organic. (IDI, Headteacher)

Likewise, others also see problems concerning reusing human waste for growing activities. This shows that a negative cultural perception of reusing human waste is present and that people will find it hard to accept it initially since it is a new idea.

> According to our traditional belief, people do not like to eat something where our urine will be used, so people will feel something terrible if we go to the market and say that these fruits/vegetables are produced by using urine, people will be afraid. (FGD, SMC/PAR committee, a female member)

The participants expressed concerns about handling the waste from the Eco-san toilet. Proper education on the advantages of the Eco-san and technical support for using human urine without touching it helps transform people's perception of the optimum use of the Eco-san toilet for changing human urine into a resource.

Perception of urine fertiliser. Though different experiments have been conducted to identify the fertiliser value of human urine globally, this study assessed the perception of human urine as an agricultural fertiliser in both pre and post-implementation phases. As human urine use as agricultural fertiliser is quite a controversial subject, the main focus of the study was directed towards its perception. We have discussed the views of co-researchers on urine fertiliser. The pre-implementation findings are the coresearchers' understanding, without any intervention.

Most FGD participants stated they were unwilling to collect urine in a bottle or drum or remove it from the toilet. However, if mechanical piping or drip irrigation—a crop irrigation system that involves the controlled delivery of human urine diluted with water directly to individual plants through pipes—does not involve handling the urine, they were interested in using it in their school garden. Handling human waste was considered a matter of dignity in the school community. The quote below illustrates this point:

> Emptying the urinal chamber by teachers is impossible. The teacher's job is to teach the students, not clean and transport urine. The teacher is not meant to work on the toilet. We can work in the school garden using human urine as fertiliser. If the auto drip-irrigation system is available, it is ok for us. (FGD, Female Teacher)

Only a few teachers were positive about using the approach of Eco-san in urine-diverting mode. They reported that human urine is a richer source of organic fertiliser. They stressed that major problem of handling the Eco-san toilets and human urine will be there urine is handled manually. They said if the technology supports its use without using one's hands, they will use human waste as fertiliser for growing crops. They were aware that human urine as fertiliser is better than chemical fertilisers since it is seen as poisonous for both the soil and human health and can lead to disease. They again asserted,

> Chemical fertilisers are destroying our soil, and the fruits, vegetables, and crops produced using chemical fertilisers harm our health. (FGD, Teachers)

However, in the FGD with SMC / PAR committee members, applying the Eco-san system in school settings like our field would be difficult. They claimed,

> Using urine fertiliser in the school garden by the students is complicated. Students do not like to do things like touching human excrement, farming, and working in the field. (FGD, SMC/PAR committee members)

Some participants in the FGD perceived the Eco-san system and urine fertiliser as beneficial since chemical fertilisers are considered poisonous for both the soil and the humans, leading to diseases and poor yields. They further went on,

> Human urine can be used as fertiliser, making people aware that not eating vegetables produced using chemical fertilisers is dangerous to our health. (FGD, SMC/PAR committee members)

A similar opinion in the teacher group depicts,

> The chemical fertilisers we buy from the market destroy our soil, but human urine has good yields. (FGD, Teachers)

In addition, in the FGD we discussed the best sanitation solution, the application of human urine as an excellent agricultural fertilizer, and how people can be motivated to use Eco-san toilets. Nearly all the teachers in the group said that education could help people accept and understand the Eco-san toilet. The health teacher who participated in the FGD said:

> Educating students in school would be a better method of teaching awareness to their parents. So, knowledge regarding the Eco-san toilet and its effectiveness needs to be shared with the students, and they can then teach their parents. (FGD, female teacher)

The statement above also demonstrates that classroom pedagogy and awareness programs can reduce misconceptions regarding the Eco-san toilet and urine application in the school garden. Additionally, classroom pedagogy and constructing a model toilet can alter perceptions and actions regarding the Eco-san toilet.

Sanitation and Hygiene Education in the School

During sanitation and hygiene education (SHE) teaching-learning, classroom-based participants' observations were made to identify the action school's practice and the associated problems. The SHE situation of the school was determined by analysing the reflective observation note and teachers' and students' group discussion transcripts prepared based on the classroom observation in two phases (pre- and post-implementation phase). Based on the information obtained from these two phases, compare contrast matrix was prepared, and the effectiveness of the intervention programme was assessed; the section only discussed needs assessment's (before intervention) findings. Primarily, this section was found on participating teachers in classroom teaching. Cantrell et al. (2013) admitted teaching is effective when it enables student learning. Further, the study focused on how good teaching practice made practical attitudes, opinions, and learning behaviour.

Good SHE in school is crucial to changing the risky health behaviour of the students. It supports students in taking more significant steps to maintain their health and motivates them to obey healthy behaviour changes. SHE also aims to promote knowing, feeling and doing healthy behaviour. SHE requires interaction between 'students to teachers' and 'teachers to students. Traditional teaching focuses on reproducing facts, emphasising lecturing and written tests. So, child-centred interactive and participatory teaching methods would be the best option to change risky health behaviour. The first phase of the PAR in terms of SHE teaching-learning practice by classroom observation is presented in Table 5.13 below.

Table 5.13. *Results Matrix of Health Education Classroom Teaching*

Themes	Major Findings
Lesson plan (Action plan)	No practice making a lesson plan or an action plan before taking the class Teacher flexibility in lesson delivery
Student-teacher collaboration	Lack of students' cooperation Not interested in favour working in pairs No project work organised in groups Did not involve in collaborative work in grade Lack of student cooperation No professional collaboration found between teacher and students Laziness of some students
Teacher motivation	Low students' motivation

	Lacking teacher motivation towards the lesson, homework, cleanliness of school toilet and school surroundings
	Poor outdoor or field engagement
	The teacher encourages students to do better in academics rather than health promotion.
	Never pop up the students to reduce doubts
	Found passion for progress
	Motive by providing students with positive feedback
	Lacking both intrinsic and extrinsic motivation
Content Coverage on SHE	Found the content coverage on personal hygiene
	Did not speak anything about handwashing with soap at critical times and HW skills
	Nothing spokes on Eco-san system and use Eco-toilet
	Covered a few contents in terms of toilet cleanliness and waste segregation
Use of teaching materials	Did not use any teaching materials in the classroom teaching
	No group practice to make teaching materials in grade
	No, assign students to make IEC materials related to HWWS and eco-san system
	Optimal use of chalk and talk and textbook-based teaching
Teaching methods	Optimal used dogmatic lecture methods
	Sometimes use question-answer and discussion methods
	No demonstration, field visit, case study, role play, or small group work was used
	Lacking classroom conversation
	No capacity-building workshop
	Poor participatory teaching and learning
	Lacking behaviour change focus learning
Co-curricular activities	No excursion visits.
	Very few times are allocated for games, sports and exercises
	No efforts to make local curriculum including SHE (HWWS and Eco-san)
	Lacking interaction programme between teachers and parents
	Lack of good academic study habits and skills exhibited by some students
Evaluation	A few oral questions about sanitation and hygiene were raised to the group mode, not individuals, as a formative evaluation at the end of the class.
	No pre- and middle-class evaluations found

Lesson plan. Reflective notes on participants' observations showed that there was flexibility in choosing and delivering the lesson. After entering the classroom, teachers selected the teaching topic without preparing the lesson plan. There were problems related to sequence, clarity, and student engagement. Without a lesson plan, starting class may be the reason why teachers seemed confused about their performance. At the same time, the student's attention did not seem to be focused on the lesson.

Student-teacher collaboration. All areas of students' growth, development, and positive change are possible through collaboration between teachers and students in classroom situations and the whole school's premises. Effective collaboration could also improve teacher performance. If not, the teacher may feel a sense of isolation. Considering this in mind, the collaboration situation between students and teachers in a public secondary school and its real needs were identified. Teachers, as well as students, needed to learn to collaborate in participatory action research. Table 5.13 shows the results of participatory observation, especially in the moment of classroom teaching; there was not much collaboration between the teachers and the students.

Similarly, there was no project work organised in groups; most of the students in the grade seemed passive and did not find any sharing and caring culture in the class. There was limited interaction in the class, where there was usually one-way communication from the teacher. Working in groups, solving problems together, and sharing ideas were not seen.

***Teachers' motivation for students' learning*.** Motivation is a necessary construct to understand sanitation and hygiene. Teachers are the key in motivating students on academic, hygiene, and sanitation behaviour (Whitaker & Valtierra, 2018). Here teachers' motivation is synonymously used as the term 'learning motivation' to describe the student's willingness, desire, and compulsion to participate in and be successful in the learning process (Bomia et al., 1997). So, Teachers' motivation is crucial in health education as a behavioural subject. The study focused on students' motivation to learning that teachers facilitated and showed that teachers encouraged students to encourage for better academic performance. Nevertheless, such motivation was not reflected in practice. Teachers’ motivation focused on reading and writing instead of sanitation and hygiene. Teachers' motivation was not visible to reduce the students' confusion in terms of advantages of the Eco-san system, Eco-toilet use and application of human urine as fertiliser. There was no effective teachers' motivation on the SHE and related behaviour.

Content coverage, teaching methods and materials used in the class. The researcher and the peer teacher did the participants' observations as co-researchers. During the classroom teaching in Health and Physical education in grades 5 and 7, the teacher was not informed that his/her class was being observed. According to the National Curriculum Framework 2076, class observation was done on teaching the total sanitation topic in grade 7 and personal hygiene topic in grade 5 under health and physical education. During the classroom teaching, it was found that the content coverage was generally not sufficient in grade five (personal hygiene); nothing spoke about HWWS at a critical time by following the recommended skills of handwashing by WHO. Likewise, nothing spoke about the Eco-san system through urine-diverting mode when taught in grade seven on total sanitation. However, the contents of toilet cleanliness and waste segregation were covered superficially.

Regarding the use of teaching materials in classroom teaching, in grades 4-8, the teachers did not use any teaching materials, no group practice to make teaching materials, and no home assignment was given to make related teaching materials on the topics. They optimally used textbook-based dogmatic lecture methods and occasionally used question-answer and discussion methods. However, they never used demonstrations, field visits, case studies, role play, small group work, or capacity-building workshops though these methods of teaching are recommended in the curriculum framework.

Co-curricular activities for learning sanitation and hygiene education. Co-curricular activities (CCAs) are intended to develop students' social and intellectual skills; inculcate moral, cultural and ethical values; personality development; and character advancement (Bomia et al., 1997 ; Kariyana et al., 2012b; Marais, 2011; Siddiky, 2019). Co-curricular activities are related to the academic structure that is primarily an extension of the academic learning experiences (Bomia et al., 1997 ; Kariyana et al., 2012b; Marais, 2011; Siddiky, 2019). Generally, it includes athletes, games, excursions, exhibitions, fairs, cultural programmes, social surveys, seminars, workshops, conferences, interaction programmes, and drama (Bomia et al., 1997). CCAs help in the holistic development of students and assist in developing critical skills and abilities, physical fitness and enhanced endurance capacity. Likewise, other aspects of personality, such as emotional development, social skills and holistic development, happen through CCAs (Kariyana et al., 2012b; Siddiky, 2019). Moreover, CCAs always support joyful teaching and learning that help improves socialisation and adjustment (Siddiky, 2019). However, in the participants' observation conducted before the intervention, we did not find a very effective practice of ECAs, both indoor and outdoor. Most of the students and subject teachers asserted that there was no excursion. Likewise, no ECAs like interaction programmes among teachers, students and their parents, cultural programmes, social survey, exercise, meditation were organized. However, students enjoyed playing games and sports for a few minutes in the playground.

Priority Needs Identifying from Participatory Needs Assessment

Several needs were prioritised after the discussion in the workshop where students, teachers, PAR committee members, and parents' representatives participated. Based on the perceived priority, PAR interventions need to be implemented in the school. The needs assessment identified that dogmatic lecture methods, especially chalk and talk, were used in classroom teaching, which was ineffective in changing the students' sanitation and hygiene behaviour. More participatory sensitisation and awareness sessions need to be implemented as interventions. Likewise, teaching materials related to sanitation and hygiene education (SHE) were not used in classroom teaching, due to which students seemed passive. Preparation of IEC materials related to HWWS and Eco-san system and installation of a drip irrigation system to collaboratively supply diluted human urine Eco-garden were identified as the actions to be implemented. Also, a tailor-made local curriculum, including enough contents of HWWS and Eco-san, was identified as the need to be implemented in the mainstream education system.

Knowledge/awareness and practice of sanitation and hygiene, especially on (Eco-san toilet and hand hygiene) were not good among students. So, awareness sessions among students needed to be implemented, and regular monitoring and supervising of hygiene and sanitary behaviour of the students was necessary. Also, we agreed on the need to conduct a child club and Eco-club lead sanitation and hygiene activities in the school. Moreover, we planned to motivate senior students to be role models among the junior students and help them with hand hygiene, school toilet cleanliness, and classroom cleanliness. In addition, the school needed to organise an interaction programme among representatives of the local government, SMC/PAR committee members, parents, teachers, school administration, students' clubs and other students to find sustainable solutions for soap management at school.

As there were not enough handwashing stations, soap cases, soap in soap cases, and school toilets, it was necessary to make proper arrangements, as well as toilets and handwashing stations need to be made more child-friendly and maintain privacy. Another important thing was that under the way of learning by sight, an observation visit could be conducted to see Eco-san/UDT, urine application as agricultural fertiliser to the project site where the same component had already been established. So, the field visit with possible co-researchers needed to be organised to the Eco-san implemented site in Nepal. That would be easy to replicate in the action school in Chitwan. Likewise, a model Eco-san or urine-diverting toilet (UDT) needed to be constructed at school to improve awareness regarding the Eco-san system. Human urine is not waste; it is a resource. It was also important to remember that before supplying human urine to an Eco- Garden, storage and water had to be diluted with urine, so it was imperative to establish a urine dilution plant and its methods near the urine diversion toilets.

In the same way, the drip-irrigation system had to be adopted to supply urine from the auto system to minimise the feeling of being slightly uncomfortable and disgusted by hand and deliver the diluted urine directly to the plant without wasting it. So, it was imperative to establish a drip-irrigation system plant along with its methods. Considering the need to increase the level of knowledge/awareness for behaviour change and create a more hygienic and sanitised school environment, it was necessary to conduct more awareness programs such as sanitation fairs, sanitation campaigns, workshops, seminars, interaction programs, cultural programs and demonstration sessions. Also, conducting more awareness sessions and imparting practical knowledge from cultivation experiments using urine fertilizer was necessary. It might diminish the negative perception that treated human urine does not carry pathogens and using it as fertiliser is not a matter of disgusting but respect.

Chapter Summary

This study was conducted in a public secondary school in a semi-urban area of the Chitwan district of Nepal. This participatory action research focused on changing the basic level of students' sanitation and hygiene behaviour. Out of three phases of PAR, chapter five covered the pre-implementation phase, also called a needs assessment. In conducting a participatory needs assessment, multiple methods were used. The concurrent transformative data collection strategy (Creswell & Tashakkori, 2007) allowed the researcher to examine the behavioural changes in terms of hygiene (handwashing with soap /HWWS) and sanitation (Ecological sanitation) of the students and perceptions of Eco-san innovations. I have endeavoured to answer research questions one and two in chapter five. We were engaged for nine months to answer research questions 1 and 2, from December 2017 to August 2018. The primary task of the PAR phase is the participatory needs assessment, including sanitation and hygiene facilities in school, knowledge, attitude and practices of HWWS and Eco-san toilet. In addition, the perception of human urine application as agricultural fertiliser and classroom pedagogy were used to share knowledge on sanitation and hygiene and motivate students to follow healthy behaviour. It is clear from the findings that there must be several conditions to improve sanitation and hygiene in the school. Finally, the needs assessment phase concludes that educational, technological and behavioural interventions must be implemented to change students' sanitation and hygiene behaviour in the school.

Chapter 6. Implementation of PAR Interventions

Overview of the Chapter

The chapter primarily presents the implementation of sanitation and hygiene-related interventions at school. Participatory action research phase II was exclusively based on the activities and reflections from classroom activities, sensitisation/awareness sessions on handwashing with soap and water and implementation of an Eco-san system with a urine-diverting toilet at school. The educational and technological activities adopted for the students' sanitation and hygiene behaviour change during the interventions and the resulting reflection are presented. Educational component refers to classroom sensitisation sessions, workshops and seminars, interaction programmes, IEC materials preparation, local contextual curriculum development, teacher manual, field visits, sanitation campaign,

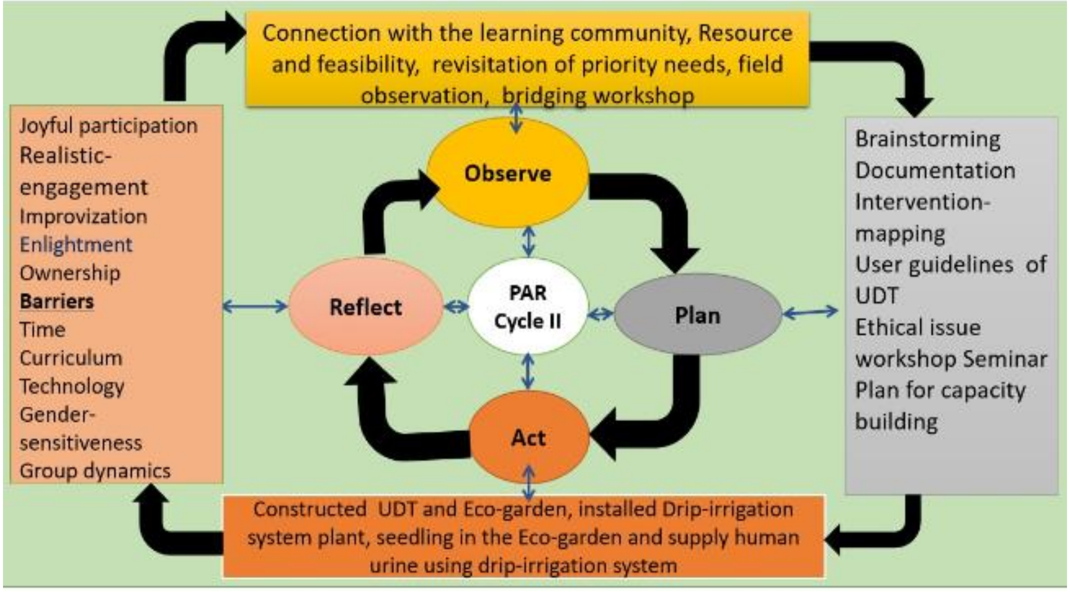

Figure 6.1. A Glimpse of the PAR Phase II

sanitation fair, and demonstration activities. Similarly, technological components include the construction of handwashing stations (HWSs), soap cases, urine-diverting toilets (UDT), urine storage and dilution system and drip-irrigation systems.

Implementation of Sanitation and hygiene Behaviour Change Interventions

The needs assessment was carried out in the first phase, and the sensitisation session related to SHE was conducted to fulfil the priority needs. As Paulo Freire believed in PAR with participants instead of top-down approaches (Freire, 1972), SHE sensitisation sessions were thus conducted in cooperation with students, teachers, school administration, SMC/PAR committee members and student clubs. Sanitation and hygiene education, including related activities implemented in the action school 2018, tended to use participatory methods and concentrated on the health promotion of the students. A wide variety of intervention methods, such as classroom lessons, songs, drawings, video play, excursions, fairs, workshops, development IEC materials, and so many others, were used in the study. Several meetings were organized to raise interest in and awareness of the study. These were often followed up with small group discussions to highlight the importance of sanitation and hygiene and barriers to behaviour change and offered support and encouragement. Table 6.1 shows intervention sessions with different activities.

Table 6.1. *Interventions to Change Sanitation and hygiene Behaviour of Students*

IT	IS	Intervention Activities	Intervention Methods and Materials
I	First	Sensitisation/awareness workshop Participatory classroom lesson Develop a local curriculum. Prepare IEC materials and teacher manual	Videos, slides, message cards, Songs, Posters, Flipcharts, Drawings, F-diagram, Charts, Play cards, Models Figures, Posters and UDT
	Sanitation fair	Students prepared charts, songs, drama and flashboards to address sanitation and hygiene issues and the sanitation campaign	Interaction meeting Models of Eco-san toilet Advantages and disadvantages of Eco-san, Urine application guidelines, Urine storage and dilution system Eco-garden Sanitation campaign
	Excursion	Visit Eco-san Project site	Observation Interaction meeting Photos session
II	Sanitation and hygiene facilities	Construt UDT and HWSs, Install urine treatment and dilution plant Develop Eco-garden	Follow the structural plan and construct
III	Demo-session of HWWS and UDT	Participatory HWWS practices at HWSs in the school	Pasting posters on the wall of HWSs with stepwise handwashing skills Vigorous rubbing together of lathered fingers, areas between the fingers, palm, and arms for at least 10-20 seconds Demonstrate HWWS by senior graders to junior graders

Note: IT: Intervention Type, IS: Intervention sessions

The first type of PAR intervention focused on cognitive domain of education, primarily related to sanitation and hygiene. Under this intervention, activities like classroom lessons, video displays, cultural programs, excursions, fairs, and campaigns, developing IEC materials, developing and applying for tailor-made local courses, and creating and following the teacher guide/manual were implemented. The educational-based interventions mainly aimed to sensitise hand hygiene and ecological sanitation system through knowledge-based approaches.

Type I Interventions: Educational Interventions

Several participatory activities, including co-curricular and extra-curricular activities, were conducted to raise awareness of sanitation and hygiene.

Sensitisation/awareness session. The intervention of sensitisation awareness

Figure 6.2 Group Work on Hand Hygiene Sensitisation Session

sessions comprised education, mindfulness engagement, reading and writing, and clarification for cognitive activation (Eriksen & Ursin, 2004). This session covered the introduction, importance and use, methods of HWWS and Eco-san system in the school. The interventions primarily focused on participatory activities that transformed the students’ sanitation and hygiene behaviour. Under the sensitisation/awareness sessions as the PAR interventions, several activities such as sanitation and hygiene classroom lessons, IEC materials, local curriculum, a teacher manual, songs, videos, educational excursions, fairs, campaigns, workshops, and interaction programmes were done.

Sensitisation/awareness workshop. Under the sanitation and hygiene issues, findings identified from the needs assessment phase were prioritised through a co-researchers workshop. During the workshop, the concepts prepared by four groups (students, teachers, SMC/PAR committee members and students' clubs) and valuable activities and models were written on a chart paper and presented in groups. As a researcher, I sometimes acted as a facilitator throughout the study period, and as a coresearcher and sometimes both. But in the sensitization/workshop, I was a facilitator. Finally, it was concluded that sensitisation/awareness sessions mainly focused on participatory sanitation and hygiene sessions needed in the first stage would be appropriate.

Hand hygiene sensitisation/awareness session. Sensitisation sessions for the students of Grades 1-3, 4-5 and 6-8 were conducted separately. Since the number of students from grades 6 to 8 was more, keeping them all in a hall for the session was impossible. Thus, the sessions were conducted in different halls on different days. The sensitisation awareness sessions were conducted with the participation of all students, teachers and all members (13) of student clubs. Senior-grade students assisted in educating junior-grade students. The intervention focused on raising students' knowledge and using proper handwashing techniques at critical times. The global handwashing session started on 15 October on Global Hand Washing Day (Devkota et al., 2020a; Pittet et al., 2009). We observed that students ate food with dirty

*Figure 6.*3 Hygiene Sensitisation through Classroom Lesson

hands during our initial school visits. We shared our observations with the headteacher, teachers, the school management committee members, PAR committee members, and students.

Figure 6.4 Students' Practice on Handwashing with Soap

Then, we developed a plan to organise a hygiene education session and a handwashing event. The hygiene education session focused on the importance of HWWS and the consequences of not washing hands properly. We, directly and indirectly, fostered the participation of teachers, students, SMC/PAR committee members, students' clubs and local government officials/ representatives to make the hygiene education session effective. In this phase, students and teachers collaboratively made posters, pamphlets, slogan cards, message cards, charts, videos, drawings, stories, and songs related to HWWS. The sensitisation in each Grade took two periods (90 minutes) per month for six months. This session started with singing the song of *Michi Michi (rubbing and rinsing hands*), followed by a demonstration of six steps of handwashing with soap.

Hand washing messages. The ‘Hygiene Message’ was spread during the awareness sessions. The specific content of the intervention message was determined by the need to reduce the students’ exposure to faecal materials and therefore concentrated on promoting handwashing with soap. Students were encouraged to wash their hands at critical times, like before meals and after toilet use. Different handwashing messages were developed for awareness-raising purposes collaboratively. One example of the messages with the short slogan *‘haat dhoaun, swastha rahaun’* translates roughly as, ‘Let’s wash hands- it makes us healthy’. Educational sessions, including hand hygiene messages, were held in the classroom to make students aware of the faecal-oral transmission route and help students identify risky practices. In addition, the handwashing message focused on the positive benefits of handwashing with soap. This intervention method helped how cleanliness made one feel ‘good’, ‘clean’ and ‘right’. Therefore, handwashing raised self-esteem among the students and promoted good hygiene compared to pre-implementation.

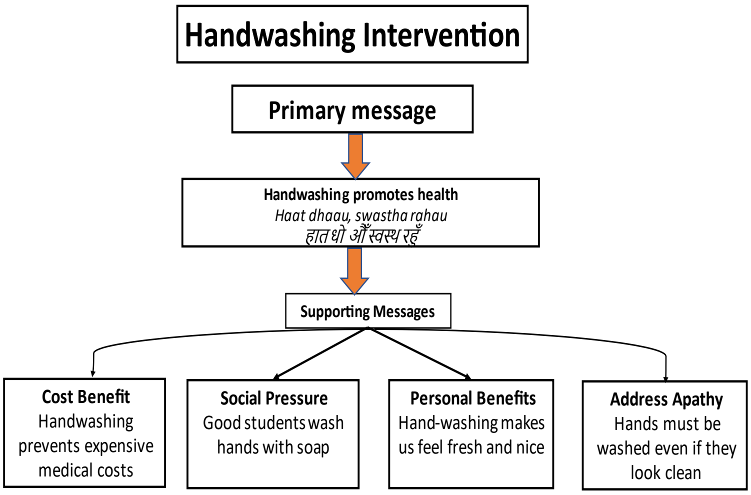

Figure 6.5. Handwashing supporting intervention messages.

Handwashing songs. Songs and dances are not only for festivals; they can also be used in classroom teaching. During the intervention sessions of this research, especially for junior grader students (grades 1-5), the songs helped increase students'

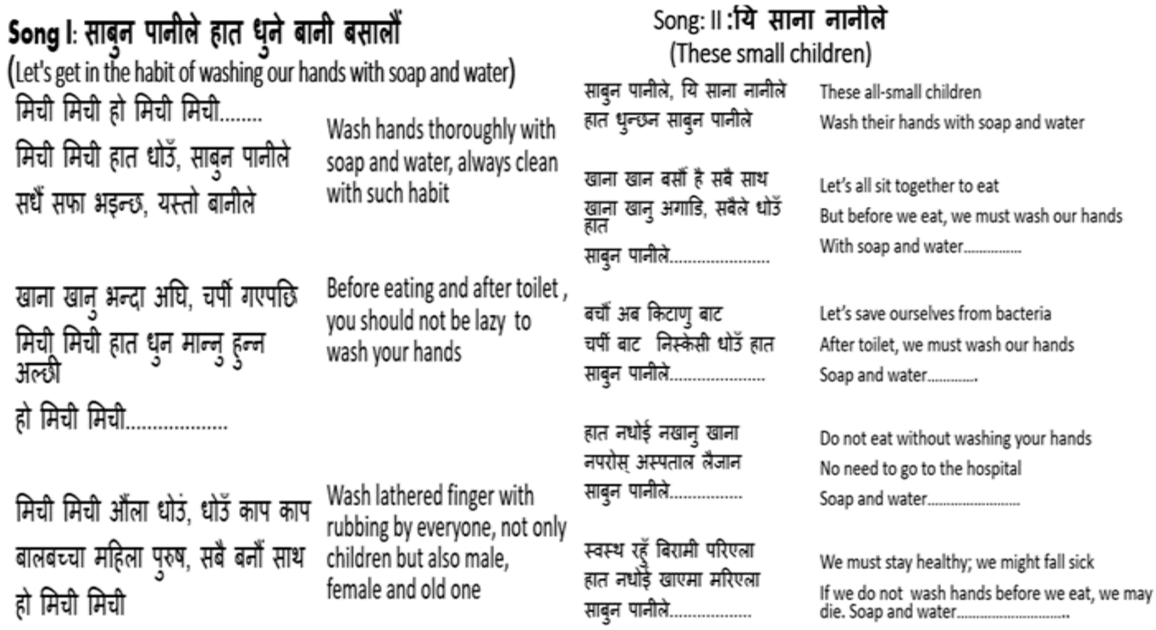

Figure 6.6. A Song Created by Students on Handwashing

participation in handwashing with soap at different critical times. The songs were written by the students, including hygiene-related messages. The health education teachers started singing these songs during the sensitisation session on handwashing with soap, and students followed similar lyrics. It was popular with the students and a compelling reminder of the handwashing intervention message because of its catchy tune and repetitive lyrics. Students enjoyed singing a song and followed the song's essence in the handwashing behaviour at school. Figure 6.6 shows a few songs and lyrics that the students and teachers used to encourage handwashing with soap.

Drawing as a participatory intervention activity. Cleaning and promoting hand hygiene are necessary everyday actions. Schools can slow the spread of infectious diseases and protect students and staff by promoting handwashing habit with soap. Cleaning with soap products reduces germs on surfaces and objects by removing contaminants and may also weaken or damage some virus particles, decreasing the risks of infections (Devkota et al., 2020a; Potdar et al., 2019). High-touch surfaces include pens, a dining table in the school canteen, door handles, light switches, desks, and toilets that may transmit germs to our bodies through hands. The recommended guidelines advise that washing hands with soap and water for a minimum of 20 seconds is the most (WHO, 2009).

Figure 6.7. Student Creative Art during Hand Hygiene Sensitisation Session

Sensitising HWWS, the school's participatory workshop, suggested conducting sensitisation/awareness sessions through health education. Keeping it in mind, the PAR team actively organised the hand hygiene awareness session in school time and again. Hand hygiene sensitisation began with senior grade students (grade 6-8) to sensitise senior graders first so that they could be peer mentors to the juniors or cascade the model to sensitise their junior friends. The sensitisation workshop was conducted in a participatory and collaborative manner by placing all the students in the ICT hall classwise through various methods and materials related to hand hygiene, such as posters, charts, films/videos, and message cards. Among them, drawing related to handwashing skills and creative arts were also used. These sessions created self-awareness and they became more attractive and popular intervention sessions. A sample drawn by a class 6 boy student during a hand hygiene sensitisation session can be seen in Figure 6.7.

Handwashing drama. We (researchers and co-researchers) discussed in the participatory workshop for the educational hygiene session as the best hygiene promotion method. The health education teacher offered a short presentation with interaction explaining how germs can be transmitted into the body and ways of preventing them by handwashing with soap and water. The teachers and students collaboratively made handwashing-related dramas for the educational sessions. They performed it in the classroom and school's common areas on Parents' Day. The students, teachers and students club followed the short drama to sensitise the importance of handwashing with soap on human health. Drama is an effective method for engaging children, imparting information and encouraging behaviour change (Galavotti et al., 2001). Some teachers and students played different roles as actors in the drama. Then rehearsals were held the week before the intervention was launched. There were six actors in the roles of different characters in this drama: the sick boy, the sick boy's mother; the father; the grandmother, the health worker's sister and *Jhankri* (traditional healer). The drama went like this;

> *A six-year-old boy falls seriously ill due to diarrhoea. After this, his mother and father are terrified in his house. The sick boy's grandmother told her son to take him to Jhankri (a traditional path healer). The ill boy is then taken by his parents to Jhankri, where they meet a health worker. The health worker then asked them what had happened and where he would be taken. The patient's parents reported that the boy had diarrhoea and was taken to Jhankri for*

treatment. The health worker's sister then requests them to take him to the health post not to Jhankri. Accepting the request of the health worker, the parents agree to take the patient to the health post and take the health post with the health worker. The health post thoroughly checked the patient's condition and made inquiries about his health behaviour. The patient was diagnosed with severe health problems like diarrhoea due to being very dirty, no handwashing with soap before eating, after going to the toilet, and at other times. Finally, it was concluded that the problem was due to dirty habits, such as not washing hands with soap and water even after going to the toilet and before having a meal. He was sent home with diarrhoea controlling medicine, suggesting that he needs to wash his hands frequently with soap and water, and the drama ended here.

Sensitisation to the ecological sanitation system. It was necessary to sensitise and aware the students, teachers, SMC/PAR committee and student clubs about Ecological sanitation (Eco-san). As the baseline needs assessment study indicated, only 3% of the participants were generally aware of the concept of the Eco-san system with urine-diverting mode. As suggested in the intervention workshop that prioritised ecological sanitation sensitisation, collaborative sensitisation sessions were conducted. Primary goal of these seesions was to inform the concept of the eco-san system. The students were sensitised to the Eco-san system, types of Eco-san toilets, use of urine diversion toilet, storage and dilution of the urine for the process of urine treatment and application of treated human urine as agricultural fertiliser through the drip-irrigation system in the school garden. Senior grade students and students' club members made junior grade students aware of the toilet's cleanliness, school surroundings, and economic and proper use of toilet cleanliness materials.

Eco-san experts from Norway and Nepal facilitated the sensitization of Eco-san technology and activities to be implemented. In addition, the co-researchers shared their understanding and perception of the Eco-san system. Likewise, Eco-san-related materials, models, sanitation practices using Eco-san, advantages of Eco-san technology, and drawbacks and challenges of Eco-san toilet/UDT were discussed using related IEC materials and videos during the sessions. Moreover, various Eco-san models and experiments used in Nepal and globally were displayed several times to make Eco-san toilet/UDT more familiar. At the end of the sensitization session, the participants prepared and presented Eco-san's benefits, drawbacks, and challenges. In addition, an interactive session regarding myths and facts regarding Eco-toilet/UDT was conducted.

Figure 6.8. Sensitization on Urine Fertiliser

Sanitation fair. The sanitation fair was one of the intervention activities implemented in sanitation and hygiene sensitisation sessions. Sanitation fair (SF) is an innovative strategy for improving sanitation and hygiene behaviour and reducing the burden of sanitation and hygiene-related diseases, including diarrhoea (Bartram et al., 2005). Sanitation fair in PAR is used to raise awareness through effective and meaningful engagement (Bastien et al., 2017) of PAR researchers and co-researchers to ensure the school's technological, economic, and educational situation. The sanitation fair conducted in the school focused on handwashing with soap and Eco-san innovations like the use of urine diversion toilets and urine fertiliser use through the drip-irrigation system in the school garden. It aimed to maintain sanitation and hygiene using technological and educational activities in the school.

Several activities were included in the sanitation fairs as the first phase of interventions, i) the exhibition of photos/ videos and models of UDTs those were previously used in different parts of the world, ii) sanitation campaign in and around the adjacent communities, iii) excursion or observation tour at Eco-san related project site Surkhet started in a school setting in 2009 with the initiative and support of Environment and Public Health Organization (ENPHO), iv) training workshop on making IEC materials, v) develop HWWS, and Eco-san related IEC materials, vi) SHE-related additional course or tailor-made participatory local curriculum, vii) develop teacher manual based on tailor-made course, ix) wall painting with sanitation and hygiene messages, x) waste segregation and cleanliness of school toilets, and xi) social entrepreneurship as means of improving health and livelihood such as mushroom farming, paddy cultivation, ginger cultivation and vegetable cultivation using urine fertiliser.

*Figure 6.9.*A Message Disseminated in the Sanitation Fair

Observation visit/Excursion. Excursion with the PAR team representing researchers, parents, teachers, students club members, SMC/PAR committee members, and farmers was one of the intervention activities. It aimed to gain practical knowledge about Eco-san components to link sanitation and hygiene behaviour change in the school setting of Nepal. It was a short excursion of three days, dated 5^{th} to 7^{th} April 2019, to observe the natural beauty, cultural heritages in

Surkhet, and the Eco-san model in the public school named Jana Jyoti secondary school.

It was learning by experience outside the classrooms. John Dewey (1978) argued that when students and teachers are together outside of the school, new educational environments and experiences are possible. Students got the opportunity to observe the Eco-san toilet, application of human urine as an agricultural fertiliser in the school garden, biochar application mixing with human urine, wastewater treatment plan, livelihood promotion activities of poor/ privileged students like fish keeping, beekeeping, goat farming, cow farming, mushroom cultivation poultry farming and pig farming. Moreover, we saw that Jana Jyoti secondary school, a public school in a remote village in Nepal, has been promoting and developing innovations related to safe and productive use in the agriculture of waste products like faecal sludge and human urine in the school garden. There was integrated use of WASH viz solid waste segregation, wastewater treatment plant, urine-diverting toilet (UDT), and human urine fertiliser application in the school garden.

Discussing the educational trip is wise because it lets students know what they experienced while away from school. Getting away from the relaxed classroom atmosphere enables students to spend time with each other in a new environment. They may be able to connect on a more personal level without the structure of the regular school day. Students may spend much of the educational excursion day in small groups, observing, chatting and learning about each other.

Figure 6.10. Students in the School's Kitchen Garden

As a researcher involved in a PAR study, my hope for this educational excursion was to provide valuable experiential learning opportunities away from the classroom without using textbooks and other tools used in a normal school setting. Students on educational tours can often learn while having fun in a more informal environment.

Figure 6.11. Urine Diverting Toilet Squatting Pan in Surkhet

The school developed young minds with innovations introduced from the Eco-san toilet, especially UDT and applied human urine in the school garden. The learning environment is more open to innovation, with room for new information and experimentation as SMC chair/ Ward president reported that demonstration, information dissemination, capacity building, policy lobbying and academic recognition with classroom pedagogy are the ways to promote innovations.

Figure 6.12. Short Beans in the School Garden

Though the school (Jana Jyoti Sec. School) is about 24 kilometres from Birendranagar, Municipality, students are involved in agricultural extension and education. The activities in school included rehabilitation of sanitation to include Eco-san (Urine diversion), composting and gardening, rainwater harvesting and biogas production. The upgraded toilet (UDT) facility has three squat pans and eight urinals for boys. The collection of urine by the school is considered through the diversion from the urinal. Urine is separated, collected and stored in an underground concrete chamber near the toilet buildings, and treated urine is applied in the school garden each Saturday. The urine from the UDT is collected in the chamber and used in the school garden for agricultural research on plants, health and productivity. Various agricultural techniques and inputs are tested, including farming practices. They have tested urine only on cabbage, potato, onion, brinjal, tomato, chilli and pea. As SMC members and teachers reported, the performance of urine fertilizer was positive and well-accepted.

Along with student engagements, teachers and other PAR committee members participated, facilitated, and monitored. At that time, the school was attracting the attention of other schools. The opinion of the school headteacher was that there was a good working relationship among the students, SMC members and teachers, which made it possible to achieve progress in innovative education and knowledge transfer. We returned to Chitwan on 7 April 2019 with new insights and enthusiasm to implement the components in the Jana Jiwan High School, Chitwan. SMC chair was committed to implementing the features such as urine diversion toilet and school garden in the school and the other components.

The information-sharing rate regarding the application of human urine as agricultural fertilizer, its process of treatment, and Eco-san as a means of sanitation was appreciated because the schools had a high influx of individuals from different levels (parents, local community, and local policymakers). In addition, the teachers and the students also conducted capacity-building activities at the community level. The activities included training and orientations, photo/video sharing, field visits, and interactions. One of the aims of working with the schools was to institutionalize the productive reuse concept in the school and academia.

The first step was integrating the effective use of urine into the school curriculum. The current curriculum has five major topics: introduction to agriculture, urbanisation and waste management; human waste: urine and compost; urine application in agriculture and guidelines; Ecosan was in discussion with the Council for Technical Education and Vocational Training (CTEVT), the local curriculum board and the school introduced the course as a non-credited course in the agricultural part of the school.

Figure 6.13: UDT in Janajyoti, Surkhet

The observation visit/excursion was made to sensitise and raise awareness about the Eco-san system, including urine-diverting toilet and urine fertiliser. By working on several components and Eco-san as per the target, Jana Jyoti School Surkhet saw significant improvement in academics and livelihood and gained immense knowledge, which motivated us to work. According to the school's headteacher, all the students above grade five studying in the school were engaged in entrepreneurial activities such as Eco-kitchen garden, fish-farming, animal farming, beekeeping, mushroom for livelihood, and classroom study. He further remarked that the students manage their entire tuition and living expenses from these agricultural activities and their income. Such a visit could undoubtedly help us to develop practical knowledge and skills.

Sanitation campaign. The sanitation campaign was one of the activities conducted to improve students' sanitation and hygiene behaviour. This was done on the occasion of World Environment Day (WED) which began 1972 by the United Nations General Assembly during the United Nations Conference on the Human Environment. However, this campaign was first celebrated on 5 June 1973. It is the most important day of the United Nations to encourage people worldwide to take some positive actions to protect our environment. It has been a major global platform for public outreach in more than 100 countries. The United Nations, aware that the protection and improvement of the human environment is a major issue that affects the well-being of people and economic development throughout the world, designated 5 June as World Environment Day. On that day, we organised a sanitation campaign at Jana Jiwan secondary school, Chitwan. Students from grades 4 to 10, teachers, parents, and SMC/PAR committee members reached the campaign to spread awareness about ecological sanitation as the best sanitation option through eco-san toilet / UDT and urine fertiliser use. All students above class 4 of the school, including teachers, SMC / PAR committee members, and some parents participated in sanitation-related rallys with play cards and banners. In this context, cross-cutting issues of sanitation like an open defecation-free (ODF) environment, clean and green school, and cleanliness were also connected. Some slogans prepared in the campaign are as follows:

Figure 6.14: Sanitation Campaign

Figure 6.15: Sanitation Campaign with Play Cards

आमा बुबा दाजु भाइ, रुख रोपौ बाच्नलाई’*((Mother, father, brother, plant a tree to survive)*
स्वच्छ बातावरण-स्वस्थ जीवन *(Clean environment-healthy life)*
बिद्यालय र समुदायको साझदारी-हरियाली बनाऊ वरिपरी, *(School and community partnership-around greening)*
Keep calm and love sanitation.
Avoid dirty scenes, keep the bathroom clean.
Cleanliness is the way to good health and happiness.
मानब मल मुत्र प्रयोग गरौ, बिषादी रहीत कृषी उपज बढाऔ, *(Use human excrement and urine, increase pesticide free agricultural yield)*
मानब मल मुत्र प्रयोग, कृषि उपजमा सहयोग (*Human excreta and urine use, support in agricultural production)*

The sanitation campaign was conducted with the participation of all teachers, students, and SMC/PAR committee members. The school’s sewage system was poorly managed, leading to open urination. The sanitation campaign’s main concerns were to spread information and education such as discouraging open defecation, promoting sanitation facilities, integrating school and community participation for a clean and green school environment, promoting collective sanitation actions, and encouraging UDT and urine fertiliser. In addition, it could motivate cleanliness and better hygiene practices that could enhance the health status of the students, complete eradication of open defecation, encourage economically feasible technology (Eco-san system), and sustainability in sanitation

Figure 6.16: Participation of Schoolgirl in the Campaign

and its relationship with public health. Similarly, the effectiveness of the sanitation campaign predicted the demand for constructing UDT in schools and their houses and sustainably using them.

Develop a participatory local curriculum. With the introduction of PAR activities in the action school, creating HWWS and eco-san courses under sanitation and hygiene education was also implemented. As the mainstream national curriculum lacks sanitation and hygiene education and the Eco-san system, teacher training/workshops were conducted as a part of this basic curriculum requirement. Moreover, it was understood from the classroom observations that the SHE subject matter was taken as a minor subject, and insufficient time was allocated for the issue in teaching. After numerous discussions and meetings among the PAR team (researcher and co-researchers), a draft curriculum and a participatory curriculum/tailor-made course were developed based on the priority needs. The curriculum was analysed regarding its content objectives, teaching methods, teaching materials and teaching-learning activities through the meaningful engagement of the students and teachers through a series of dialogue conferences and workshops. The school's time and resources were considered when developing the new curriculum. The participatory curriculum or tailor-made course is presented in Table 6.2.

Table 6.2. *Participatory Tailor-made Course*

Group	Specific Objectives	Contents
Grade 1-3	Conceptualising sanitation and hygiene Describing the importance of handwashing with soap and water Discussing material used to wash hands.	Concept of sanitation and hygiene Needs and importance of handwashing. Materials for handwashing

	Illustrating steps to wash hands with soap and water. Discussing toilet, classroom and school compound cleanliness Planning handwashing and toilet cleanliness demonstration Reasoning like or dislike of human urine use as vegetable fertiliser Demonstrating urine fertiliser use in the school garden	Demonstration of handwashing with soap skills Demonstration using urine fertiliser in the school garden
Grade 4-5	Defining sanitation and hygiene education in schools Provisioning of hand sanitation and hygiene facilities Describing the importance of handwashing Discussing material used to wash hands. Illustrating the steps to wash hands with soap and water Discussing the critical time to wash hands with soap and water Cleaning school compound, classroom and school toilets Conceptualising Ecological sanitation technology through urine-diverting mode Developing using guidelines for urine-diverting toilets Reasoning like or dislike of human urine use as vegetable fertiliser Showing the effects of human urine on vegetables	Concept of sanitation and hygiene education Provision of handwashing and toilet facilities Importance of handwashing Materials require washing hands Skills of handwashing Concept of Ecological sanitation Guidelines for using the urine-diverting toilet (UDT) Reasons for liking or disliking urine fertiliser Demonstrate effects of human urine on vegetables Role of Eco-san system with urine-diverting mode The situation of using urine fertiliser in Nepal

	Explaining the roles of the urine-diverting toilet and Ecological sanitation system Exploring the situation of using human urine as an agricultural fertiliser in Nepal	
Grade 6-8	Defining sanitation and hygiene education Sensitising hand hygiene and soap Ecological sanitation technology Provision of hand sanitation and hygiene facilities Describing the importance of handwashing Discussing material used to wash hands Explaining the importance of handwashing Illustrating steps to wash hands with soap and water Discussing the critical time to wash hands with soap and water Demonstrating handwashing with soap Cleaning school compound, classroom and school toilets Reasoning like or dislike of human urine use as vegetable fertiliser Developing using guidelines for urine-diverting toilets Sensitising urine treatment/ sanitise methods Describing urine dilution with water (Ratio)	Sensitisation/awareness of sanitation and hygiene education Concept of hand hygiene and Ecological sanitation Access to sanitation and hygiene facilities Materials required to wash hands Importance of handwashing with soap and water Hand washing skills with soap and water Cleanliness of school compound, handwashing stations and school toilets Explore reasons for liking or disliking urine diversion toilet. Guidelines for UDT use Treatment/sanitise human urine Application guidelines for urine fertiliser The dilution ratio of treated human urine and water Application of urine fertiliser through the drip-irrigation system in the school garden

	Applying urine fertiliser in the school garden through the drip-irrigation system Illustrating benefits and challenges of urine fertiliser use Demonstrating the effects of human urine on vegetables Explaining the roles of the urine-diverting toilet and Ecological sanitation system Exploring the situation of using human urine as an agricultural fertiliser in Nepal	Benefits and challenges of urine fertiliser used Roles of UDTs and Eco-san system The situation of urine fertiliser used in Nepal

The participatory curriculum was designed for grades 1-3, 4-5 and 6-8, considering the learning capacities of the basic level of students and the resources available in the school. Based on the categories, sanitation and hygiene messages were developed and used IEC materials prepared with the involvement of students and teachers.

While designing this curriculum, we planned to use standardised teaching methods, learning activities and teaching materials. The powerful techniques, activities and materials targeted in this curriculum are presented in Table 6.3.

Table 6.3. *Methods, Materials and Activities of a Tailor-made Course*

Group	Major Methods	Appropriate Materials	Major Activity
Grade 1-3	Singing songs Miming Play	Sheets, pencil, colours, natural materials, soap, glue, posters,	Prepare songs for small children that allow them to mime specific habits of hand hygiene

	Video shows Storytelling Demonstration	flip charts, videos, songs	Singing clean hands song before the school meal Encourage students to develop storytelling, drawing, open discussion, demonstration, a video showing and play.
Grade 4-5	Drawing Singing songs Video play Pair work Short drama, demonstration	Flip-charts, posters, sheets, glue, scissors, soap, pen/pencils, videos, songs, natural materials	Singing handwashing songs. Drawing handwashing and cleaning toilet Demonstration of handwashing with soap Develop posters and flashcards related to Eco-san Prepare a short drama and role play Take the students on an environmental walk to visit the sanitation facilities.
Grade 6-8	Short lecture, Drama Seminar Workshop Sanitation campaign Group works Role play/drama Presentation Discussion Experiments Excursion	Flip-charts, posters, sheets, glue, scissors, soap, pen/pencils, videos, natural materials, PPT slides,	Collaborative participation in the cleanliness of school toilets, school compounds and HWSs Demonstrate handwashing with soap and water to junior graders with seven steps of handwashing skills. Collaborate to develop IEC materials, using guidelines of UDT, urine application guidelines, drama, sanitation fair and classroom presentation. Communicate with junior graders, parents and community people on HWWS and Eco-san Participate in cultivation experiment using urine fertiliser in the school garden

After rounds of discussion among the PAR team, the curriculum was finalized as the main resource for classroom teaching and sensitisation/awareness and it was implemented. The suggestions, challenges, and shortcomings received during the implementation phase were adequately addressed, and approval was taken from the expert community. Thus, without any impediment to the national mainstream curriculum, this curriculum was operated in grades 1- 8, one period in a week or four periods in a month, giving three credit hours.

Develop a teacher manual. A 'Teacher Manual' was developed to facilitate the participatory curriculum scientifically. A draft 'Teacher Manual' was produced with brief lesson plans, appropriate methods and materials related to SHE, and the teaching-learning process for making the SHE session effective. The manual included specific objectives, contents needed to facilitate the curriculum, IEC materials, teaching methods and teaching-learning activities. The learning goal comprises knowledge, attitude, practice, and psychological skills. At the same time, the participatory methods include singing and miming, pair work, games, discussions, group work presentation, project work and demonstration and are not limited to only these activities. It also mentions using various teaching materials such as posters, flip charts, message cards, photo videos, drawings etc., as required for the subject matter.

Development of information education communication (IEC) materials on Eco-san and behaviour change. IEC materials related to Hand Hygiene and Sanitation Education, Eco-San system, Urine Diversion Toilet, Storage, Treatment and Dilution Process, Drip-Irrigation System, and Eco-garden with urine application as agricultural fertilisers and cultivation experiment were finalised with the necessary consultations from the respective experts and co-researchers. However, for the Information Education Communication and Behavior Change Communication (BCC) materials to be used nationwide and globally, YouTube videos and policy-level workshops and meetings are underway. IEC materials and YouTube videos were shown to inform them about the importance of Eco-sanToilet. It was also used to guide on building Eco- san toilet/UDT, method of operation, managing Eco-san toilets, handling and collecting human waste to make compost,

Figure 6.17: Methods Making Urine into a Fertiliser

Figure 6.18. Eco-san in the school

storing, treatment, dilution, and supply urine fertilizer through drip-irrigation system to the school's Eco-garden.

Sanitation and hygiene classroom lesson. The teacher's manual, including the lesson plan, was developed to easily anticipate hands-on facilitation and behaviour changes. It includes pair work, project work, fieldwork, demonstration, discussions, games, exercises, etc. Contrary to the school evaluation system, the teacher manual mentions evaluation through observing patterns of behaviour change and participatory peer observation. This model of assessment emphasises application in behaviour and competence build-up. The sensitisation programme included the UDT concept, handwashing with soap (HWWS), toilet cleanliness, and waste segregation linked to teaching practical knowledge. It attempted to make students and teachers aware of and responsible for specific ideas, events, situations, or phenomena. Students, teachers, and the PAR committee members knew about sanitation and hygiene linked with classroom teaching and learning in this context. It is a non-associative learning process in which repeated administration of a stimulus results in progressive amplification. Sensitisation often is characterised by an enhancement of response to whole class stimuli.

It is essential to ensure that classroom teaching is linked with sanitation and hygiene. Eco-san toilet/UDT and HWWS, is developed as part of the national effort to improve education quality and expand access to education for children. This implies a multiplicity of factors (the expansion of the school network, rehabilitation of school infrastructure, teaching and administrative staff training, availability of learning materials, the relevance of curricula, and incentive for staff posted). Ideally, sanitation and hygiene must be planned as part of the National Plan Commission initiative as related components are operationalised and implemented. Governments should envision how eco-san initiatives can fit into the country's educational goals. Plans should complement this for financial, physical and pedagogical sustainability.

The motivation in classroom sessions for becoming attracted to the Eco-san toilet is mainly due to the easy availability of fertilisers with high nutritional value. The possibility of establishing eco-san/UD toilets depends on their interests and consequent national policies in schools and wider communities.

Behaviour changes through sanitation and hygiene education. The eco-san system with urine-diverting mode was implemented in combination with educational and technological components necessary for transforming students' sanitation and hygiene behaviour and sustainable sanitation solutions in school. In the classroom, we had an informative discussion about using soap to wash hands and using ecological sanitation toilets to divert urine, as untreated human urine contains many pathogenic organisms that may pose a high risk to users. Urine must be free of pathogenic microorganisms for safe handling. To use human urine as fertilizer safely and safely, it is necessary to understand how microorganisms, including pathogens, behave during the storage period. For the complete inactivation of microorganisms in the Ecosan of various nations, a storage period of one month has been established (Vinnerås et al., 2008a; Zhou et al., 2017). In 2005, WAN and ENPHO conducted research in Nepal on the investigation of pathogen die-offs in stored urine using Ecosan toilet designs with storage periods ranging from 30 to 50 days (Kabir. Rajbhandari, 2008). The study found that 45 days of urine storage at 20 degrees Celsius was sufficient to inactivate the pathogen completely.

Type II: Technology-based Interventions

The Technology-based sanitation and hygiene interventions often focus on the construction of toilets, handwashing stations (HWSs) with soap cases, and adequate water supply to change behaviour or improve health and educational outcomes and tend to require more capital investment from the government, funding agencies, communities or individuals (O'Reilly & Louis, 2014). Once built, infrastructure-based interventions need further maintenance, which means additional financial and human capital. Without maintenance, all progress (initial investment) will dissolve (Bennett et al., 2016).

In this study, the technology-based interventions were supported by NORHED/ Rupantaran, a project working on teaching and learning innovations through contextualised approaches to increase education quality, relevance, and sustainability in Nepal. This technology-based intervention has come to complement the identified needs. Before constructing the infrastructure, the construction company was selected through a legal process or tender related to Tribhuvan University (TU). The construction was completed in collaboration with the school stakeholders. The technology-based intervention was implemented due to a change in expected sanitation and hygiene behaviour. It was challenging to address the needs without the model eco-san toilet, HWSs, water taps, soap, soap case, toilet cleaning materials, human urine storage and dilution, and drip irrigation system.

Handwashing stations (HWSs). The construction of HWSs was essential to embody the hand hygiene message in the awareness/sensitisation session. With the


Figure 6.19: Handwashing stations for small children

main agenda of ‘clean hands save lives; four handwashing stations were constructed to promote students’ handwashing behaviour. Altogether 16 handwashing taps at four HWSs were established. For an average of 600 school families (students, teachers, staff), 16 taps were not enough to wash their hands, but since not everyone washes their hands at once, it can be considered a work in progress. Two soap cases were placed in each HWS, and soap was managed regularly. But the sustainable solution of soap management is still a challenge. Local government officials have expressed their commitment to fund the school’s health sector budget for regular soap management in the discussion on this issue. Similarly, handwashing basins and soap cases with soap and mirrors have been managed in each toilet for handwashing purposes.

A model urine diversion toilet (UDT). Sensitisation sessions, including classroom lessons on Eco-san toilet/ UDT, handwashing with soap, human urine treatment and dilution system, drip irrigation system to supply diluted human urine to the Eco-garden, urine fertiliser use, Eco-gardening and cultivation experiment, were not enough. Observation and practical activities were required for better understanding, which is time-consuming, expensive, and


Figure 6.20: Urinal constructed in the school.

impossible to construct by individual researchers. Thus, the Norwegian Agency for Development Cooperation (NORAD) supported Capacity Development in Higher Education and Research for Development (NORHED) to help with technological/construction-based interventions. It was expected to improve the cognitive and psychomotor level of sanitation and hygiene through the effective use of technology-based intervention in the school. As per the expectations and emergent needs, the infrastructure, such as handwashing stations, soap on soap cases at HWSs and toilets, a model urine diversion toilet, human urine treatment and dilution system, drip-irrigation system, and an Eco-garden were constructed in the school with and technical and financial support of NORHED/ Rupantaran project.

UDT is a toilet with urine diversion that can provide safe, free-of-cost sanitation in various contexts worldwide (Prithvi Simha & Mahesh Ganesapillai, 2017). The construction of UDT began as soon as the agreement was signed, in October 2018. However, because the Eco-san pans were not easily available in Nepal, and there were other technical difficulties, the construction process was not as smooth as expected; ultimately, the toilet was completed in April 2019. Since these are also more technical components, the structure was completed six months before its target date. A 2-storey urine diversion toilet has been constructed on 108 square meters of land adjacent to the school building. There are nine urinals, two common toilets on the ground floor, and four common toilets on the first floor. Only nine urinals on the ground floor are used for human-urine collection. Two separate, underground safety tanks/chambers were constructed, one for collecting fresh human urine and the next for collecting faeces, urine and anal cleansing water from the first-floor toilets. The urinal chamber has been built underground and can store 7000 litres of urine. The Eco-san toilet /urine diversion toilet is targeted to improve students' sanitation and hygiene behaviour.

Urine treatment and dilution system. From a hygiene perspective, human urine use may have the risks of pathogen exposure. The pathogens generally excreted in the urine are E.coli, Leptospira Interrgans, Salmonella typhi, Salmonella Paratyphi and Schistosoma haematobium (Höglund et al., 2002; Prithvi Simha & Mahesh Ganesapillai, 2017). The risk may be enhanced due to improper handling and inappropriate treatment practices. Likewise, the risks of disease transmission from handling and using human excreta are related to faecal cross-contamination of urine (Prithvi Simha & Mahesh Ganesapillai, 2017). The storage conditions affect the survival of various micro-organisms in urine through time (Shonde, 2016; WAN, 2008). Storage is continuously increasing the protection of humans exposed in the field. Based on the risk assessment calculation for urine, a withholding time of one-month storage at 20^{o} C (Höglund et al., 2002) is recommended.

The urine diversion toilet is connected to the underground reserve tank/chamber that stores around 7000 litres of urine. Pure urine is transferred from the underground tank into the Hill take tank kept on the roof of the toilet by pumping. The urine is stored for a minimum of one month. Since the urine storage plastic tanks were exposed to solar heat, some disinfection was expected. In

Figure 6.21: Urine Treatment and Dilution System Plant

addition, a withholding period of one month between fertilisation and harvest is applied.

Another important aspect of urine fertiliser is appropriately diluting human urine and water. The plant's nature determines this dilution; the storage duration and the amount of solar heating (Alemayehu et al., 2020). Several studies recommended diluting urine to one part and five-part water (1:5). However, for small vegetable plants, one part of urine to eight parts of water dilution is better (Egigu et al., 2014; Kodama et al., 1955; Winblad & Simpson, 2004). In this, dilution ratio of one part urine to three parts water (1:3) was adopted- This dilution process is done in another tank with a urine treatment tank on top of the UDT. Finally, the drip-irrigation system supplies the diluted urine to the school's kitchen garden, which can be done from the automatic system without manual handling.

Eco-garden. The NORHED/*Rupantaran* project in collaboration with the research participants established a school garden in the school premises that spread over 0.3 hectares area. The garden is bordered on two sides by walls which six feet in height, and ten-feet-high iron poles surround the remaining sides with metal wire and an Eco-san toilet building. An underground urine reserve tank and a 30 feet deep soak pit are prepared in the school garden. An Eco-san toilet is made on one of the sides of the school garden from where human urine can be easily supplied in the garden.

Coincidentally, the national movement of Nepal was underway to establish a school garden in each public school when we started our work under this study. The cabinet of the Nepal Government declared to implement 'one school, one garden' program in the year 2020, while this study was going on in one public school in Nepal (Bhattarai & Schreinemachers, 2020; Schreinemachers et al., 2017).

The school garden infrastructure was developed to create an academic and sanitary environment (Acharya, Devkota, et al., 2020) and apply urine fertiliser to produce organic vegetables to promote students' nutritional status. Through the school garden, on one hand, students enhance their learning through learning by doing, and on the other hand, they raise awareness of human urine as a resource, not a waste. Similarly, treated human urine as a fertiliser increases the production capacity. Additionally, the vegetables produced are nutritious and delicious and they could easily draw community's attention towards utilizing urine as fertiliser. The school's Eco-garden will give a positive message to the broader community that urine fertiliser is not a disgusting matter, and the products using such fertiliser will not stink.

Drip-irrigation system. A drip-irrigation plant was installed to supply diluted human urine in the Eco-garden. The drip-irrigation system plant was introduced to handle and supply diluted human urine to the Eco-garden to avoid direct contact with urine. Although there were some technical issues related to sharing distribution among stakeholders, there was an attempt to make them aware of this with more content and related expertise.

Figure 6.22: Drip-irrigation Plant

Drip-irrigation is a kind of micro-irrigation that does not allow unnecessary leakage of dilute urine under the ground. In this system, networks of pipes distribute water directly to the roots of the plants. It can be done above or below the soil surface (Taylor & Zilberman, 2015). The goal is to place diluted urine directly into the root zone and minimise evaporation. It provided the most efficient way to conserve irrigation urine directly to the plants through pipes. This is delivered directly to the roots, optimising growth and preventing diseases. The lower volume allowed the diluted urine to be absorbed into slow percolation (penetrating the soil below the roots system and flowering into the water table) soils such as clay, minimising runoff (Yang et al., 2011). There were many holes of 0.5mm in the dripping pipe in one foot range. The pipes were 0.5 inches and related to the main 2-inch pipe with a check valve. The check valves regulate the drops from fast to slow and complete block based on the requirement. Thus, there were no difficulties for any students or teachers handling the dilute urine supply to the Eco-garden.

Several meetings and workshop sessions were organised with co-researchers and experts to make technical support available during installation, urine application and troubleshooting. Implementing steps was not very difficult, and teachers and students participated in seedling and planting vegetables with diluted urine in the garden. Plants were placed on both sides of urine supply pipes. We did actions and research (data collection) side by side. Co-researchers and experts share results and experiences through meetings in the action school and at the *Rupantaran* office located in Tribhuvan University, Kirtipur, Kathmandu. We discussed the advantages, disadvantages, challenges, effectiveness and other related issues. Finally, we concluded that urine supply through drip irrigation was labour-saving, cost-effective, and crop-matured earlier than those other fertilisers used and found more production. In addition, learning with garden pedagogy on sanitation and hygiene education was effectively used to improve Eco-san technology. The collaboration between researchers, coresearchers and neighbouring farmers was cohesive due to increased interaction.

Moreover, urine application through a drip-irrigation system delivered immediate and tangible benefits. The method of drip irrigation was found simple and easy to operate. Collaboration with community people, neighbouring farmers, students, teachers, and SMC/PAR committee members effectively promoted this technology. However, several challenges were faced regarding using urine in the school garden. These problems were i) only 1000 litre of urine could be treated at a time; ii) sometimes there is a shortage of urine collected in the urinal chamber; iii) the valve of the pipe was clot; iv) the check valves were broken while operating; v) all vegetables were not harvested at the same time, and vi) all students have not equally participated in the school garden activities, and there was a shortage of urine when the school was closed due to COVID-19.

Figure 6.23. Garden Activities

Type III: Behavioural Interventions

Getting support from educational (educational) and technological (technological) interventions, the behavioural or application-based interventions on sanitation and hygiene, a special focus on handwashing with soap and water and an ecological sanitation system was introduced in the third phase of interventions. It proceeded through demonstration and fieldwork in the urine-diverting toilet and school garden activities. The demonstration specially focused on handwashing with soap and fieldwork regarding the cleanliness of UDT, urine storage, treatment, dilution, and supply into the school garden through a drip irrigation system. Demonstrating handwashing with soap and water is one of the best and most cost-effective interventions (Bhutta & Sylva, 2015) that helps minimise infections, including diarrhoeal diseases. Likewise, Ecological sanitation, the best solution to control environmental pollution (Egigu et al., 2014), is implemented in the action school to change sanitation behaviour and use urine fertiliser for organic vegetable production from the school garden. It was expected to be an outstanding achievement to control the prevalence of sanitation and hygiene-related diseases and change human waste (urine) into resources (agricultural fertiliser) for organic fertiliser in the school garden. Furthermore, knowledge, perception and self-efficacy with behaviour change of the basic level students regarding hand hygiene and eco-san system were expected to improve through behavioural/application-based interventions.

Demonstration of handwashing with soap and water. The needs assessment study at the first phase of this PAR indicated that the students at the action school did not practice handwashing with soap and water at critical times, like before meals and after toilet use. Before implementing PAR interventions, there were almost no handwashing stations, soap cases and soap. Also, there lacked participatory classroom

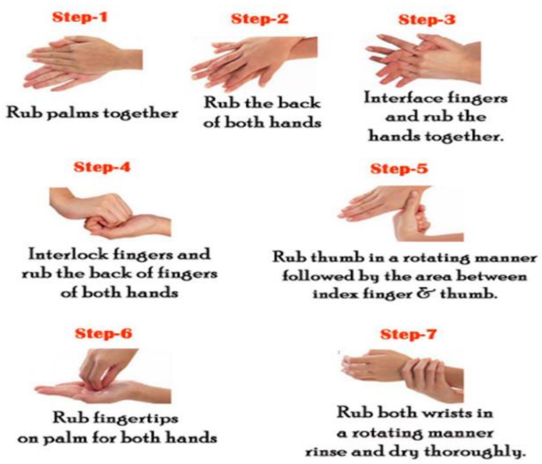

Figure 6.24. Hand washing steps recommended by WHO

pedagogy regarding hand hygiene. Therefore, to improve practical problems like hand hygiene, various handwashing-related sensitisation and participatory handwashing demonstration sessions were conducted with the appropriate method of washing hands with soap and water. The demonstration is mainly based on the WHO instructions of seven-step HWWS skills. It was a one-week-long session due to the high volume of students in grades 6 - 8. All the senior grade students demonstrated handwashing for the junior grade students. Similarly, PAR/SMC members' and teachers' participation in the handwashing demonstration was applauded by all. Posters of HWSS skills with pictures have been pasted on the wall of all toilets and handwashing stations.

Figure 6.25. Demonstration of Handwashing Skills

Workshop to disseminate knowledge on urine diversion toilets. Before using the UDT, a workshop on using UDT was conducted among students, teachers, SMC, and the PAR committee. During these workshops, there was an extensive discussion on ‘using guidelines of UDT/urinal’ applying to national and international practices and local knowledge reviews. Finally, a written guideline was developed and utilised accordingly. The guidelines outlined the methods of UDT / urinal use and cleanliness in which areas; i) the UDT / urinal pan should always be kept clean and tidy, ii) urine should not cross-contamination with faeces, iii) Do not allow wood, paper or other debris to enter the urinal, iv) Water should not be added to the urinal, as it may not be used to distribute water and urine in proportion to the crop, v) Urinals should be wiped with a disinfectant and clean cloth, vi) After defecation, go to a separate tap to wash your hands with soap and water, vii) Water from the hand washing stations should not be allowed to enter the urine collection tank, viii) The toilet must have soda water, disinfectant and a brush, and ix) Posters mentioning how to use the UDT for information to guests or visitors should be tossed on the toilet wall.

Demonstration and sharing of human urine storage, dilution and supply system. Due to the high concentration of macro and micronutrients (Nitrogen, Phosphorus and Potassium) in human urine, its use as an agricultural fertiliser increases production and provides more nutrition to the vegetables and fruits produced (Egigu et al., 2014; KC & SHINJO, 2020). Utilising human urine in Eco-garden has improved school sanitation and developed garden-based pedagogy in schools (Acharya, Budhathoki, et al., 2020).

In this system, the pathogens in the human urine were disinfected by keeping them at 20°C for 25- 30 days. Later, they were transferred to the dilution tank and diluted in the ratio of 1:3 to avoid over-application of fertiliser to the crop. Different sources in the literature (Jonsson et al., 2004; Volpin et al., 2019; Yang et al., 2015) mention that the urine can be diluted in the ratio of 1:1 to 1:10 according to the nature and age of the plants.

After diluting the urine in the ratio of 1:3, the diluted urine was supplied to the thirteen plots, and the other thirteen plots were filled with cattle/animal fertiliser. The diluted urine was provided from the drip-irrigation system in the required amount twice a week for the plants to not let them with and to avoid ammonia in the urea from evaporating since the diluted urine was dripped 10 cm into the plant to prevent the spread of the urine in other areas and wastage.

Application of urine fertiliser in the school garden. The essential macronutrients (Nitrogen, Phosphorus and Potassium/NPK) required for a plant are found in human urine. Human urine is free of cadmium and other toxic heavy metals (Ganrot, 2005; Rana et al., 2017; Tidåker, 2003). However, two or three-vault toilet pans are unavailable in Nepal, and building a three-vault toilet system is financially expensive and technically challenging. So, we used a simple urinal pan for defecating urine. A brief overview of the school garden's urine application process is presented in Figure 6.26.

These were connected to the underground urinal chamber through a pipe directly.

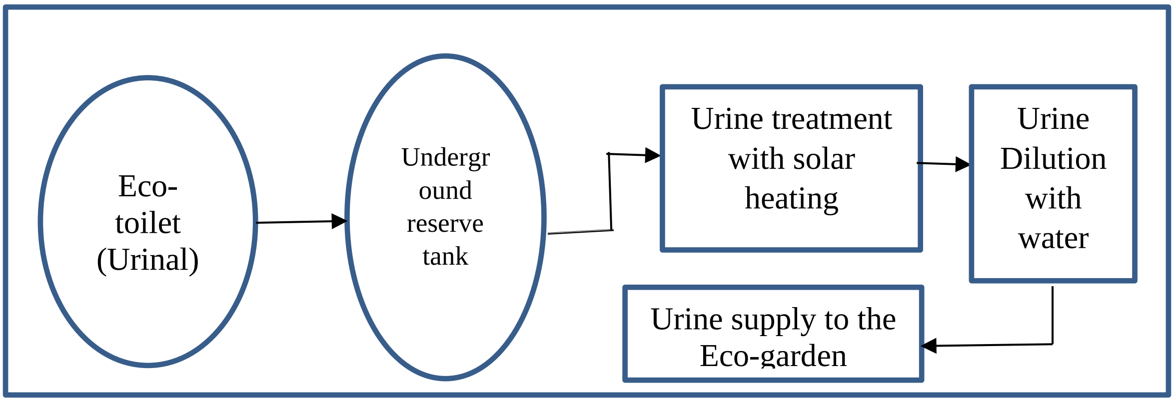

Figure 6.26: Urine Storage, Treatment, Dilution, and Supply System

After collecting the fresh urine into the underground chamber/tank, it was pumped up to the rooftop *hiltake* tank for treatment with solar heating and dilution with water. The fresh urine was stored in the *hilltake* tank for 25-30 days at about 20°C to kill the pathogens in the human urine. When fresh urine is kept in a rooftop tank at a temperature of about 20° Celsius for 25-30 days, its pathogens are destroyed/disinfected; hence, it is usually called urine treatment (Tice & Kim, 2014). Then the treated water is poured into the next tank placed nearby the treatment tank connecting with a pipe and diluting it with water. Diluted urine is supplied in the first seven days of the plant/seedling, and then it is supplied twice in a week. A Drip-irrigation system is used to supply urine fertiliser into the Eco-garden. The urine supply is stopped one month before the vegetable harvest. Furthermore, the PAR team, including experts, developed brief urine application guidelines collaboratively, presented in table 6.4.

Table 6.4. *Urine Application Guidelines*

SN	Urine Application Guidelines
1	The urinal pan should be made clean, free from moisture and avoid dust particles inside the pan,
2	There should be clean running water and soap at the washing basin placed in the toilet
3	Make sure the toilet is clean after your use
4	Always wash your hands with soap and water after using, cleaning or maintenance of the toilet
5	We should clean the urinal holes with a clean piece of cloth little amount of water and vinegar to dissolve the accumulating salts
6	Drawing and instructions on the toilet wall should be an excellent way to introduce the proper use
7	The connecting pipes of the urinal should be joined to the underground urinal chamber directly
8	The urinal chamber should be fitted with lids because nitrogen evaporates and ammonia emissions easily to the air
9	It is better to follow the most common dilution ratios of 1:3 or 1: 5 (one part urine, three-part water, or 1 part urine, five-part water
10	Diluted urine should be directly into the soil, not on the plant
11	Foliar fertiliser should not be used due to odour, loss of nitrogen, risk of plant toxicity and hygiene risks
12	Air contact should be minimised, and the urine should infiltrate into the soil around the root zone as quickly as possible
13	Urine should be applied according to the needs of the plants
14	Good availability of nutrients is important in the early stages of cultivation, through once the crop enters its reproductive stage, nutrients uptake diminishes

15	Minimum one month period between fertilisation and harvest should always be stopped urine supply
16	Drip-irrigation using urine as a fertiliser is a possible application technique without handling urine
17	Polyethene piping, with 30 cm between holes, and the urine flowing with gravity from a rooftop tank directly to the crops was implemented in the action school. No blocking of pipes has been found. So, it is recommended to replicate the model of drip irrigation to supply human urine fertiliser into the kitchen garden in all public schools in Nepal.

Cultivation Experiment Using Urine Fertiliser

The weight of five types of vegetables (pumpkin, cucumber, gourd, cauliflower, and cabbage) produced using urine fertiliser and animal fertiliser at the harvesting time was measured. Reflective notes were also recorded, and multi-model evidence like photographs and audio-video tapes were also used.

After constructing the eco-san toilet, an Eco-garden was built with 26 plots covering 0.3 hectares of land. The size of each plot, either for urine application or animal dung, was 45 feet long and 4 feet in breadth or 15 m^2. As suggested by several studies (Pradhan & Heinonen-Tanski, 2010), diluted human urine in the ratio of 1:3 was supplied only in 13 (50%) plots (case), and the other remaining plots were used as a control and e only water was used. The treatment consisted of two concentrations: urine as a fertiliser and animal fertiliser.

The urine was collected from 227 boy students' compound 1000 litre from 9 urinals for a month. The urine was stored for one month (1 March 2019 to 30 April 2019) at the ambient temperature of 25^o C to 33^o c. Storage is used to raise the pH and kill potential pathogens in urine (Goetsch et al., 2018; Lahr et al., 2016). A storage time of one month is reported as adequate to mitigate risks associated with even urinary tract viruses (Goetsch et al., 2018). The current study stored human urine for the former reason and appropriate dilution. The diluted human urine in 13 plots was supplied using a drip-irrigation system, whereas animal fertiliser was used in 13 plots.

Pumpkin, cucumber, gourd, cauliflower and cabbage were cultivated in the Eco-garden. From planting to twenty days before harvesting, diluted human urine was used four times. The weight measurement of vegetables produced using human urine and animal dung at the harvesting time was recorded separately. The group discussion identified qualitative information regarding the perceived differences between vegetables grown using human urine or animal dung. At the same time, the applicability of UDT in a school setting was also assessed through group discussion.

The result of the study was based on the perceived benefits of UDT and Eco-garden, the application of human urine as an agricultural fertiliser in the school garden, and a cultivation experiment in the Eco-garden. Considering the present sanitation situation in schools, an Eco-friendly alternative with a urine diversion toilet (UDT) was established. The technology of UDT constitutes three steps containment, sanitisation and recycling, which are practised by collecting in underground tanks and finally applying in the field as fertiliser. The urine diversion toilet has improved the school's sanitation behaviour and condition. Moreover, urine fertiliser from UDT is utilised as nutrients for vegetables planted in the school garden.

After the infrastructure development of UDT, installing a drip-irrigation system plant, and the field of Eco-garden was prepared, the soil was made fine and loose to make it ready for seedlings and planting vegetables. Of 26 plots, 13 were supplied with diluted human urine (1:3) as fertiliser, while the remaining thirteen were animal fertilisers. The selected vegetable plants (pumpkin, cabbage, gourd cucumber and cauliflower) were planted separately in the plots designed for cultivation experiments. The total urine supply plots were planted with 50 pieces of cauliflower, 30 cucumbers, 20 gourds, 50 cabbage and 20 pumpkin plants. At the same time, the same number and types of plants were also supplied on animal fertiliser supply plots. After preparing the soil and constructing the plots, the prearranged number of plants were planted, and 13 plots were supplied with urine fertiliser from the drip-irrigation system. The remaining 13 plots were filled with animal fertiliser and water. In 13 plots with such animal fertiliser, a drip-irrigation system was used for water supply. Still, as the animal fertiliser was dust / solid-like soil, it was planted only by mixing in the soil. The fertiliser was supplied the same day and twice a week after planting. The fertilisers were supplied two times a week for five weeks (35 days). Fertilisers were supplied for up to one month before harvesting vegetables. A month between fertilisation and harvest should stop urine supply (Egigu et al., 2014), which is considered safe for health hygiene (Wohlsager et al., 2010). The effectiveness of urine fertiliser was identified by selecting the largest of the two types of plots and measuring their weight.

At the time of harvesting, the weight of 25 pieces of each type of vegetable was measured to identify the performance of human urine as agricultural fertiliser, and the same quantity of similar vegetables from plots supplying animal fertiliser was measured. The result from the weight measurement of vegetables produced using human urine as fertiliser and animal fertiliser is presented in Figure 6.26.

Fig. 6.27 shows the difference between the total weight in Kilogram of the pumpkin, cabbage, gourd, and cucumber from the plot where urine is used as fertiliser and from the plots using animal fertiliser. The weight of 25 pieces of each type of vegetable was measured. The weight of 25 pieces of pumpkin was 50 kg, cabbage 45 kg, gourd 30kg, cucumber 25kg and cauliflower 60 kg from urine supplied plots. In contrast, the weight of vegetables in plots with animal fertilizer was recorded as pumpkin 18 kg, cabbage 15 kg, gourd 12 kg, cucumber 15 kg and cauliflower 20 kg. The total weight differences between the plots using urine fertiliser and animal fertiliser were pumpkin 32 kg, cabbage 20 kg, gourd 18 kg, cucumber 15kg and cauliflower 40 kg. The result showed a significant difference in vegetables' weight between urine fertiliser and animal fertiliser plots. The weight of vegetables in the plots using human urine fertiliser and animal fertilizer (animal dung and urine) is presented in table 6.5.

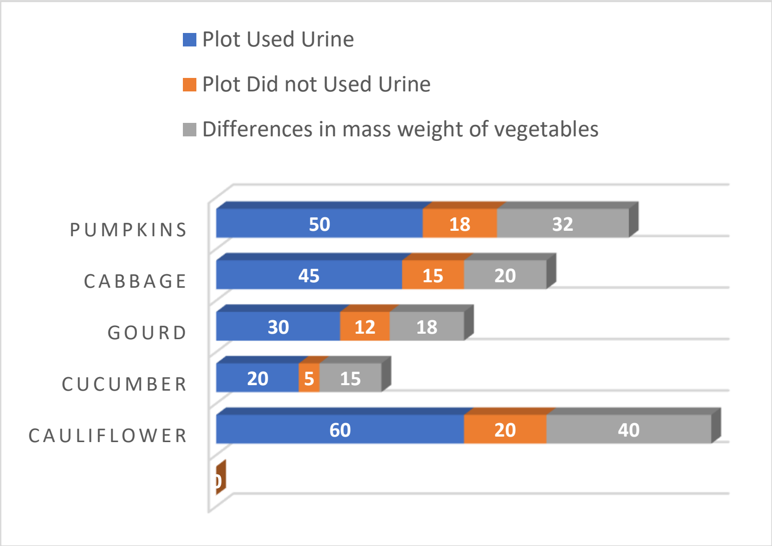

Figure 6.27. Result of Cultivation Experiment

Table 6.5. Weight Measurement of Harvested Vegetables

SN	Vegetables	Plot with Urine		Plots without Urine		Weight Differences (More quantity in urine applied plots in kg)
		No.	Weight (kg)	No	Weight (kg)	
1	Cauliflower	25	60	25	20	40
2	Cucumber	25	20	25	05	15
3	Gourd	25	30	25	12	18
4	Cabbage	25	45	25	15	30
5	Pumpkins	25	50	25	18	32

Chapter Summary

This chapter includes three interventions with a number of participatory activities to contextualise teaching and learning through indoor and outdoor sessions**.** The chapter also depicts the critical and emancipatory approach emphasised in the PAR that has led to the implementation of hand hygiene and urine-diverting toilets in the public-school setting of Nepal in a convenient way for the research participants. Implementation of the PAR was mainly designed for educational, technological and behavioural interventions. The students were willing to adopt innovations introduced as a part of the PAR, such as happily accepting the Eco-san innovations, co-creating knowledge getting help through sensitisation and observing handwashing skills and Eco-san and participatory classroom pedagogy. This chapter also incorporated classroom teaching methods, gaining trust and collaboration, and co-creating knowledge by observing the Eco-san innovations in the school.

Furthermore, the pedagogical approaches through several PAR activities as interventions related to sanitation and hygiene mainly focused on handwashing with soap and urine-diverting toilet use were interconnected in the classroom teaching.

The interventions used a variety of strategies to promote handwashing with soap and sanitation behaviour of students, including songs, drama, drawings, sanitation fairs, sanitation campaigns, infrastructure development and demonstration, which were also described in this chapter.

For intervention mapping, rounds of discussions, meetings, workshop dialogue conferences, and bridging workshops were organized between the PAR committee, teachers, students, local government officials, school administration, and other concerned individuals and groups. Several meetings were held on field reflection with the involvement of the expert community, national and international coordinators team, the core team of the NORHED/Rupantaran project, and me, a PhD research fellow. But the fact that predetermined or ready-made strategies, messages, and activities do not fit in, PAR was becoming a reflection day by day. Dozens of meetings, workshops, dialogues, and conferences were organized in interventions that lasted for three years. Even though I feel that PAR is never ending and never saturated, I had to reach a stage and do a follow-up study, which prepared this PhD dissertation.

Chapter 7. Impact Evaluation of the PAR Interventions

Overview of the Chapter

Chapter VII provides an overview of the impact evaluations of intervention regarding the sanitation and hygiene behaviour of the students and multiple impacts of Eco san. Mixed methods research design with the PAR approach was used to evaluate the changes after the PAR interventions. In this third phase of the PAR, I used more or less similar methods and tools with needs assessment, such as survey, FGDs, IDIs, participatory classroom observation, observation of handwashing practice, school record review, reflective notes, and daily diary. The evaluation included the impact of the intervention from 2018 to 2021. This period was expected to demonstrate immediate, medium and longer-term impacts. The effects of different educational, technology-based, and behaviour-based interventions on learning and hygiene education and students' sanitation and hygiene behaviour change have been assessed. The impacts of interventions were identified by examining knowledge, perception and practices of hand hygiene and the Ecological sanitation system (using the urine-diverting toilet as the best sanitation solution and applying human urine as an agricultural fertiliser in the school garden). Similarly, the impact of various documents prepared during interventions, such as tailor-made course / local curriculum, IEC materials, teacher manual, UDT guidelines, and urine fertiliser use guidelines on sanitation and hygiene education (SHE) teaching and learning, are also assessed and incorporated in this chapter. This chapter also describes the qualitative and quantitative findings on classroom pedagogy, content coverage of SHE and knowledge, perception, hand hygiene practices, the Eco-san system through the urine-diverting toilet, and urine fertiliser used in the school garden.

Improvement in Sanitation and Hygiene Facilities

The participatory action research in the public secondary school developed a hybrid, bottom-up approach to school-based field research to assess the situation. The situation analysis focused on the sanitation and hygiene facilities, infrastructure development, compared to pre-and post-intervention phases. During the research handwashing stations (taps, sinks, soap case) were built, soap management was ensured at handwashing stations and toilets, the infrastructure of flush (for girls) and urine-diverting toilets (for boys) was built and an Ecological sanitation technology was installed. Final assessment carried out through a participatory approach shows that various improvements have been recorded in the overall sanitation system in the school compared to the situation before the project. Moreover, photos/videos were also used to assess the school's situation. Details of sanitation and hygiene facilities found in the school are presented in table 7.1.

Table 7.1. *Sanitation and hygiene Facilities in School (2021)*

Variables	Interventions	
	Before (2018)	After (2021)
Number of toilets	06	16
Toilet student ratio		
Girls	1: 139	1: 38
Boys	1: 96	1:32
Handwashing stations	10	24
Soap with soap cases	No	20
Urine diverting toilets	No	Available
School's Eco- Garden	No	Available
Urine fertiliser use	No	Available

Table 7.1 presents the progress observed in the action school as a result of the intervention. In 2018, the school had only six unorganised toilets andthere was neither soap nor proper cleanliness in the toilet. The superstructure of the toilet was in ruins. Faecal matter was visible in the toilet pan. Students were found urinating everywhere on the walls of the toilets. The school toilets were dirty and smelly. There were no cleaning materials inside the toilets. No handwashing with soap was practised after toilet use. Students had to stay in the queue long to use toilet. The students' toilet ratio was 1: 96 for boys and 1: 139 for girls, much higher than WHO/UNICEF (JMP) reports (WHO UNICEF JMP, 2020). Some students would go to the toilet at home if they felt it during school hours, while others used the public toilet next to the school. Students suffered due to human and urgent needs like the toilet. Due to this toilet problem during menstruation, female students suffered inferiority in school and stayed home. The PAR committee decided to find a sustainable solution by constructing a urine-diverting toilet with an ecological sanitation system and using human urine as a fertiliser. Accordingly, with the help of the NORHED / *Rupantaran*

project in school, an essential component of technological / infrastructure-based intervention, urine diversion toilet, urine treatment system plant, drip-irrigation system plant and school garden were developed. After the intervention, the school (2021) has 16 toilets with normal and standard urine-diverting toilets. It is seen in the ratio of toilet students to 1:38 for girls and 1:32 for boys, although it is not in line with WHO / UNICEF minimum standards (1: 50 for boys and 1: 30 for girls) (WHO UNICEF JMP, 2020). The headteacher says, “After constructing UDT in the school, students have been more enthusiastic, and absenteeism has decreased, especially among girls.”

Schools must ensure basic facilities such as toilets, handwashing facilities and safe drinking water (WHO/UNICEF (JMP), 2021). Children learn better when these facilities are available in schools (Kere et al., 2016) and change sanitation and hygiene behaviour. The basic principle underpinning this PAR in school can be essential in changing sanitation and hygiene behaviour and promoting better health. The status of sanitation and hygiene facilities stated before and after implementing PAR intervention in the school is mentioned in table 7.2.

Table 7.4. *Reported Status of Sanitation and hygiene Facilities (Pre-post comparison)*

Parameters of Sanitation and hygiene facilities	Results	
	Pre (n=209) (%)	Post- (n= 225) %
Handwashing facilities (HWFs)		
Provision of regular running water at HWSs and toilets	90	100
Availability of soap at HWSs and toilets	00	100
Inappropriate height of taps at HWSs	32	15
Not comfortable washing hands at HWSs	43	7
Not comfortable using school toilet	48	14
Dirty washbasins	56	23
School toilets facilities		
Feeling lack of privacy in school toilets.	14	00
No child-friendly toilet door	36	06
Overcrowding in male urinal (n= 99)	45	00
Open urination (boys only) (n= 99)	13	00
Queue for toilet	84	00
Used to go to the public toilet	17	00
No, disabled-friendly toilets	17	19
Cleanliness of school toilet		
Faecal matters were found in toilets	40	09
Poor cleanliness and bad odours	54	18
Lacking supervision of toilet cleanliness	77	54
Helper (peon) cleans the toilet	89	56
Drinking water		
Lack of safe drinking water at school	97	22
Brought drinking water from their home	7	10

Table 7.2 indicates that majority (90%) of students reported regular running water available at HWSs and toilets. Almost all participants (98%) responded similarly after implementing PAR intervention. Similarly, 32% and 15% of participants in the pre-and post-implementation survey reported being uncomfortable using HWS taps respectively. Again, in the pre-implementation study, those who queued for toilet use (84%) and sometimes had to go to the public toilet without turning at the school toilet (17%) said that after the implementation of PAR intervention, such a problem was completely solved. However, a tiny percentage (5%) of participants stated that they did not feel privacy in the school toilet which is much lower than the pre-intervention phase (14%). Likewise, 6% participants reported the lack of privacy after PAR intervention which was 36% in the baseline. However, toilet cleanliness is improved. In the post-intervention, participants still reported faecal matter found in toilet pans (9%), lousy odour in the toilets (18%), lack of supervision to maintain proper cleanliness of toilets (54%) and helping staff clean toilets (56%).

Knowledge of hand sanitation and hygiene. This section mainly summarises basic-level students' sanitation and hygiene-related knowledge immediately after implementing sanitation and hygiene sensitisation sessions. The key aspects covering knowledge on sanitation and hygiene are: i) sources of information, ii) importance of handwashing, iii) sanitation and hygiene-borne diseases, iv) required materials while washing hands and v) association between demographic variables and sanitation and hygiene.

Sources of information regarding sanitation and hygiene. Participants were asked the sources of information regarding handwashing through the questionnaire.

As table 7.3 shows, more than two-thirds (69%) of the survey participants reported teacher/school was the source of information, while 12% of participants said the source of information was their parents. Similarly, neighbours, friends, and Radio/TV were also quoted sources of handwashing.

Knowledge of the importance of handwashing. Knowledge assessment of the survey participants about the importance of handwashing is mentioned in table 7.4. which shows that majority (96%) of them reported preventing diseases. Similarly, 92 per cent and 88 per cent of them were aware that handwashing with soap was helping to keep clean and kill germs, respectively.

Knowledge of sanitation and hygiene-related disease. Participants were asked whether they knew of any hygiene-related diseases. Almost all (96%), (94%), (93%), (92%), and (85%) per cent of survey participants answered worm infestation, skin diseases, typhoid and diarrhoea were caused by poor hygiene, respectively.

Knowledge of required materials while washing hands. When asked what materials should be used for handwashing, a high majority (94%) of survey participants answered water and soap, whilst only 6 per cent reported water. (See table 7.3). However, no one was aware of seven steps handwashing techniques that WHO suggests (Pan et al., 2014).

Table 7.3. Knowledge of Required Materials while Washing Hands (Post-intervention)

Handwashing materials	Responses	
	n	%
Water and soap	212	94
Water only	13	6
Total	225	100.0

Association between socio-demographic variables and sanitation and hygiene-related knowledge. There was a statistically significant association between educational status/grade and HWWS knowledge in terms of advantages of HWWS i) killing germs, $p<0.05$, ii) keeping clean, $p<0.001$, and iii) preventing diseases, $P<0.001$). Table 7.7 shows the association between socio-demographic variables (grade and HWWS knowledge regarding the advantages of washing hands with soap.

Similarly, there was also a significant relationship between sex and the importance of HWWS, i) killing germs ($\chi 2$ =8.799, P=.003), ii) keeping clean ($\chi 2$ =3.559, P=.046), and iii) prevents from diseases ($\chi 2$ =5.527, P=.021).

Association between background variables and knowledge in terms of handwashing materials. There was no significant association between background variables of the students (grade, sex, age, caste, religion, mother's occupation and income sources of the family) and their knowledge of better handwashing materials need to be used ($\chi 2$ =1.306 and P=.224, $\chi 2$= 0.24 and P = .547, $\chi 2$=.452 and 346, $\chi 2$= .248 and P=.879, $\chi 2$= .038 and P=.572, $\chi 2$ =.952 and .253, $\chi 2$=3.553 and P=.196) respectively.

Sanitation and Hygiene Behaviour

From this study, I learned valuable information on the handwashing practices of students in school. This part considered the handwashing behaviours while the students were in school. It mainly focused on the handwashing (HW) place/stations, the timing of handwashing with soap, handwashing materials, and the availability of water and soap at HWSs and toilets. Handwashing was evaluated at two universally critical times, namely after toilet use and before a midday meal. Table 7.4 shows that out of 225 survey participants in the post-implementation phase, the majority (94.2%) of them washed their hands with soap and water at both critical times (before the meal and after toilet use), whilst the remaining (5.8%) students have also washed their hands with water only.   Almost all students participating in the post-intervention survey (225) washed their hands at the school's HWSs and basins. In response to "when to wash your hands at school", most participants (91.8%) washed their hands both critical times before midday meals and after toilet use. When asked if HWSs are comfortable, 92.9% of participants said they feel comfortable, while the remaining 7.1 % of students said handwashing stations were not convenient. Still, regarding school toilets, 85.8% of students said comfortable, and the remaining (14.2%) said not convenient. Similarly, in school, when it comes to washing hands with soap and water, it was found that 84% after the toilet and 75 % before the meal wash hands with soap and water.

Basic level students were asked to identify sanitation practices after providing sensitisation or intervention programme. In response to 'When asked where you defecate when you are in school', 100% of the participants said they do it in the school toilets. Similarly, all survey participants said the school toilet had maintained privacy and reported no tragic situation of waiting in a queue for toilet use.

Table 7.4. Sanitation and hygiene Practices of the Students at School (Post Intervention)

SN	Variables	n	%
1	Handwashing practice		
	Handwashing with soap and water	212	94.2
	Handwashing with water only	13	5.8
	Total	225	100.0
2	Handwashing with soap and water		
	After toilet used	189	84
	Before the midday meal	169	75
	Total	212	
3	Perceptions of the comfort of handwashing stations in school		
	Yes	209	92.9
	No	16	7.1
	Total	225	100.0
4	Perceptions of the comfort of using the school toilet		
	Yes	193	85.8
	No	32	14.2
	Total	225	100.0
5	Availability of enough running water	225	100.0
6	School toilet as a place of defecation while students are in school	225	100.0
7	Perceived privacy in school toilet	225	100.0
8	No waiting in the queue while going to the school toilet	225	100.0
9	Comfort with using the school’s toilet		
	Yes	193	85.8
	No	32	14.2
	Total	225	100.0

Association between demographic variables and sanitation and hygiene practices of the students at school. More than half (63.6%) of survey participants felt the school toilets were comfortable, about one-third (36.4%) of them, mainly junior graders, reported school toilets uncomfortable because it is a bit difficult for them to open the doors, turn on the taps for water and toilet pans are higher for them. It was also found that there was a statistically strong relationship between junior and senior grade students and comfortable use of school toilets (χ^2 = 91985, df = 1 and P-value=.000).

The perceived uncomfortable use of school toilets by caste/ ethnicity was not statistically significant (χ 2=2.399, P= 0.031), but there was a strong association between uncomfortable use of the toilet by age (χ 2=19.758, P= 0.000). In contrast, there was no association between comfortable use by sex/gender (χ 2=2.986, P= 0.057).

Similarly, the idea of being comfortable in handwashing stations (HWSs) and socio-demographic variables (sex, age, caste and educational level) of students was not found statistically significant (χ 2= 1.796 and P-value .156, χ 2= 3.143 and p-value .252, χ 2= 1.936 and P-value= .128 and χ 2=2.039 and P-value= 421) respectively.

Association between background variables (sex, age, grade, caste and mother's occupation) and materials used to wash hands. It has been found that female students have more hand-washing practice with soap and water than male students. Similarly, its Chi-square test (χ 2 =14.947, P=.000) indicates a significant association between background variables (sex) and materials used to wash hands with soap and water. But (age χ 2 =.161, and P=.453,), grade (χ 2= 3.167 and P-value= .063) caste (χ 2= 1.614 and P-value =.430 and mother's occupation (χ 2= .653 and P-value =.316) did not find statistically significant with hand washing materials.

Table 7.5. Association between background variables (sex, age, grade, caste and mother's occupation) and materials used to wash hands

Background Variables		Materials used to wash hands: Soap and water %	Water only %	Total %	χ 2	P-Value
Sex	Male	44.8	100.0	48.0	14.947	.000***
	Female	52.2	00.0	52.0		
Age	≤12	51.9	46.2	51.6	.161	.453
	>12	48.1	53.8	48.4		
Grade	4 & 5	19.8	00.0	18.7	3.167	.063
	6-8	80.2	100.0	81.3		
Caste	Dalit	27.8	15.4	27.1	1.614	.430
	Janajati	51.4	69.2	52.4		
	Brahmin/ Chhetri	20.8	15.4	20.4		
Mother's Occupation	Agri.	66.0	76.9	66.7	.653	.316
	Others	34.0	23.1	33.3		
Total		100.0	100.0	100.0		

***=p<0.001

Association between background variables (sex, age, grade, caste) and hand washing practice especially before the meal and after toilet use. There are various critical times to wash hands with soap and water, such as before eating, after going to the toilet, after returning from work on the farm, after changing the menstrual pad, before preparing food and after cleaning children's defecation). Table 7.6 below shows a statistically significant relationship, or there was a significant association between handwashing with soap and water before a meal and sex of the students (χ 2= 7.491and P <0.01) but not for the grade (χ 2= .943 and P-value = .223), caste (χ 2= .428 and P-value = .308), age (χ 2= 2.098 and P-value = .350).

Table 7.6 Handwashing practice (before meal) by demographic variables (sex, age, grade, caste)

Background Variables		Before meal		Total	χ 2	P-value
		Yes	No			
Grade	4,5	20.1	14.3	18.7	.943	.223
	6,7,8	79.9	85.7	81.3		
Caste	Dalit	25.4	32.1	27.1	.428	.308
	Janajati	52.1	53.6	52.4		
	Brahmin	22.5	14.3	20.4		
Age	≤12	56.8	35.7	51.6	2.098	.350
	>12	43.2	64.3	48.4		
Sex	Male	46.7	51.8	48.0	7.491	.005**
	Female	53.3	48.2	52.0		
	Total	100.0	100.0	100.0		

** p<0.01

Similarly, table 7.7 below shows that there was a statistically significant relationship between grades (4-5 and 6-8) and age of students (≤12 and >12) by hand washing practice with soap and water after toilet use (χ 2 = 23.018, P-value=.000 and χ 2 = 2.490, P-value = .000) respectively but not for caste/ethnicity (χ 2= 1.168, P-value= .534), and sex (χ 2= .069, P-value= .467).

Table 7.7. *Handwashing practice after toilet by demographic variables (Post Intervention)*

Background Variables		Handwashing after toilet Yes (%)	No (%)	Total	χ 2	P-value
Grade	4,5	13.2	47.2	18.7	23.018	.000***
	6,7,8	86.8	52.8	81.3		
Caste	Dalit	26.5	30.6	27.1	1.168	.534
	Janajati	51.9	55.6	52.4		
	Brahmin	21.7	13.9	20.4		
Sex	Male	47.6	50.0	48.0	.069	.467
	Female	52.4	50.0	52.0		
Age	≤12	45.0	86.1	51.6	2.490	.000***
	>12	55.0	13.9	48.4		
	Total	100.0	100.0	100.0		

*** P <0.001

Head-teacher was interviewed to share the results of the intervention in the overall sanitation situation and students' health behaviour as the resusts of the PAR intervention. The headteacher's IDI shows that most school students and teachers wash their hands with soap and water before meal/ tiffin and even after toilet use. Soap was managed at school, both in HWSs and toilets. The number of toilets in the school is enough for students and teachers as the toilet-student ratio is recommended by WHO (1:20) (Ashu et al., 2021). Likewise, the Government of Nepal, Ministry of Education, Science and Technology (MOEST) emphasised separate toilets for girls and boys; this also met the school requirements. As MOEST highlighted, a 50:1 student toilet ratio for boys and 30:1 for girls as a minimum standard (National Planning Commission, 2011). However, the school's toilet-student ratio (128: 1) was as high as the recommended standard by WHO and MOEST. In addition, students and teachers developed a culture of cleaning school toilets. It has also been done by helping staff (peons), but it cleaned the toilet perfectly and regularly.

Observation of Hand Hygiene Practice after Interventions

Though handwashing with soap in school and its measurement is challenging, this study applied PAR methodology with collaborative activities to address this complexity. HWWS behaviour was observed during tiffin breaks before and immediately after health education intervention sessions. I attended the use of toilet by students and their handwashing behaviour from 30 meters distance and handwashing alone from ten meters. Students' Hand Washing with Soap (HWWS) was recorded in the observation checklist during the short- and mid-day snack breaks. Fifty observations were recorded between April 10 and 17, 2018 (in seven days). A similar observation was made immediately after the intervention (May 7-14, 2019). The spot checks were made on structural elements at handwashing stations in school to determine handwashing behaviours, particularly soap. The key indicators used to determine the handwashing behaviour of basic-level students were soap for washing hands, effective or dedicated handwashing stations, following WHO's recommended six steps of handwashing skills, and time is taken to wash hands. These indicators were used to collect information on hygiene behaviour and practice.

After implementing PAR intervention on hand hygiene (hand hygiene sensitisation and demonstration sessions), an evaluation was conducted to assess students' performance, especially on handwashing with soap and water. The unstructured observation of HWWS found that handwashing behaviour increased after several promotional activities related to hand hygiene like classroom teaching, singing songs, drama, drawing and demonstrations were conducted using a participatory approach. It was noted that HWWS practice is more immediate after PAR interventions. It also found that compared to boy students, more girl students washed their hands with soap and water after using the toilet.

Washed hands with soap and water. Out of fifty handwashing events observed during school tiffin break within a week, forty-four events followed handwashing with soap and water. The observation found that the students who came out of the toilet turned on the water tap at HWSs. They wet their hands and wrists first and use soap. They were lathering and scrubbing both hands for a few seconds. They removed soap bubbles and thoroughly washed their hands, back, fingers, nails, and fingernails. Lathering and cleaning hands create friction, which helps lift dirt, grease, and microbes from the skin. Microbes are present on all hand surfaces, often in exceptionally high concentration under the nails, so the entire hand should be scrubbed (Friedrich et al., 2017; Gordin et al., 2007). Likewise, determining the length of time for handwashing was challenging to measure (Friedrich et al., 2017), while in this study, the boy students gave a short time (less than 15 minutes) compared to girl students. Most of the events observed found no care for the time duration for handwashing. Usually, they spend more than 20 seconds washing their hands. Regarding techniques/ skills of handwashing, we (I and senior grade students) demonstrated the proper way and steps that must be followed to ensure one has washed hands properly. Most students followed the procedures described in hand hygiene lessons, handwashing-related videos, IEC materials and demonstration classes. In a few cases, handwashing skills were not found to be stepwise as shared in the hygiene sensitisation session.

Similarly, another weakness observed was that the water wasted due to lack of turned-off water taps, the hands were not wiped after washing, or there was no system for drying the hands, and with wet hands, the students went to the classroom. And negligence is still found in washing hands with soap and water properly. I recommend it should be an area for future inquiry.

Washed hands with water only. Out of fifty handwashing events observed at tiffin break within a week after intervention, only six events were found to wash hands with water only. It is important to note this because some believe washing their hands without soap kills germs. Students continued to exhibit some degree of nonconformity or resistance to the message for various reasons. The students cited the soap smell as one of the main reasons. This mostly happened when they were about to eat, as the bad smell seemed to affect their food.

Similarly, people who only used water to wash their hands believed this was enough to eliminate any small germs they might have picked up when they went to the bathroom. This was especially evident among male students who urinated in the toilet. Since urine is considered harmless, it is presumed that they have not touched their faeces. However, intervention messages emphasised using soap to avoid germs and related infections. Male students who did not use soap for handwashing asserted that

> Hands are clean; soap is not necessary. It takes a long time to wash hands with soap and water; just rinsing with water is fast. *(*FGD, male students)

Distance of toilets from HWSs. Another observation finding is that the distance between the toilets and the HWSs (about 30 meters) influences the handwashing behaviour. Students said they might want to wash their hands as soon as they leave the toilet, but they are likely to get distracted between the toilets and the HWSs if they are located a bit near. As one student during FGD added:

> We have been taught and sensitised that washing hands with soap and water is important after toilet use and before we eat. Apart from the teachers telling us the same, we have participated in sensitisation sessions on hand sanitation and hygiene and messages on Television and listening on the radio encouraging us to follow hygiene, including hands with soap. But when we move to the toilet, we hurry back to eat our meal/snack and return to class. If HWSs and toilets were nearby, it would be easier for us. (FGD, male student)

Students rushed to the restrooms during lunch break and had to wait in line to use them, according to observations of their handwashing habits. According to discussions about the conditions with co-researchers, students were less likely to wash their hands with soap and water the longer they waited in the canteen line. After using the restroom, they had no choice but to rush back to class or wait in line for food immediately.

Did not see handwashing practice. We did not see where their movement from class to the toilet and toilet to HWSs was in groups, rushed and too fast. Handwashing practices could not be seen well due to overcrowding in HWSs, lack of enough soap cases at HWSs, and speeding up handwashing activities. I recommend further study to improve handwashing practices by observing all handwashing events well.

Comparison of Handwashing Knowledge and Practice by Pre and Post Interventions

The study findings showed that implementing sanitation and hygiene behaviour change activities using multiple PAR interventions significantly impacted hand hygiene knowledge and handwashing behaviour. This part considered changes in hand hygiene knowledge and hand washing behaviour, especially at two critical times (before a meal and after toilet use) were assessed in two phases (pre- and post-intervention).

Perceived knowledge of the importance of handwashing with soap and water during the intervention (pre and post). The students reported the importance of handwashing with soap and water, which kills germs, keeps them clean and prevents diseases, which seems to have increased by a much higher percentage after the intervention. There was a strong or significant association between handwashing knowledge with soap and water and intervention (kill germs: χ^2= 63.347, p-value=.000, keeps clean: χ^2= 84.965, p-value=.000, prevents diseases: χ^2= 190.520, p-value=.000,). Table 7.8 below shows the importance of handwashing with soap and water by the intervention (before and after).

Table 7.8 *Perceived Importance of Handwashing with Soap and Water by Interventions*

Advantages of washing hands		Interventions Pre (n=209) %	Post (n=225) %	Total %	χ 2	P-Value
Kill germs	No	52.6	16.4	33.9	63.347	.000***
	Yes	47.4	83.6	66.1		
Keeps Clean	No	52.6	11.6	31.3	84.965	.000***
	Yes	47.4	84.4	68.7		
Prevents from diseases	No	72.7	8.0	39.2	190.520	.000***
	Yes	27.3	92.0	60.8		
Total		100.0	100.0	100.0		

***P <0.001

Condition of washing hands with soap by interventions. The condition of handwashing before a meal and after toilet use compared to before and after hand hygiene-related interventions is presented in table 7.9. The result reported by the survey participants showed that there was a significant relationship between handwashing practice after toilet use and interventions (χ 2= 8.482, P<0.05). However, there was no significant relationship between handwashing practice before meals and intervention (χ 2= 1.434, P= 0.138).

Table 7.9. *Condition of Washing Hands with Soap by Interventions***.**

Condition of washing hands with soap and water		Interventions Pre (n=209) (%)	Post (n=225) (%)	Total (%)	χ 2	P-value
After toilet	Yes	72.3	84.0	78.6	8.482	.003*
	No	27.7	16.0	21.4		
Total (Row)		100.0	100.0	100.0		
Before meal	Yes	69.9	75.1	72.7	1.434	.138
	No	30.1	24.9	27.3		
Total		100.0	100.0	100.0		

*P<0.05

Place of Washing Hands at School by Interventions. A comparison of handwashing facilities before and after the intervention was compared in table 7.10. The infrastructure or technological-based interventions improved the number of handwashing facilities and enhanced the quality of handwashing facilities at the action school. Before the intervention, there was a practice of washing hands in public places or outside the school compound. After improving the quality and quantity of handwashing facilities on the school premises, the outgoing practice was completely avoided/prohibited during school hours. The study revealed a significant relationship between handwashing facilities and intervention (χ 2= 21.391, P <0.0010).

Table 7.10. *Place of Washing Hands at School by Intervention*

Place of washing hands at school	Intervention Pre (n=209) (%)	Post (n=225) (%)	Total (Column)	$\chi 2$	P-value
Hand washing station (basin)	90.9	100.0	95.6	21.391	.000***
Open space outside of the school	2.90	0.00	1.40		
I don’t wash my hands at school	6.2	0.00	3.00		
Total (Row)	100.0	100.0	100.0		

***p <0.001,

Feeling comfortable washing hands at the handwashing station by Intervention Type. Table 7.11 revealed a significant relationship between intervention and perceived comfortable handwashing facilities at school (χ 2= 6.690, P <0.001). The study result also depicts that almost all the students still do not feel satisfied with the handwashing facilities available in the school. As one student during focus group discussion (FGD) remarked:

> There is a crowd at the handwashing stations. The strong ones push, and it isn’t easy to get our turn. Also, the taps in the handwashing station are in more height. The taps cannot be opened or closed. Like us, it is only a matter of time before others open the stream. (FGD, male student)

Table 7.11. *Perceived Comfort of Washing Hands at the Handwashing Station by Interventions*

Feeling comfortable washing hands at HWSs	Interventions		Total (%)	χ 2	P-value
	Pre (n=209) %	Post (n=225) %			
No	14.8	7.1	10.8	6.690	.000*** (df=2)
Yes	85.2	92.9	89.2		
Total (Row)	100.0	100.0	100.0		

***=p<0.001

Availability of soap at handwashing stations. The school has been implementing HWWS initiatives either with the support of NORHED/*Rupantaran* projects or independently. One of the major challenges they experienced and were struggling with was finding a remedy to manage and securely store soap for handwashing. Before the intervention, there was no provision of soap in the action school. During three years of the PAR interventions, the NORHED/*Rupantaran*, *project* (a Norad-funded project) supported infrastructure/ technology-based intervention and hygiene materials in the action school that ensured soap at the handwashing facilities. The survey participants in the PAR reported the provision of soap at both HWSs and toilets regularly. Soap availability by intervention types was statistically significant (χ 2= 197.613, P<0.001). Table 7.12 shows the situation of soap management in the school.

Table 7.12. *Availability of Soap at Hand Washing Station (Reported)*

Soap availability at handwashing stations	Interventions Pre (n=209) %	Post (n=225) %	Total (%)	χ 2	P-value
No	100.0	0.00	29.7	197.613	.000***
Yes	0.00	100.0	70.3		
Total (Row)	100.0	100.0	100.0		

***=p<0.001

Discussion with the stakeholders found that creating a ‘soap fund’ collecting a rupee from the students and teachers daily was the best solution to managing soap in school. Likewise, social entrepreneurship and requesting the local government for a budget to manage soap at school would be the next alternative. Similarly, other options like direct budget allocation from the Ministry of Education for public schools, SMC/PTA/PAR financing, and students contributing portions of soap and bring own soap from home to school were discussed. The stakeholders interviewed explored some possible avenues for obtaining soap. They include direct budget from the Ministry of Education for public schools. Most stakeholders interviewed said that as the government budgets for funds to support school activities, there should be an allocation for buying soap. This would ensure that the schools supplied soap like the ministry supplies books for educational purposes.

Several options were suggested to ensure soap in the HWS: i) Private schools would ensure they bought and provided soap for handwashing from the fees they received from the pupils. This proposal, however, would require lobbying and advocacy efforts as it would require both a policy shift and political will to succeed, ii) PTA financing - the second option suggested by the stakeholders is to consider the school management working out modalities under the parents-teachers association to support soap procurement. The members would then pay the agreed amount to the school management to purchase the soap, and iii) Students contribute portions of soap the third option to ensure soap supply is through an individual family contribution of soap. Based on the management agreement, each student would be asked to bring a designated amount of soap to school. The soap would be kept in a central place from where it would be placed at the handwashing stations within the school. Depending on the structures, the school's soap storage and management would be a matter to be agreed upon.

Availability of adequate running water to wash hands in school. During the pre-implementation of the PAR intervention phase, only ten per cent of the survey participants reported water problems at handwashing stations. After the intervention, almost all participants reported no problems with water in toilets and HWSs on these days. Results in Table 7.13 show a significant association between intervention and water availability in the school (χ 2= 23.757, P<0.001).

Direct observation shows sufficient water availability in the school. The school has access to water from two sources (underground / deep-boring and public water supply/surface water). The water supply system was not good in the past, so sometimes, there was a water shortage. After repairing it with technological intervention, enough water is available every time. But there is no water purification system in the school yet.

Table 7.13. Availability of Adequate Running Water to Wash Hands in School

Availability of sufficient water to wash hands in school	Interventions Pre(n=209) %	Post (n= 225) %	Total (%)	$\chi 2$	P-value
No	10.0	0.00	4.8	23.757	.000
Yes	90.0	100.0	95.2		
Total (Row)	100.0	100.0	100.0		

***=p<0.001

Comparison of hand hygiene behaviour between pre-and post-intervention (observed data). At the pre-intervention, there was no provision of soap at HWSs and toilets, but after the intervention, each of the toilets and HWSs had soap put on the soap case. The number of taps increased during PAR interventions' infrastructure/ technological development session, making it easy to wash hands. Similarly, a post-intervention observation noted that handwashing practice increased when several promotional activities were conducted and soap was placed at HWSs regularly. It was also stated that handwashing with soap and water, mainly observed during the tiffin break, was good. The observation recorded that more girl students than boy students washed their hands with soap and water after toilet use and before the meal. It also found that sometimes they used water only to wash their hands. Another notable difference was observed regarding the students' handwashing skills, which were comparatively better among senior graders than juniors. The summary of handwashing observation findings before and after the intervention is mentioned in table 7.14 below.

Table 7.14. *Observation Results of Handwashing Behaviour (Pre-Post Intervention)*

Theme	Pre-intervention	Post-intervention
Handwashing facilities	Water taps at HWSs- 6 Basin for HW-2 Soap in soap case at HWSs and toilets- no Towel- No towels at HWSs Water availability- enough running water	Water taps at HWFs: 16 Basin- 8 Soap in soap case at HWSs and toilets- yes Enough running water for both HWSs and toilets No towels at HWSs.
Materials used to wash hands	No soap used to wash hands even after toilet use and before a meal	Almost HW events observed among girl students found the soap to use for handwashing, but a few boy students used water only for handwashing
Hand washing skills	Only rubbing and rinsing hands with water and found any steps recommended by WHO	Most of the girl students and some boy students followed WHO's recommended stepwise guidelines of HWWS except step seven
Time is taken for handwashing	None of the students used more than 12 s for handwashing. In comparison to boys, girls washed their hands for a little longer.	Students washed their hands with soap and water for 10–20 s.
Challenges	Lacking soap management The height of taps at HWSs is not appropriate for some students Crowding at HW	Sustainable source of soap management The height of taps at HWSs is not appropriate for some students Crowding at HW

Handwashing observation before intervention indicated that some students avoided going to the toilet during tiffin break due to the overcrowding experienced at the handwashing facilities. They would then wait a while after the break and request permission to go to the toilet. Some teachers would scold them for not obeying school rules if they go without permission. However, the teacher has no choice but to give them time to use the toilets when requested. In this regard, the headteacher stated:

> The school policy is clear. Students are allowed the time allocated to use toilets and midday meals. The idea is to have less disruption during class time. It is, however, inhuman to refuse the student to go to the toilet when they request it because we see it as a genuine request. We also understand that we allow them to do it when they want to because of overcrowding at the toilets during the break. (IDI, Headteacher)

But the situation now has improved with more handwashing stations. The number of toilets, HWSs, and water taps at HWSs is increased, where there was no queue, but there is still overcrowding at HWSs to wash their hands. Similarly, washing hands with soap and water before eating and after using the toilet has not been developed yet. Some students only wash their hands with water before eating and after using the toilets. Another PAR cycle seems necessary for its complete improvement, which I recommend for further research.

Participants' Perception and Performance of Ecological Sanitation in School

This PAR presented a model of ecological sanitation to improve students' sanitation behaviour and organic vegetable production using urine fertiliser in the school's garden. This study was conducted in three different phases, including participatory intervention in a public school in Nepal. The impact of the PAR intervention on the perception of the Ecological sanitation system, sanitation and hygiene behaviour changes of students and performance of urine fertiliser are included in this section.

Perceived knowledge of Ecological sanitation and urine diversion toilet (UDT). Before the intervention, nearly all research participants (co-researchers) were unaware that ecological sanitation, eco-san toilet, urine diversion toilet, compost toilet and human excrement could be used as agricultural fertiliser. Onlly a very few participants reported hearing about eco-san. But they perceived that Eco-san, Eco-san toilet and UDT were the same terminologies. Some participants who had a family relationship in the Darechowk area of the Chitwan district who used urine fertiliser said they ate vegetables produced using human urine as agricultural fertiliser (see chapter V).

In contrast, participants' understanding of Eco-san changed after three different types of PAR interventions (see chapter VI) related to eco-san technology were implemented in the school. Participants reflected that Eco-san toilets, UDT, change human excreta into resources and could be used as agricultural fertiliser is the umbrella term of eco-san. These are said to be complementary innovations of the Eco-san system. Regarding the perceived understanding of Eco-san, one of the participants in teachers’ FGD asserted that,

> Ecological sanitation is a sanitation approach that prioritises environmental protection and micronutrient recycling. It consists of many terminologies like eco-san system, eco-san technology, UDT, human excreta change into resource or agricultural fertiliser, etc. (FGD, male teacher)

The science teacher, a participant in the FGD, again added:

> Human excrement is converted to the soil for agricultural purposes and water to land in an ecological sanitation system. Eco-san is a toilet system that reuses human waste back to treatment activities. (Teachers' FGD, male teacher)

Eco-san, a participant in the FGD of the PAR Committee, which has seen the use of human urine as agricultural fertiliser since the time of pre-intervention, claims:

> The ecological sanitation system describes systems that recycle excreta more safely and benefit agriculture rather than releasing them into the environment without treatment. It considers human excreta (urine and faeces) as a resource instead of waste. (FGD, a PAR member)

A student from the child club in the school added,

> Ecological sanitation is a new technology that involves the disposal of excreta. (FGD, female child club member)

Another student made a discourse regarding ecological sanitation. He added:

> Ecological sanitation is a friend to the environment promoted as a good way of promoting sanitation through improved toilets. (FGD, male member of child club)

Changing the perception of ecological sanitation system and urine fertiliser use. Before the PAR intervention, the research participants reported no information on the Eco-san system, UDT, and urine fertiliser. Eco-san-related content had not been included in the school curriculum. No organisation or institution had conducted any sensitisation programme about Eco-san in schools or communities. The research participants were unaware of the Eco-san's technical functionality and did not understand how the diversion of urine and faeces and handling of sanitary problems. Participants who knew little about Eco-san did not look positive either. They perceived human excreta as always harmful to our health, whether treated or not. However, some of the research participants who were optimistic about Eco-san insisted that the negative of Eco-san was unintentional. To eliminate negative perceptions, it was suggested that the related information should be conveyed to the stakeholders scientifically and properly through sensitisation sessions.

As the need assessment phase (pre-implementation) suggested, multiple interventions (see chapter VI) were implemented using a participatory approach. After implementing PAR interventions regarding changing the perception of the Eco-san system and applying urine fertiliser, the PAR was assessed in the third phase (post-implementation). The summary of the views and perceptions of the co-researchers on ecological sanitation systems, UDT use, and urine application as agricultural fertiliser (before and after intervention) is presented in table 7.15.

Table 7.15. *Perception of UDT and Urine as Fertiliser (pre-post intervention)*

Summary of the perception of using UDT and urine fertiliser	
Before the PAR interventions	After the PAR interventions
Human urine is a waste and suitable only for disposal	Human urine is a resource for the soil
Handling excreta is a great risk Human excreta should not be handled in any way Human urine has no benefits for human	Sanitised human excreta can be used as fertiliser

It is taboo to handle urine	The taste of vegetables changed when fertilised with urine
I don’t like vegetables fertilised with human urine and faeces	Vegetables fertilised with human urine are good for consumption.
I never consumed vegetables fertilised with human urine	Human urine fertiliser has better performance than animal fertiliser
Vegetables fertilised using human urine have a bad smell and health risk	No bad smell and health risk of vegetables fertilised using human urine
Human excreta are a matter of disgust	Vegetable gardens apply human urine as fertiliser does not attract insects
Urine diversion toilet is not (UDT) is not kids and women-friendly	UDT is the best toilet to minimise pollution
Worried might bring diseases from using UDT	
High monetary investment at the initial phase of instaling UDT	
UDT requires more maintenance	

Sanitation perspectives of UDT. Regarding sanitation aspects, all research participants perceived the benefits of the Eco-san system, which they connected to the poor sanitation situation experienced before PAR interventions in the school. As they explained, Eco-san is seen as a possible and suitable solution to improve the sanitation situation in the school. The participants, therefore, observe several advantages that an Eco-san system can give. One participant from the PAR committee addressed:

> After the school's construction and operation of the urine diversion toilet, the student’s habit of urinating outside has been removed, and now there is no need to be in the queue for toilet use. (FGD, Female member of PAR committee)

Health education teacher who participated in teacher FGD made the following remark:

> The ecological sanitation system is the system that helps to create a safe environment and also to eliminate diseases that are caused by poor sanitation systems. (FGD, male teacher)

Similarly, the headteacher, in his in-depth interview, reiterated:

> After constructing the UDT in our school, the pain of digging the safety tank again has been relieved. (IDI, headteacher)

Urine diversion toilet was a sanitary achievement in school and a sustainable sanitation solution. An SMC member spoke in this regard:

> It is good because we don't need to build another toilet soon after building one toilet with an underground safety tank. (FGD, male member of SMC)

Acceptance of urine diversion toilet. Although the participants in the first phase of the investigation (pre-implementation) did not know about the Eco-san system and its benefits, the multiple interventions included sensitisation and installing urine diversion toilets in schools. Fortunately, an assessment study after implementing PAR interventions foresees numerous benefits of UDT. Participants who were previously unsure about the eco-san system are now happily accepting it through their lived experience gained from their activities in the school. A female student about Ecosan/UDT in students’ FGD remarked:

> I do not have a problem using UDT, and I have been using it since PAR interventions were implemented in our school. (Students' FGD, a female student)

Boys in FGD had similar views about UDT acceptance as girls. One boy student mentioned:

> I am okay with using the UDT because I understand the value of human urine and the sanitation aspects of UDT. (FGD, a male student)

All research participants, including the heterogeneous nature of PAR committee members, accepted the Eco-san system and UDT installed in the school. With regards to Eco-san technology, one member of the PAR committee claimed:

> In this school and adjoining community, I don't think anyone can avoid disobedience about the Eco-san system and functionality of UDT in the school. I hope no one will disagree with this from now on. (FGD with PAR committee, a male participant)

Changes in perceptions towards urine diversion toilet. In the pre-implementation (needs assessment) phase, almost all the research participants, knowingly or unknowingly had negatively perceived UDT. After implementing PAR intervention, the trend of perception eco-san toilet / UDT was changed into positive directions. However, some said that there were some negative attributes. The post-implementation study found that everyone in the school strongly adopted using UDT and urine fertiliser. Attitudes of the participants were slowly softening towards UDT use and urine use. Understood human urine as organic fertiliser, it has become more popular even in the school kitchen garden. Eco-san is becoming a part of the school system as it is the most cost-effective way to utilise toilet waste in the school garden. The positive attributes regarding UDT and urine fertiliser use after post-implementation are presented in table 7.16.

Table 7.16. Perception of UDT and Urine Fertiliser

Positives attributes	Negative attributes
Absence of flies	Not kids and women-friendly
Lack of bad odour	Need more repair and maintenance
High resource or reutilise agricultural value	Worms may be found
Preventing pollution by treated human urine	Require more education/awareness for sensitisation
No need for more running water and a drainage system	Handling excreta is the great health risk
Modern and attractive toilet structure	
Decentralise sanitation system	Worried might bring diseases
The crops grown will not smell urine. There is no need to fear eating such food	Our culture strongly objects to the use of urine as fertiliser

Perceived effectiveness of urine application. Human urine has been used as an agricultural fertiliser in different parts of the world and Nepal, especially in the community. It has been proved to be effective. However, this is the first time in Nepal that urine fertiliser has been used in the school garden by the drip-irrigation method after proper treatment in combination with classroom pedagogy with appropriate participation of students in school setting. Four years of study at the action school indicated that treated and diluted urine fertiliser was the best additive to the soil for better yield and quality. It also found that the combination of urine as nitrogen-rich fertiliser gave the best product of vegetables from the school’s garden.

Human urine was used as organic fertiliser, healthier for both the environment and humans. Reusing human urine has a positive impact, increasing the acceptance of human urine as fertiliser in their crops. A participant from the teacher FGD expressed:

> The food we eat will not be lost, but it will be back as fertiliser to produce goods from Eco-field. (FGD, A male participant from the PAR committee)

After using the Eco-san system in the school, some parents have used urine on their farms even though it is done manually. This shows that the possibility of diffusion of eco-san innovation on a large scale has increased. A member of the PAR committee made the following remarks:

> I have been impressed by the UDT established under the eco-san system run in the school and the massive increase in productivity and better taste found in urine-fertilised vegetables from the school garden. I have started using urine collected in the bottle in my kitchen garden even though I could not apply all the techniques used in school Eco-san, like lifting urine on a rooftop tank, urine treatment, dilution with water maintaining ratio and supply it using drip-irrigation system etc. Others in my neighbourhood are doing this activity (simply collecting human urine in a bottle, solar heating and using it in their kitchen garden). (FGD, male member of PAR committee)

The quotes above shared a positive motivation for the Eco-san system, generally found in the discussion. A participant from a similar group or PAR FGD added:

> There is no disadvantage but more advantages to reusing human urine as fertiliser. (FGD, A female participant from the PAR committee)

In the beginning, reusing human urine as fertiliser in the school garden was hard to accept since it was a new idea. Initially, people at the local market (*Chautara*) would likely see vegetables grown with urine fertiliser as offensive. One member from the PAR committee who helped to sell vegetables produced using urine fertiliser at the local market (*Chautara*) reflected the following statement:

> I think that everything at the beginning has a problem. Using vegetables fertilised by human urine feels terrible, but people use such vegetables happily as time goes on. It was challenging to sell vegetables produced in the school garden for a while, but later the same product started to be liked by everyone. Now it is sold from the school garden; we don't have to take it anywhere to sell. (FGD, male member of PAR committee)

After observing better production of vegetables fertilised by human urine in the school garden, whole school families, including farmers living nearby the school, perceived urine reuse was good. They named urine fertiliser 'Liquid Gold'. Many participants in the school were interested in getting UDT in their homes and using human urine as fertiliser in their farmland.

Though urine is already allowed to be used in gardens, some doubts remain about the pathological side. The health post-in-charge, who is also a member of the PAR committee, pointed out that the health aspects the use of human urine as fertilizer were unknown that must be explored further, and she argued:

> I want to raise the issue of the prevalence of parasites and pathogens. How long it will take to remove them from urine is relatively straightforward. The

> problems regarding pharmaceuticals and hormones are unknown. (FGD, a female member of the PAR committee)

In contrast, the teachers pointed out that there is no chemical or pathological effect on human health after properly treating human urine, using such urine as fertiliser and using vegetables produced from it. In this context, a teacher claimed:

> Storing urine for a certain period (one month stored at 30^0 C temperature) will be free from pathogens. We can eat vegetables fertilised with treated urine without any doubt. It would become applicable. (FGD, male teacher)

Effectiveness of utilising urine diversion toilet and urine fertiliser. This section covers the effectiveness of urine diversion toilet and urine fertiliser utilisation based on four years-long collaboration with research participants / co-researchers. This is a reflective judgment based on objective field experience as a researcher. The efficacy here refers to stakeholders' maximum use of available facilities. This is because the stakeholders naturally took more ownership of the achievement created using their knowledge and skills. A vivid example of this is the changes from this study. This is the beauty of PAR.

Effectiveness of utilising urine-diverting toilet (UDT) as a sanitation behaviour change. Urinals are used here as a model of Eco-san as they are quick and easy to install and use. Urinals are considered UDTs here due to limitations such as the unavailability of two vault toilet pans, more time-consuming treatment, more hassle to use dust particles and less collection of human faeces during school hours. However, modern toilets with normal toilet pans without urine and faeces diversion are also installed along with urinals. A person urinates in a pan system so that the urine spray does not fall on the shoe and cloth. After urinating, a separate water taps not connected to the urinal for handwashing with soap and water behaviour has developed among students. But after urinating with every attempt, the urinal cleanliness habit of using a wet and clean cloth seems to be lacking.

Effectiveness of utilising urine fertiliser in the school garden. The message that human urine is one of the fastest-acting, most excellent resources of soil nutrients (Nitrogen/N, Phosphorus/P, Potassium/K) and trace elements for plants was shared at the PAR sensitisation session with references. First, such messages can be considered the cognitive level efficacy of urine fertiliser. This is also evidence of the efficacy of urine fertiliser in the school garden. Similarly, the participants knew using fresh urine as a fertiliser for baby plants could cause death. Therefore, it should be used as fertiliser only after storage at 20-30^{0} C or require solar heating. Likewise, they used technical knowledge and skills, such as diluted urine on the ratio of 1:3- 1:10 (urine and water), especially for baby vegetable plants. We (the researcher and co-researchers) made an effort to make urine using guidelines consulting with scientific literature (see chapter VI). Even in storage, treatment, and dilution with water, they strongly followed the guidelines and supplied it into the school's kitchen garden. The co-researchers fully cooperated during the technological/infrastructure development of UDT, reserve tank, urine lifting system, treatment plant, dilution plant and system supply diluted urine through drip-irrigation. Subsequently, twice a week, at a distance of about 10 cm from the plant, diluted urine from the drip-irrigation system in the vegetable garden was used as fertiliser. We continued this process for one month before harvesting vegetables. The urine fertiliser yielded almost twice as much as the other fertiliser used and provided the opportunity to eat tasty and nutritious vegetables produced from the school's Eco-garden.

Perceived challenges using UDT and application of urine fertiliser in the school garden. While using UDT and urine fertiliser under the Eco-san system in the school setting, as a researcher, the research participants who are directly or indirectly involved in this process and I have noticed some challenges despite their various achievements. Research participants were asked about the difficulties of utilising UDT and urine fertiliser. Urinary incontinence has not been eliminated, such as closing the urinal, removing excess water and detergents, blocking dripping pipe holes, directing urine supply to plant roots, and using urine fertiliser while eating vegetables. The reflection of the research participants and myself regarding the challenges of using UDT and the application of urine fertiliser are briefly presented in table 7.17.

Table 7.17. *Challenges Using UDT and Urine Fertiliser in the School*

Theme	Issues
Political will and legal framework	The interests between school and political leadership had different views on implementing Eco-san in school. There were no regulations governing sanitation in a particular system and related legal framework
Cultural and acceptability	Culture appeared to be a central issue in the adoption of UDT. Some students and teachers still refuse contact with human urine
Affordability and availability of construction materials	Two or three vault Eco-san pans and dripping pipes are inaccessible in the local market, and buying from major cities of Nepal and out of Nepal can be more expensive. Due to the non-availability of two- or three-volt Eco-san toilet pans in school, urine collection through the urinal is being practised.
Limited knowledge and understanding	Some participants have not confirmed the nutrient value of urine, urine treatment (time, temperature), urine water dilution

	ratio as per the nature of the plants, and urine supply using drip-irrigation.
Lacking content in the mainstream school curriculum	Another challenge to eco-san promotion is the lack of Eco-san related courses in the school-level curriculum to make students aware of the ecological sanitation system, human excreta as agricultural fertiliser and nutrition and livelihood enhancement.
Cleanliness of UDT	Due to impediment to the water-urine dilution ratio, the urinal pan cannot be cleaned using a lot of water, and it has to be cleaned with a cloth soaked with a little water and detergent. This practice has not been done well, which is another critical challenge to the sanitary use of UDT in the school
Time management	Since teachers and students have a regular class schedule and SMC PAR committee members cannot regularly monitor school activities, cultivating urine fertiliser in the school garden is challenging due to time management.
Impact on human health	The die-off of pathogens in urine is well-reviewed and proven that it may not have a considerable health threat if treated well. If not treated well, human urine can contain a large amount of *E. Coli*, which may affect human health badly.
Operational factor	Urinary incontinence has not been eliminated, such as closing the urinal, removing excess water and detergents, blocking dripping pipe holes, direct urine supply to plant roots, and using urine fertiliser while eating vegetables.
Urine scarcity	There is also the challenge of failing the urine fertilised cultivation practice if the urine chamber is empty as the school is closed due to various problems. In the past, due to the COVID pandemic, the school was closed for a long time, and the urinal chamber was emptied. Due to this, the vegetable cultivation in the school garden was badly affected

Implementing the Eco-san system in the school required the active involvement of many participants. Working in a group and catching the sentiments of equal participation at the school level was challenging. Especially cleanliness of toilets and field engagement in the school garden faced challenges. The headteacher, in his IDI, stated:

> The participants on cleanliness did not find equal all the time. One major challenge is cleaning urinal pans with a piece of cloth. (IDI, Headteacher)

In a similar issue, student participants also felt cleanliness of UDT without using water is a great challenge. One male student added:

> Cleaning urinal pans without running water is not clean. One person's clothes are disgusting to be wiped by another, the toilet is not a regular chemical/detergent, and it will be more time-consuming. (FGD, male member of students' club)

Impact of Interventions on Sanitation and hygiene Education in the School

The teaching-learning process and classroom lessons under PAR interventions were conducted after the baseline /need assessment study, mainly focused on problem-solving related to sanitation and hygiene behaviour among basic-level school students. (See detailed PAR interventions in chapter VI). This section examined the impact of PAR intervention on teaching-learning in the classroom. It incorporated the comments from teachers' and students' approaches to teaching-learning used in the class to promote school sanitation and hygiene education (SHE).

Pedagogical perspectives (methods, materials and manual or 3M).

Teachers were asked during FGD what kind of qualitative changes in the teaching/instructional practices took place in the classes as the results of the PAR PAR interventions (PAR Cycle II). They reported that at the beginning of the PAR cycle, they felt less confident in their knowledge of pedagogy applicable to all students, including students studying SHE. None of the participants made any references to SHE-specific methodologies. Moreover, Teachers would only apply what they already knew and were doing. It did not matter if the students liked it or not. Phrases like, ‘I know what I am doing’. ‘I have been applying it for many years. Before implementing the PAR intervention in the school, the teachers did as the phrases told. Students learning problems identified by teachers included lack of motivation, lack of classroom activities participated by students, students, laziness, lack of intellectual curiosity of some students, the poor cognitive inability of SHE to handle rigorous content and poor socialisation. Major findings from the classroom teaching-based intervention sections are presented in table 7.18.

Table 7.18. *Changes in Teachers’ Pedagogical Practices (Post Intervention)*

Themes	Major Findings	
	Pre-intervention	Post-intervention
Lesson plan	No practice making a lesson plan or an action plan before taking the class Teacher flexibility in lesson delivery	Generally, Teachers used to prepare lesson plans before taking the class The specific lesson has been taken routinely
Student-teacher collaboration	Lack of students’ cooperation Not interested in favour of working in pairs No project work organised in groups	Maximum collaboration between teachers and students Every class have been found group work and students’ participation

	Did not involve in collaborative work in class Lack of student cooperation No professional collaboration found between the teacher and the students Laziness of some students	Teachers facilitated demonstration classes and other group work by the senior students to the juniors Sometimes teacher suggested specific roles and duties
Teacher motivation	Low students motivation Lacking teacher motivation towards the lesson, homework, cleanliness of school toilet and school surroundings Poor outdoor or field engagement The teacher encourages students to do better in academics rather than health promotion. Never pop up the students to reduce doubts Found passion for progress Motive by providing students with positive feedback Lacking both intrinsic and extrinsic motivation	Students were highly motivated to engage both in indoor and outdoor activities in terms of sanitation and hygiene Teachers always encouraged students both for health promotion and academic progress Teachers always helped to clarify the doubts Passion for progress was always welcomed Motivation was always the formula for students' progress and betterment of their academic careers and livelihood
Content Coverage on SHE	Found the content coverage of personal hygiene Lacking HWWS contents at critical times and HW skills Nothing spokes on Eco-san system and use Eco-toilet Covered a few contents in terms of toilet cleanliness and waste segregation	The contents lacking regarding SHE was hugely addressed by making participatory tailor-made course or local curriculum and implementing well The local curriculum covered Eco-san system contents that the mainstream school curriculum may not have covered.

Teaching materials use	Did not use any teaching materials in the classroom teaching No group practice to make teaching materials in class No, assign students to make IEC materials related to HWWS and eco-san system Optimal use of chalk and talk and textbook-based teaching	All class students were encouraged to develop teaching materials. Also, manage teaching materials available in the market. Internet, YouTube videos, photos, posters, and flipcharts were used. Fewer used chalk and talk methods compared before the intervention
Teaching methods	Optimal use of dogmatic lecture methods Sometimes use, question-answer and discussion methods No demonstration, field visit, case study, role play, or small group work was used Lacking classroom conversation No capacity-building workshop Poor participatory teaching and learning Lacking behaviour change focus learning	Optimal use of participatory methods of teaching and learning. Demonstrations, field visits, fieldwork, campaign, interaction, sanitation fare, role play, music and games were also used. Students, teachers, the headteacher and the SMC/PAR members were invited to attend seminars, excursions, and workshops. A particular focus has been given to the teachers and students to make the class more participatory and practical.

Co-curricular activities	No excursion visits Very few times are allocated for games, sports and exercises No efforts to make local curriculum including SHE (HWWS and Eco-san) Lacking interaction programme between teachers and parents Lack of good academic study habits and skills exhibited by some students Lack of intellectual curiosity of students The inability of SHE to handle rigorous content and poor socialisation	Excursion visits, games, storytelling, drawing competition, sanitation fare, interaction programme, seminars, and workshops were organised, which helped to have extra knowledge and competency build-up of all the participants Participatory tailor-made course or local curriculum focused on sanitation and hygiene was made and implemented well. Capability enhanced with rigorous content on SHE and Eco- san system Better performance on ECA and CCA
Evaluation	A few oral questions about sanitation and hygiene were raised in the group mode, not individuals, as a formative evaluation at the end of the class.	More focus has been given to observation and survey techniques to assess the level of understanding of sanitation and hygiene knowledge and related behaviour.

After pedagogical intervention in the second cycle of the PAR, when classroom teaching was observed to their knowledge targeting SHE classes especially, teachers stated that they felt more confident than before in their understanding of SHE-specific pedagogy. Health education teachers about the methodology of teaching SHE admitted:

> I was impressed with the PAR intervention on classroom pedagogy. Methods, materials and manual (3M) related to SHE with students' full engagement were impressive. (Teachers’ FGD, a male teacher)

Other teachers also gave similar responses, and they wanted to continue learning about interactive and engaging instructional strategies in the respective subjects as they experienced from the PAR interventions. In this regard, one teacher in teachers’ FGD added:

> I have a lot to learn from the PAR interventions. I need to improve my teaching skills based on specific gaps in specific skills. (Teachers’ FGD, a female teacher)

During the discussion conducted after the PAR interventions, the SMC / PAR committee chair emphasised that the environment of our school today is as we want it to be. Also, the students prefer classroom teaching strategies. He described the following quotes:

> School-age is a critical time in developing a human being, and the school setting provides a strategic point of entry for improving their health, esteem, life skills and behaviour. Schools can provide the environment to introduce health information and technologies students have provided. (FGD, SMC/PAR committee member)

Perceived impact of classroom-based PAR interventions in the school. Classroom-based interventions such as SHE lessons, SHE-related IEC materials, participatory teaching and learning methods, development and implementation of participatory tailor-made courses or local curriculum, and teacher manual based on the local curriculum reflected happiness, great satisfaction and motivation to change health behaviour. They incorporated the educational component, especially in classroom teaching, effectively improving the outcomes (handwashing and sanitation behaviour). In the PAR intervention, the classroom lesson includes message cards, IEC materials, drawings, singing songs, and demonstration class, and it is perceived as valuable and motivational. Concerning the classroom-based PAR interventions, a teacher participant in the teachers' FGD stated:

> It was suitable for teachers and students to enhance their knowledge and develop hand hygiene and ecological sanitation skills through participatory techniques. Today, we realise many weaknesses in the teaching methods adopted in the past. (Teachers' FGD, a male teacher)

In addition, student participants also reflected happiness and satisfaction with the classroom teaching-based PAR intervention. One student participant in the FGD reiterated:

> Based on the subject matter, we have been greatly influenced by the learning and teaching methods used in several activities prepared by students ourselves, such as storytelling, singing songs, drawing, role play, posters, message cards etc. (students' FGD, a female student)

Furthermore, some of the content related to hand hygiene was in the existing mainstream school curriculum, but it was not customary to devote enough time to it. Also, content associated with Eco-san was not in the school curriculum. The school's tailor-made course or participatory local curriculum related to SHE has been made very important by allocating two monthly periods in each class. This has led to significant changes in students' sanitation and hygiene-related behaviour. Its indicators are washing hands with soap and water before eating and after using the toilet and the cleanliness of toilets, classrooms, and school compound. Students also used UDT and applied urine fertiliser in the school garden well. In this regard, the headteacher, in his interview, mentioned:

> The implementation of a collaboratively prepared need-based local curriculum has been highly effective. It is being taught through participatory methods by allocating time with priority. The participatory local curriculum covers content related to the eco-san system that the mainstream school curriculum could not cover. Such a curriculum needs to be incorporated into the mainstream school curriculum. (IDI, headteacher)

As a part of classroom-based interventions, we developed a teachers' manual. We provided the teachers with content specifications and a lesson plan (behavioural objectives, teaching materials, teaching methods, teaching-learning activities, and evaluation process). Moreover, the teacher manual has mentioned a brief concept of content that we share in the class. Before entering the classroom, the teachers were found to have studied this manual in detail and also made a short lesson plan. Observations have also revealed that teaching materials have been prepared with the participation of students. Student-oriented activities (drama, singing songs, drawing, message cards etc.) were also observed to make teaching-learning more participatory. As a result, the students were very impressed with the classroom teaching and learning. Concerning the teacher manual, the health education teacher in the teachers' FGD noted:

> The teacher’s manual is not only a reference material for us, but it also has a concept of the subject matter and guidelines of the lesson plan, so it has proved to be a milestone for classroom teaching about hand hygiene and the Eco-san system. (teachers’ FGD, a male teacher participant)

The reflection of students on classroom-based PAR intervention was also exciting. They described the intervention as “unforgettable”. One member of the Eco-club remarked:

> The Eco-san system we learned from the school’s Eco Garden increased our knowledge from the cultivation experiment. It helped reduce the negative perception of urine fertiliser and improved handwashing practices with soap and water after using the toilet and before a meal. (Student’s FGD, a female member of Eco-club)

Chapter Summary

In this chapter, I have made an attempt to answer the four research questions i) what are students’ and teachers’ knowledge, perceptions, and practices towards hand hygiene, Eco-san toilet, and human urine application as fertiliser; ii) how did the students, teachers, and SMC/PAR committee members perceive the possibility of using an Eco-san toilet for the production of fertilisers; iii) what are the intervention’s pedagogical implications, and how can this align with curriculum development; and iv) how are the classroom teaching, training and behaviour-change actions performed before, during and after the intervention. It is clear from the findings that there must be several conditions to facilitate sanitation and hygiene in a public basic-level school in Nepal. These conditions include infrastructure or technological such as urine diversion toilets, handwashing facilities, soap, toilet cleaners etc. Other needs to be addressed include the implementation of sensitisation activities, participatory classroom pedagogy, the participatory collaboration of stakeholders in school activities, and social mobilisation to enable implementation and monitoring of the initiative.

The analysis of the changes due to PAR interventions shows that knowledge acquisition disrupts before-intervention learning and inspires the insightful reforming of severely deep-rooted knowledge, practices and belief structures. Transformation observed among SMC/PAR committee members, health education teachers' pedagogical practices, changing role of teachers, student-teacher collaborative relationship and status of changing sanitation and hygiene behaviour of the students. This chapter also deals with the impact of the PAR interventions on changing the sanitation and hygiene behaviour of students and the implication of the Eco-san system using sanitised/treated human urine as fertiliser in the Eco-garden. It assesses the perception of consuming urine-fertilised vegetables from the school's Eco-garden.

Chapter 8. Discussion

Introduction

This chapter discusses the overall findings from the participatory action research conducted in the Jana Jiwan public school of Chitwan. The sections below synthesise the findings derived from empirical data (qualitative and quantitative) along with the findings from the review of literature. The discussion is presented under the themes that include: i) awareness and practices/skills of handwashing with soap; ii) knowledge, perception and application of ecological sanitation; iii) impact of the participatory curriculum in changing sanitation and hygiene behaviour; iv) pedagogical transformation and improvement in classroom practices; v) reflections on participatory action research and sustainability of the interventions; vi) reflection on theoretical and analytical framework; vii) cross-collaboration in PAR activities in the school, viii) challenges with the implementation of participatory action research**.**

This chapter also examines the research questions presented in table 8.1 and interprets the theories, methods, and my conclusions against previous literature.

Table 8.1. *Research Objectives and Questions*

Research objectives	Research questions
To assess knowledge, perceptions and practices of students and teachers towards hand hygiene, Eco-san and the use of human urine as fertiliser,	What are students' and teachers' knowledge, perceptions, and practices towards hand hygiene, Eco-san toilet, and human urine application as fertiliser? How did the students, teachers, and SMC/PAR committee members perceive the possibility of using an Eco-san toilet to produce fertilisers?

To assess the effectiveness of the intervention to promote hand hygiene and the use of Eco-san in the school setting,	What is the potential for Ecosan to become more feasible and adopted within mainstream sanitation in the school?
	Do the students, teachers and parents prefer sanitation interventions following the PAR approach or a top-down intervention approach? Why? How best can the researcher and co-researchers collaborate to co-create knowledge on sanitation and hygiene?
To identify the impact of participatory pedagogy on using Eco-san toilet and handwashing with soap (HWWS).	What are the implications of participatory pedagogical interventions, and how could this contribute to curriculum development?

Awareness and Practices/Skills of Handwashing with Soap

There was a significant improvement in the overall knowledge concerning the importance of handwashing, awareness about the diseases caused by poor hand hygiene, skills of properly washing hands with soap, and materials needed for handwashing. After the intervention, 94% participants reported that their hands should be washed using soap against 46% before. It means the result increased by 48% compared to pre-intervention. There was a significant relationship between their level of education and knowledge of handwashing materials that need to be used ($\chi 2$ =4.750, P <0.05). These findings were similar to several other studies conducted in different parts of the world, including Nepal (Almoslem et al., 2021; Bhutta & Sylva, 2015; Gyi, 2019; Celia McMichael, 2019; Siwach, 2009; Suen & Rana, 2020). In contrast, a cross-sectional study conducted in Hongkong found that female respondents had significantly ($P< 0.05$) better hand hygiene knowledge than male participants.

Concerning the importance of handwashing with soap and background variables of the students, there was a significant association between grade and reported importance of handwashing with soap and water ($P < 0.001$), but no such result was found before intervention. In the pre-intervention (needs assessment) phase, <50 % of research participants had poor knowledge regarding the diseases transmitted due to improper handwashing like in a similar study conducted in India (Amunda et al., 2018; Garg et al., 2013). Likewise, hand hygiene-related interventions such as awareness/sensitization, hygiene-related lessons and demonstration sessions have changed students' hand-washing habits. The results of this study confirm the findings of several other studies conducted in the school setting in Bangladesh, Indonesia, and Nepal (Grover et al., 2018; Karon et al., 2017; Shrestha et al., 2016) and also related to IBM-WASH theory linked to the contextual factor in which students of higher grades and older children had better performance than those of lower grades and age.

Handwashing with soap was significantly affected by age, sex and class ($P<0.001$). Female students were more likely to comply with good handwashing practices with soap under running water at handwashing stations, especially after using toilets, than male students as evidenced in other similar studies (ALBashtawy, 2017; Amunda et al., 2018; Bhutta & Sylva, 2015; Boubacar Maïnassara & Tohon, 2014; Gyi, 2019; La Con et al., 2017) There were intrinsic differences in handwashing rates, skills and more time taken for handwashing among girls compared to boys indicating that girls are more sensitive to hygiene and hand-washing practices. They may change sanitary pads during the periods, motivating them to wash their hands carefully. Studies also show that girls spend more time washing hands than boys. Likewise, senior grade students (grades 6,7,8) were more likely to practice with soap and water than junior graders (grades 1-5). Furthermore, boys were more likely than girls to wash their hands without soap even after using the toilet.

This study found that handwashing facilities available in the school that was supported by the *Rupantaran* project motivated students to wash their hands from time to time. Water facilities and hand washing stations with soap in the schools contributed to change the health habits of students and teachers. Adequate water and soap at handwashing stations and toilets in an action school influenced students' handwashing behaviour change. Similar studies (Mufida & Pandin, 2022; Rosen et al., 2006; Scott & Vanick, 2007) showed that adequate water and soap at handwashing stations and school toilets influenced students' handwashing behaviour change.

Concerning the comfort of handwashing stations and toilets, there was a significant relationship between age, grade and use of sanitation and hygiene facilities. Feeling uncomfortable using handwashing stations and school toilets has no connection with students' grades or caste. It was found to be related to their height and strength; these findings correspond with the study conducted by Appiah-Brempong et al. in Ghana and Nigeria where uncomfortable handwashing facilities caused poor sanitation and hygiene behaviour among the students (Appiah-Brempong et al., 2018; Boubacar Maïnassara & Tohon, 2014).

There was a positive shift in the handwashing behaviour among the students and the most common steps they followed were i) wet hands with running water, ii) lather hands by rubbing them together, iii) scrub hands and iv) Rinse hands with running water. Handwashing sessions improved the practice of using soap before the meal and after toilet use. The performance among senior grade students was found to be better than among the junior grade students. A study conducted in Korea recorded similar observations with better performance of senior students than juniors proper handwashing (Lee et al., 2015).

The intervention implemented after the needs assessment regarding handwashing in the action school was cost-effective and collaborative. Teachers who participated in the study contributed maximum time to develop information education communication materials, teacher's manuals, and preparation of tailor-made participatory local curriculum that mainly focused on sanitation and hygiene education. Moreover, teachers demonstrated handwashing skills using soap, facilitating students to apply the Eco-san system, including human urine treatment, dilution with water, and supplying such urine to the Eco-garden as fertiliser using a drip-irrigation system. They also played as role models in implementing the eco-san system, developing cultivation practices using treated urine as fertiliser, and changing the negative perception of urine fertiliser among the whole school family and neighbourhood community. Participatory classroom pedagogy, which the teachers implemented during the intervention, made students active, creative, and healthy. The teachers encouraged students to write stories, draw figures, write songs, role play, and other participative activities which made learning joyful and meaningful.

Similarly, students' clubs formed as part of the intervention collaboratively participated in making hygiene sessions effective. The students' club members assisted the students with sanitation and hygiene behaviour change activities. A few examples are a demonstration of handwashing skills, making classroom teaching and learning more participative, cleanliness of toilets and classrooms and cultivation experiment using urine fertiliser in the school's Eco-garden. The study concludes that students' sanitation and hygiene behaviour change is possible due to the continuous support and collaboration of students, teachers and the whole school family. The results of various studies from around the world, including Nepal, have also found that there is a significant impact in classroom pedagogy and hygiene behaviour change through participatory intervention (Erin et al., 2017; Freeman et al., 2012; Mufida & Pandin, 2022; Pradhan et al., 2020). Participatory approach also make changes sustainable as priority is given to classroom-based intervention, which is cost-effective.

Knowledge, Perception and Application of the Ecological Sanitation

Human urine contains Nitrogen (N), Phosphorus (P) and Potassium (K) contributing 88%, 67% and 73% respectively (Fittschen & Hahn, 1998; Kirchmann & Pettersson, 1994b; Maguire, 1987; Maurer et al., 2003). However, the composition of human urine varies from person to person and region depending on their feeding habits, the amount of drinking water consumed, physical activities, body size, and environmental factors (Jonsson et al., 2004). Most of the Nitrogen fractions in urine are taken up by plants which is the same as the urea or ammonium fertiliser, with nitrogen efficiently approximately 90% of the mineral fertiliser (Jonsson et al., 2004) be used as agricultural fertiliser.

Before implementing PAR interventions, 97 % of the research participants were ignorant about ecological sanitation systems, including urine diversion toilets and human excrement as agricultural fertiliser. The remaining 3% of the participants also did not know enough about the Ecological sanitation system. They did not confirm the clear concept of Eco-san, its importance, and the value of urine fertiliser.

In the first phase of the PAR, it was also noted that participants provided fewer advantages than disadvantages associated with the Eco-san/ urine diversion toilets. The major dislike was uneasy about using urine diversion toilets. They prefered pour-flush toilets compared to Eco-san/urine diversion toilets.

Similarly, the Ecological sanitation and human excreta perception as agricultural fertiliser was negative before intervention.   Most of the participants stated that the Eco-san system is not sound and the reasons they mentioned include; i) Eco-san toilets stink more than other toilets, ii) Human excrement is not something to be re-used, iii) This is a dirty thing, iv) We don’t look back our urine and faeces, v) vegetables produced using human excrement stink like urine and faeces, vi) Diseases are spread if human excreta is used in agriculture, vii) Crops produced using human excreta harm our health, viii) Eco-san toilets are challenging to clean etc. Similar findings were recorded among farmers in central Nepal, where nearly half of the people were unaware of the Eco-san system and UDT. Similarly, more than half participants did not accept the value of urine fertiliser at the pre-intervention stage, which corresponds with the findings of a previous study conducted in Nepal by Water Aid Nepal (Practical Action, 2011).

After conducting several types of PAR interventions (Educational, technological and behavioural) in the school, positive changes were observed in the level of knowledge and perception of the Ecological sanitation system and urine diversion toilets. In particular, the senior grade students (grades 6-8) acquired better knowledge than junior graders. The student clubs which represent those whole students at the school have a better capacity to learn in recreational conditions such as using urine diversion toilets, treating human urine, diluting urine with water in the proper ratio, and supplying it to the school's Eco-garden using a drip-irrigation system. Vegetables that are now grown using urine fertiliser from the school's Eco-garden are cooked in the school canteen and consumed by all students and teachers without hesitation.

All the research participants (students, teachers, SMC/PAR committee members, students' club members and parents), including the expert community, provided valuable inputs to make a tailor-made course/ local curriculum focused on hand hygiene and Ecological sanitation. They also contributed to develop a teacher manual based on the local curriculum and urine application guidelines in the school's garden. They also developed IEC materials to improve classroom teaching and sensitisation to all research participants. The negative perception of Eco-san found at the beginning of this study has changed drastically after the various stages of PAR intervention.

Regarding the users' perspectives of the urine diversion toilets, there was a positive change, despite some technical problems. During the post-intervention survey, most participants (87%) reported they liked it and found it easy to use the urine diversion toilet in the school. However, a few (13%) survey participants said urinals were a bit of challenge because of their height. This finding is consistent with MC Conville and Rosemarin's findings (2011) that it was recommended to maintain the height of the urinals considering the students' height. Another challenge perceived by students was UDT cleanliness. Because of the erratic water and urine dilution ratio, using enough running water in the urinals is not allowed. The urinals must be wiped clean with a cloth soaked with detergent, making the students feel uncomfortable and disgusting. Similar studies conducted in South Africa supported UDT acceptance due to operational shortcomings such as lousy smelling, cleanliness difficulties, and unhygienic (Matsebe, 2011; Mkhize et al., 2017; Roma et al., 2013). On the contrary to this, several studies conducted in different parts of the world revealed that UDT design could influence its resource value; for example, using human urine as fertiliser reduces chemical fertiliser, and saves money, so the benefits outweigh the disadvantages (Martin et al., 2020; Matsebe & Boshoff, 2012; Nagy & Zseni, 2017; Winblad & Simpson, 2004).

The study findings indicated the growing potential of using human urine as fertiliser. The school is taking this issue seriously, especially concerning promoting ecological sanitation systems. Almost all students from grades 4-8 and other co-researchers (teachers, SMC/PAR committee members, parents, and students club members) were engaged in the school's garden for cultivation, mainly vegetables, which may raise the feasibility of ecological sanitation. Their main concern was using urine fertiliser to produce organic vegetables, and sanitation awareness needs to be solved in the cultivation experiment, cauliflower, cucumber, gourd, cabbage and pumpkins to compare with the fertiliser value of human urine and animal fertiliser. The cultivation experiments in the school's garden showed a significant difference in vegetables' weight using urine fertiliser and animal fertiliser. There was an increase of 33% vegetables (in kilograms) production using urine fertiliser, much higher than animal fertiliser on the plots.

Eco-garden activities provided opportunities for active learning, focusing on the collaborative engagement of co-researchers and researchers instead of using dogmatic lecture methods in classroom teaching. Students enjoyed working in the school garden, becoming happy and cheerful. There was no single sign of fear and loneliness in the students' demeanours when they participated and learned in the school Eco-garden. They developed great enthusiasm for doing activities. This is consistent with the other study findings which confirms that Eco-garden is an important arena in schools for transformative learning (Acharya, Budhathoki, et al., 2020).

Similarly, consistent with the findings of other studies, it was found that urine diversion demonstrates its potential to elegantly separate and collect nutrients to control pathogens, and micro-pollutants help in sanitation (Noe-Hays et al., 2015). However, before the intervention, it was found that teachers' perceptions of the urine diversion toilet system and the use of human urine as a fertiliser for the school garden were negative. They further found that teachers disliked this toilet due to a foul odour and the uncomfortable sitting position on the UDT, particularly for females. They felt using urine as fertiliser was unnecessary (Lahr et al., 2016). One of the most important takeaways from the study is that before using human urine as a fertilizer in the school garden, schools and local governments should use participatory approaches to understand and engage local stakeholders, including teachers, to reduce negative perceptions (Devkota et al., 2020b).

It was also found that teachers and SMC members experienced the garden as an opportunity to learn and get first-hand experience in growing vegetables by applying human urine as fertiliser. This study's findings were similar to those that established that knowledge of urine application in the field is beneficial (Mariwah & Drangert, 2011).

Similarly, Segrè Cohen et al. (2020) found that human urine diversion and recycling are viable and energy-efficient means of recovering nitrogen, phosphorus, and potassium from wastewater. We also saw that the vegetables produced in the school Eco-garden using human urine yielded more than animal fertilizer and the taste of the vegetables was good. It is mirrored that the Eco-garden is the place for transformative learning for school children. It is the source to convert waste into a resource. Eco-garden is the place to do the first-hand experiment, understand nature, control pollution, and an arena of learning through collaboration. In this regard, Acharya, Budhathoki, et al. (2020) also found that students can learn a lot from the garden when meaningfully engaging in activities. Planting flowers, fruits, vegetables, and medicinal plants in the school garden helps maintain greenery in the school (Easzkiewicz & Sikorska, 2020; Huys et al., 2017). As the school is a part of the wider community, knowledge about retaining the vegetation can be transferred to the surrounding community.

Impact of Participatory Curriculum on Changing Sanitation and Hygiene Behaviour

Basic-level students in public schools in Nepal are at an increased risk of infectious diseases. One of the major objectives of this research was to investigate the transformative pedagogy for Eco-san toilet use and handwashing with soap (HWWS). There were two research questions under this objective; What are the intervention's pedagogical implications, and how can this align with curriculum development? How are the classroom teaching, training and behaviour-change actions performed before, during and after intervention? This study examined the hand hygiene behaviour of students in the action school in grades four to eight and described hygiene facilities after the PAR intervention. It was found that teaching students facts about hygiene does not automatically lead to changes in their behaviour and practices. Many authors (Chan et al., 2018; Chong & Hung, 2017; Kariyana et al., 2012a) researched and argued that engaging students in handwashing with soap and water is important. Students' engagement in class or the handwashing stations is among the most inspiring and effective learning techniques. In particular, students are enthusiastic about immediately setting their newfangled knowledge and skills into practice.

Through the PAR intervention packages, students in the action school realized that when technological-based interventions are linked with educational-based activities like sanitation and hygiene facilities, it promotes better hygiene practices. It was a good learning experience that plan-act-observe and reflect helped students understand and learn about handwashing practices, which is a good learning experience. Students and teachers are passionate about the classroom pedagogy of handwashing throughout the PAR intervention sessions as pointed out by Lazaro and Anney (2016) who argue that behavioural interventions effectively encourage teachers and students in participatory activity-based teaching and learning. In this study, there was a joyful and realistic engagement of all students in different activities such as handwashing with soap skills and developing guidelines on using UDT and urine fertiliser. It was a good learning experience for all the teachers and students who participated in the handwashing activities throughout PAR cycles.

Hand washing sanitation, and hygiene pedagogy, including cultivation practices such as identifying the effectiveness or benefits of urine fertilisers and promoting sanitation and hygiene behaviour through UDT, is outstanding and skill based. However, sustainable handwashing at the school lacked regular funds to buy soap. Regarding the practical issue, some students still perceived handwashing with soap in toilets or handwashing stations would take longer, disturbing the class. Similarly, the eco-san system has observed problems with regular urine collection, proper storage, treatment, dilution, and urine supply with a drip-irrigation system.

Participatory curriculum in an action school includes handwashing music, art (drawing hand washing), and drama (students' engagement in a drama where few students are sick due to unsafe and non-hygienic behaviour). Students learnt more about the importance of hygiene and handwashing practices through these activities as participatory curricula help students get real-life experiences (Bergen-Cico & Viscomi, 2012; Sukadari & Huda, 2021).

Few students participated in extracurricular activities like games and sports, debate forums, and student newsletters of a wall magazine. Such an engagement and participation help develop emotional, social and physical aspects of life (Kwon et al., 2020; Tomlinson & Jackson, 2021)**.** This study found that blending extra and co-curricular activities with educational lessons are important to provide knowledge, develop skills and change the attitude of students and teachers. It is found that the students' engagement in handwashing and sanitation develops their logical and analytical thinking among them as they develop to analyse the cases with reasons behind events and circumstances. After engaging in sessions related to sanitation, students develop critical thinking among the basic level students (Riddle et al., 2021; Sukadari & Huda, 2021) as they examine the concepts, ideas, problems and issues other than sanitation and hygiene activities. It was found that developing social skills like collaboration among friends and teachers, building teamwork, and developing good relationships with peers are also positive aspects of PAR engagement in an action school. More importantly, PAR intervention creates recreational values like understanding the importance of leisure and recreation among basic-level students.

Furthermore, sanitation and hygiene education in classroom teaching implemented as an intervention has promoted knowledge and behaviour among the students. The students and teachers organised several sensitisation/awareness sessions, covering issues such as promoting and using better sanitation and hygiene practices through extra and co-curricular activities in an action school. As a part of students' sanitation and hygiene behaviour in the action school, IEC materials were developed in coordination with the students and teachers. The overall sensitisation/awareness sessions are hands-on due to participatory activities developed, keeping in view the imperative need of students and using IEC materials in collaboration with the teacher.

In addition to this, students were engaged in solid waste management, non-biodegradable materials and deposits in the allocated area, preparation of compost manure, and handwashing practices. All the activities were tied up with the curriculum and daily lesson plan. The TPS (think, ink and pair) teaching approach links the sanitation activities with the curriculum. During the intervention, students think, pair the work with what they thought, do project work, engage in fieldwork, and demonstrate the work they have done in PowerPoint slides and sketches. Through these activities, as Jasien and Gresalfi (2021) found, students understand abstract concepts through engagement in hands-on activities. Further, students participated in discussions, played games, solved exercises, etc. Contrary to the school evaluation system, the teacher manual mentions evaluation by observing behaviour change patterns.

Through the PAR interventions about handwashing and hygiene sessions, co-curricular activities were carried out outside the normal classrooms. Still, they complement the academic curriculum and help in learning by doing. Students' engagement in activities helps students to develop problem-solving skills, reasoning capacity, critical thinking habits, creative thinking mindsets, communication techniques and skills, and collaborative abilities of the basic level students in an action school.

Pedagogical Improvement in Classroom Practices

Basic-level students and teachers were the key research participants in sanitation and hygiene intervention. They were engaged in all types of activities throughout the PAR cycles. After engaging in the sanitation and hygiene intervention activities, teachers and students realised that the activities could be the solution for those who scored low in the examination. Health teachers blended the themes of each activity while teaching a lesson in class. They link hands-on activities with minds on activities through sanitation and hygiene intervention throughout PAR cycles. Confirming this finding, a study conducted by Xiao et al. (2022) in Vietnam said that engaging students in hygiene and handwashing activities develop their full learning potential. Due to this, students scored high marks in written examinations in their term examinations.

Teachers collaborated extensively with parents and students in handwashing and solid waste management. Students realised to separate biodegradable and non-biodegradable wastes and encouraged parents to prepare compost manure from decomposable materials. It was found that parents were preparing compost manure from the bio-degradable materials during the transect walks in the community. It was a good learning transformation. Health and environment subject teachers are facilitating students to learn the contents of the handwashing practices by engaging them in such activities. Engagement of students in sanitation and handwashing became a part of co-curricular activities, which deal with a process through which students construct knowledge, skill and value from real-life experiences. The stereotype teaching approach transformed through the meaningful engagement of students in collaboration with the teachers and parents (Langhout & Thomas, 2010; Westhues et al., 2008). This PAR study transformed the belief and practices of teachers. The engagement of students and teachers in the school in doing science curricular activities provided a powerful contextual scaffold to learning health and population subjects. There was a pedagogical transformation in class. Research has shown that accompanying teachers can help ensure successful learning in informal settings (Jarl et al., 2021).

Basic schoolteachers are the cornerstones in implementing educational innovation and teachers' knowledge and skills. Before the students' engagement, the participating teachers neither understood nor practised active learning pedagogies and envisaged handwashing and sanitation activities based on the curriculum. The lack of activity-based training for schoolteachers impedes to adopting learner-centered pedagogies in the schools of Nepal. Therefore, in this study we organized training focusing on developing teachers' capacities and skills from real-life activities to apply the existing locally available assets and related contextual practices in science learning.

Cammarota and Romero (2011) and Cammarota and Romero (2009) argued that students play, learn and understand through activities. Thus, engaging students in activities is one of the learning resources. The teachers argued that students' participation and engagement are transformed through the participatory action research concerning handwashing and sanitation activities. In this context, the teachers stated that activities based on collaboration with parents and students allowed them to discover creative and original ideas. As part of curricular activities, engagement in the school provided a powerful contextual scaffold to learn. This study found that the parents, teachers and students meaningfully engaged in the school as a part of sanitation and handwashing as a part of participatory action research. This finding is similar to the view of many scholars as to the positive role of imparting education in leading students to the lesson (Jang et al., 2010).

Similarly, Oludipe and Awokoy (2010) and Ongeri (2017) argue that the chalk-and-talk technique of teaching is ineffective due to its less contribution to students' academic performance, who are passive and mere recipients of bookish knowledge. It was found that activity-based learning positively affects students' learning as achievement scores increase in examinations. Students and teachers learn through collaborative activities and link with the theoretical part. This argument was in line with other research findings (Fencl & Scheel, 2005), who focused on the principally used for students' learning activities. Although some researchers found activities could positively impact students' awareness of learning and understanding of the concepts (Fontes & Piercy, 2000). Previous studies by Furlan (2009) suggested that sanitation activities positively affect students' learning and satisfaction. Previous studies by Furlan (2009) suggested that sanitation activities positively affect students' learning and satisfaction.

Reflections on Participatory Action Research and Sustainability of the Interventions

Participatory action research (PAR) supports sustainable development by providing the means to create transformative backgrounds for students' participation and engagement. The operational practice is a part of a wider action research paradigm that accompaniments qualitative and quantitative research through the interventions related to sanitation in public schools. Studies showed that the major cities in Nepal lack water resources and increase environmental pollution. Drainage from the residential areas is directly mixed with water. Studies showed that applying human urine and excrement as agricultural fertiliser (Heinonen-Tanski & van Wijk-Sijbesma, 2005; Kumwenda et al., 2014) proved that it is not a waste of a resource. It controls water pollution. Applying human urine and excreta in the agricultural field produces nutritious food and minimises the purchase of chemical fertilisers. Therefore, considering the country's miserable sanitation and hygiene situation, there is an emerging need for a holistic approach to call for hygienic, sustainable and eco-friendly, hence the Eco-san toilets option. Sanitation and hygiene promotion is crucial in changing collective and individual behaviours and fostering ownership and sustainable use of knowledge, practice and praxis (Dumba et al., 2013). To promote hand sanitation and hygiene, the management and use of the technology and services of the systems must be implemented correctly. It promotes sanitation and hygiene behaviour (Haque & Freeman, 2021). It works on the premise of school and community to gain awareness of water, sanitation and hygiene through participatory activities and develop and carry out a plan to improve the situation (Dumba et al., 2013). Students' engagement in sanitation provided all the roles to the community by discouraging the top-down policy implementation approach. The bottom-up implementation perspective emphasised that the work done is sustainable and the community-owned the experience of that achievement. The knowledge transformed from the school to the community, and thus it can be claimed that PAR helped the sustainable development of society.

Participatory action research is entrenched in the postcolonial and postmodern critiques of power, informing Freirean pedagogy and emancipatory social science

(Keahey, 2021). Although this study is based on a postmodern philosophical paradigm, it focused on students' engagement in the class, handwashing stations, and the garden. In this line, teachers transformed the social relations of knowledge production by shifting research control to local stakeholders who understand the issue at hand (Keahey, 2021). Power-sharing is achieved through a socially reconstructive participatory inquiry and democratic decision-making methodology (Ammentorp et al., 2018). As a part of the sustainability strategy, teachers mobilise students and parents as companies to incorporate grassroots knowledge, empowering students and parents to develop practical solutions to sustainability problems. Information related to the main essence of the study, like participatory teaching on handwashing with soap, proper use of the toilet and application of human urine as agricultural fertiliser for sustainability. Through a series of participatory activities over three years, the transformation and sustainable use of handwashing with soap was explored. Eco-san technology is also implemented through classroom teaching, learning, and field-based activities using a participatory approach. We (researcher and co-researchers) explored the motivations and changes in classroom teaching and learning practices through a series of participatory activities over three years.

Further, this study suggests that participatory action research is an effective methodology for transitioning to sustainability. The Eco-san system with urine-diverting mode was implemented for the sustainabile solution with technological and educational components necessary for transforming students' sanitation and hygiene behaviour. It created sustainable sanitation in the action school. However, the intervention practices still require more and continuous strengthening for sustainability. This is mainly due to managerial, technical and financial sustainability constraints. The continuity of tailor-made participatory curriculum, classroom practices, course preparation, lesson plans before taking class, and theoretical and practical demonstration classes are also in the process and they need to be further strengthened. But it is observed that students and teachers use water and soap for handwashing after a long intervention. It is a good part of the sustainability of the PAR study.

Furthermore, teachers and students faced some challenges, like sustainable soap management at handwashing stations and toilets and urine collection in the urinal chamber in the school. In this line, Sukadari and Huda (2021) discuss the emerging field of sustainable development and participatory action research across disciplines, topics, and regions where grassroots efforts are embedded. PAR intervention in the action school changed the process of social dialogues and engagement of students.

Reflection on Theoretical Analytical Framework

This study is based on a completely transformative participatory worldview (Mertens, 2010; Wood et al., 2019) that was done following the three principles: i) democratic principle (Bherer et al., 2016), ii) Social justice principle (Kaushik & Walsh, 2019; Mertens, 2007), and iii) collaborative reciprocity and improved social practice (Jones & Brazdau, 2015). The study was not blended on any already prescribed or developed theory. The reflection obtained from this study cannot be studied based on any established theory in participatory action research. However, as a theoretical backup, the Integrated Behavioral Model for Water, Sanitation and Hygiene (IBM-WASH) influences the PAR interventions and results in the action school. The IBM-WASH model is specifically linked with PAR intervention with hand hygiene-related findings, the application of ecological sanitation and perceived changes.

Integrated Behavioural Model of Water, Sanitation and Hygiene (IBM-WASH). We used the Integrated Behavioural Model for Water, Sanitation and Hygiene to guide the intervention activities concerning sanitation and hygiene-related knowledge perceived importance of handwashing with soap at critical times, and urine diversion toilets use during the school hour. The handwashing and toilet facility were linked to the school premises. Factors presented in the IBM-WASH guided on knowledge, perception and practice and related facilities identified in three domains (contextual, psychosocial and technological) (Dreibelbis et al., 2013a; Hulland et al., 2013). The participatory intervention sessions were conducted at the intrapersonal and interpersonal levels under the contextual domain to increase knowledge and motivation on sanitation and hygiene (Erin et al., 2017; Thomas et al., 2020). Likewise, technological factors such as handwashing stations, water taps, soap cases, and toilet facilities were repaired, and some of them were newly constructed. Under psychosocial factors, intervention activities were conducted collaboratively at different levels (habitual, individual, interpersonal and school). Classroom lessons related to sanitation and hygiene using information education communication materials and demonstration classes. In addition, indoor and outdoor activities (drawings, storytelling, sanitation fair, YouTube video display, role play, singing song) were also conducted collaboratively based on the participatory local curriculum. This study's interventions were consistent with previous studies conducted in different parts of the world (Bastien et al., 2016; Nizame et al., 2016; Parvez et al., 2018; Thomas et al., 2020). Likewise, the study conducted in Bangladesh provided extensive school-based interventions such as technological-based interventions, handwashing supplies, cleansing materials, sanitation and hygiene promotion messaging and IEC materials to familiarise and habituate students to adopt good hygiene practices (Rahman et al., 2019).

This interventional participatory action research revealed that the students, after interventions, were better aware and performed better on hand hygiene practice than before. Psychosocial factors (self-efficacy, knowledge, disgust and perceived threat), contextual factors (access to handwashing facilities, regular running water, soap) and technological factors (demonstration, capacity build-up) positively influenced the performance of hygiene behaviour of the students. These findings are consistent with the findings of a systematic review conducted by Robert Dreibelbis and other similar studies (Bastien et al., 2016; Dreibelbis et al., 2013a; Parvez et al., 2018; Thomas et al., 2020). However, contextual and technical factors (hygiene lessons, handwashing facilities) are associated with the performance of poor hygiene practices. This study showed that some students were not aware of proper handwashing skills as recommended by WHO, and knowledge regarding handwashing correctly was a major barrier at a critical time related to the psychosocial dimension of IBM-WASH at the individual level. Compared the studies carried out in other countries (Ghana, India and Bangladesh) recorded better performance toward hand hygiene awareness and handwashing practice with soap (Dajaan et al., 2018; Gawai et al., 2016; Parvez et al., 2018).

Cross Collaboration in PAR Activities in the School

This study entitled 'use of ecological sanitation toilet in transforming sanitation and hygiene behaviour of students at the basic level in Chitwan district of Nepal' follows participatory action research methodology that helps students to develop collaboration and sharing culture. Basic level students developed the habit of washing hands with soap and water, especially before a meal and after toilet use and cleaning toilets, classroom and school compound. More importantly, the students improved their health status by using eco-san technology, producing organic vegetables from the school garden, cooking them in their school canteen and eating them as a midday meal. This study helps nutrient cycling in the soil-plant ecology, an essential constituent of sustainable Eco-garden and agriculture. Human urine helps restore the nutrients removed from the soil by crops, leaching, and erosion. But the importance of the major and minor nutrient content in human urine (e.g. phosphorous) has never been realized as an alternative source of fertilizer for crop production. The introduction of UDTs in the action school shaped prospects for sanitation and hygiene and recycling human urine as fertilizer. This PAR study uses human urine in the Eco-garden in an action school to grow green vegetables like radish, cauliflower, grout, cabbage, coriander, cucumber, pumpkin etc. Organic productions from the school Eco-garden are supplied in the school canteen. Students consumed healthy foods produced from the Eco-garden where human urine (in different ratios) is used as fertilizer.

Human urine is as effective as a fertilizer and can be used as an efficient source of plant nutrients. The efficacy of urine increases in association with Phosphorous (P) and potassium (K) from human urine in the soil. It is shown that green vegetables are grown using human urine as fertilizer with significant production or yield. UDT helps in safer sanitation and recycling of human urine as fertilizer, which ultimately helps reduce the food emergency by increasing crop yield. Not only WASH and Eco-san issues, the other activities like making IEC materials and creative arts in the school, students' dialogical changes and creative thinking skills are increased.

As a part of the study, the primary goal is to improve basic school students' sanitation and hygiene behaviour. The practice of handwashing with soap and using the Eco-san toilet aimed to promote the students' health by developing knowledge and skills in using human urine as an agricultural fertiliser in the school garden. It helped produce organic vegetables, cooking them in the school canteen and incorporating them into the students' mid-day meals. A comprehensive assessment of the current school curriculum, its specified content and teaching methods, professional teachers and physical facilities was done. The school curriculum is inadequate for hand hygiene, ecological sanitation, eco-san toilet, urine fertiliser, a drip-irrigation system plant and a school garden. Also assessed adequate water for handwashing, land for Eco-garden and suitable space for eco-san toilet construction. This part considered the handwashing behaviours while the students were in school. It mainly focused on the handwashing place/stations, the timing of handwashing materials, students' perceptions of handwashing stations, and water availability at hand washing stations and toilets.

Health and hygiene are one of the most important factors of this study. Concerning hygiene, the students prepared sanitary pads that were used properly. It maintains hygiene among teenage girls and decreases the school's absence rate. The cultivation experienced that Eco-garden activities provide opportunities for engaged learning, focusing on students' and teachers' appointments and interaction instead of the excessive use of sermons in the basic level public schools in Nepal. There is a good cross-collaboration and multiple effects of Eco san in an action school. This application of human urine in the Eco-garden helps to cultivate green vegetables. It is linked with school students' nutrition as a midday meal through the school garden. Collaborative cultivation practice using urine fertilizer in the school's Eco-garden and thus it is linked with the social entrepreneurship development of parents, children and teachers. The income from selling vegetables produced from the school garden using urine fertilizer has been able to manage sanitary materials (soap, *harpic* / detergents, toilet brush, brush, etc.). Still, it has also created a sanitary fund in the school. Wash and hygiene are related to preparing sanitary pads and their appropriate use in schools and homes. It developed menstrual hygiene. Interconnection among these factors is shown in figure 8.1.

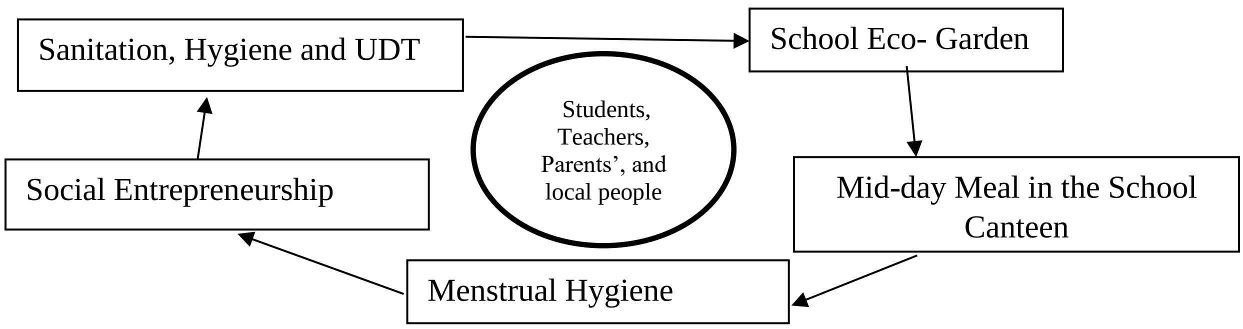

Figure 8.1. Interconnection among the PAR Interventions in the School

Challenges with Implementation of the Participatory Action Research

While conducting participatory action research in the action school, the major challenges from the beginning of the PAR study were building relationships with the co-researchers like teachers, students, parents and the local people. Another challenge was acknowledging and sharing power among them and encouraging participation and engagement during activities. In this aspect, Irizarry and Brown (2014) said that the main challenge of PAR is to create harmony among the co-researchers. The major challenge was exploring the issues researchers and participants face when engaging in sanitation and handwashing practices. Negotiation processes and sharing are the ways of resolution by co-creating meaningful activities that arise from students' and teachers' lived experiences. Due to the subjective nature of the study, developing trust among the co-researchers was a challenge (Husni, 2020). During the study, we reflected on power issues, self-reflexivity and the potential to develop credible accounts that can be supportive and transformative.

Main challenges in this study were negotiation processes, and identified skills for building relationships a must, acknowledging and sharing power, encouraging participation, making change, and establishing credible accounts. As we discuss each area of challenge, we present pictures from our research that could serve as examples and possible strategies for achieving the goals. Mutual faith between the researcher and co-researchers is essential to successful outcomes in a PAR (Wilson et al., 2018). If participants do not trust and do not respect each other, they would hesitate to collaborate with the researcher. All research participants' mutual relations and efforts are required in PAR study. Though the students were equally interested in participating in this study, they engaged in classroom study and could not attend all the sessions of this PAR. Also, students sometimes felt dominated and felt inferior to participating in session activities due to unequal power relationships among teachers, the SMC chairperson, the headteacher, and students. Furthermore, the insufficient research skills of students caused teachers to take more control over the research process, especially during field engagement. As a co-researcher, I negotiated with them that it was possible even in their regular classroom teaching if participatory sanitation and hygiene pedagogies were connected.

Furthermore, schools' dependence on funding from peripheral sources is another challenge of participatory action research. PAR has been progressively viewed as a fundamental approach to increasing students' sanitation and hygiene behaviour. Methodological challenge was also there as it was time-consumin (Dubois et al., 2022). The research methods of this study were decided by mutual agreement between the co-researchers and the students. Despite the vital role of all the strategies adopted in this study, junior grade students have not participated in some activities like solid waste management due to health perspectives. Therefore, this study has not included their views and reflections. Additionally, this study demanded a more iterative and cyclical process which took more time and tremendous commitment from the research participants. Moreover, it is also challenging to triangulate data from different data sources, theories, and methodologies.

Ethical challenge was also there in this study. It was not free from a breach of confidentiality, given that it engaged more research participants, especially in the implementation phase of this study. Lack of confidence in maintaining the facts of work done, lack of equal participation in PAR activities, the occasional practice of not washing hands even after toilet use and before eating and did not collaborate with friends. However, the collaborative works conducted in this study are relatively open, increasing the risk of exposing participants' identities. As this study period is long and there are many groups, there is no vital confidentiality. Another challenge we faced in this study was the planning timeframe. The PAR method of this study was time and resource-intensive and involved a high degree of personal collaboration on behalf of the researcher. The researcher must develop a close working relationship with co-researchers conducive to sharing ownership. As a PAR researcher, I coordinated multiple activities and facilitated dialogue and knowledge exchange among participants. Sometimes it is tedious, and thus the researchers might frustrate to continue with the study.

. The students and teachers organised several sensitisation/awareness sessions, promoting and using better sanitation and hygiene practices and effective interpersonal communication among all PAR teams. Motivational videos were organised, and different behaviour change communication (BCC). IEC materials were used and available among the teachers and students conducting classroom teaching in the school found it exciting and saw it as relevant. We were encouraged to take what we have learned from teachers and seniors through the child-to-child approach. It is claimed that practical IEC materials development related to hand hygiene and Eco-san, participatory local curriculum, teacher manual, and the school's Eco-gardening and handwashing facilities improved the sanitation and hygiene behaviour of the students and other research participants. Different cycles of the PAR interventions covered the views on the negative perception of the Eco-san and poor handwashing practices at different critical times (before meals and after toilet use). The overall sensitisation/awareness sessions are practical due to the participatory tailor-made course developed, considering students' urgent needs and using IEC materials constructed collaboratively. This sensitisation model is good considering the overall sanitation and hygiene sensitisation sessions.

However, the intervention practices still require more and continuous strengthening. The area of sustainability is still weak. This is mainly due to managerial, technical, and financial sustainability constraints. The continuity of tailor-made participatory curriculum, classroom practice using IEC materials, lesson plan before taking class, and theoretical and practical demonstration class side by side are only in the process waiting for their continuation in a sustainable manner.

Similarly, the Eco-san system has observed problems with regular urine collection, proper storage, treatment, dilution, and urine supply with a drip-irrigation system. For example, i) prolonged school closures due to unforeseen circumstances such as the COVID pandemic, lack of human urine, forcing to use other fertilisers (animal dung, chemical fertiliser), ii) collecting pure urine in the safety tank and taking at least one month for the treatment, iii) to dilute urine and water in the appropriate ratio, and iv) sometimes the check valve breaks, the valves were closed when supplying diluted human urine from the drip-irrigation system.

The present study concludes that public schools in Nepal need to construct Eco-garden as a resource for learning and earning. Teachers, students, and SMC members realise Eco-garden activities play an important role in sharing the knowledge and skills connected with garden activities to students as a framework for learning. The cultivation experiment found a difference in the weight of vegetable biomass produced from the plots using human urine as agricultural fertiliser, comparable to biomass with the plots using animal fertiliser. If the urine collected from UDT could replace chemical fertiliser, the money spent buying chemical fertiliser would be saved. Further cultivation experiments on using human urine proved that the performance of human urine as agricultural fertiliser is good.

The cultivation experience demonstrated that Eco-garden activities provide opportunities for active learning, focusing on students' and teachers' engagement and interaction instead of excessively using lectures in classroom teaching. Finally, a small but strong suggestion would be to construct an Eco-garden in every public school and grow vegetables that help provide nutritious food for the school children in mid-day meals.

During the second phase of participatory action research, the researcher and co-researchers collaboration was more pragmatic since practical issues needed more interaction, participation, and enthusiasm. This PAR was more important in steering and forming the interventions collaboratively, which was effective. During the implementation phase, the researcher and co-researcher expressed some astonishment about active participation in sanitation and hygiene, mainly focused on handwashing with soap and the ecological sanitation system in the school. However, we faced some challenges, like sustainable soap management at handwashing stations and toilets and urine collection in the urinal chamber in the school. Along with implementing handwashing facilities and urine diversion toilets, the participants showed an improved understanding of the importance of HWWS and the Eco-san system in school.

Consequently, we succeeded in developing sanitation and hygiene-related IEC materials, participatory tailor-made courses, teacher manuals, and necessary infrastructures to promote the students' sanitation and hygiene behaviour. After implementing the PAR interventions regarding hand hygiene and using UDT with urine-diverting mode, the research participants' behaviour found more collaborative research processes. It has led to the empowerment of the participants and confidence-building in themselves. The implementation phase developed more innovative and experiential learning through technological and educational-based interventions (Sandberg & Wallo, 2013). However, the path was not straight but complicated as there were challenges with time management, cultural belief on human urine fertiliser, and technical problems with the Eco-san system instalment. Though the journey was long with a duration of nearly four years and we were sometimes annoying, there are no motivational problems to engage in PAR activities due to its practicality and behavioural importance. Realising the collaborative engagement through educational-based sanitation and hygiene sensitisation/awareness sessions, infrastructure development and behavioural/ application-based session minimised power hegemony between the researcher and co-researchers and teachers and students throughout the study (Ritchie et al., 2013). It was also crucial for developing ownership of sanitation and hygiene behaviour change during and after PAR interventions. In addition, the enactment of PAR interventions was a rich learning opportunity for all of us to improve our knowledge and skills. It was worthy of developing a sanitation and hygiene education course, teacher manual, IEC materials, Eco-san and hand hygiene-related infrastructure development, and urine fertiliser in the school garden. Indeed, students benefitted from improving sanitation and hygiene education-related knowledge through experiential learning with full participation. Teachers also reflected that the intervention activities implemented in the second phase of the PAR stimulated and encouraged them to adopt the school's participatory and contextually relevant SHE strategies.

I got more reflections and insights from the Eco-san activities. I enjoyed the joyful participation of the participants in experiential learning. Similarly, cocreation knowledge, personal and interpersonal learning, mutual understanding, democratic participation of all co-researchers, a way of balancing research and actions side by side, collaborative findings rather than ask and say, and improvisation with self-reflection were the key features I loved in the PAR activities.

Based on the assessments of various interventions after three years (2018 August to 2021 July), positive changes in handwashing behaviour and perception towards Eco-san have been found. It turns out that negative attitudes seemed to be the biggest, most difficult to tackle. However, as it slowly becomes clear that the nutrient value of human urine is recovered from wastewater, Eco-san technology is gradually being developed. Attitudes regarding human waste as a resource are slowly softening, urine diversion toilets are being developed, and nutrient recovery from wastewater is reaching new solutions. In the construction of the Eco-san /urine diversion toilet, school, community and local government authorities cooperate to transform the school's ecological sanitation system. Organic fertiliser use has become more popular as the practice is deemed safe and effectively produces organic vegetables from the school garden. Eco-garden-based pedagogy is used in the school. There is a potential for human waste energy to be used in schools and neighbouring communities that may scale the system. Developing soil nutrients by converting human faeces into fertilisers will be the subject of further study.

The toilet slowly changed 'drop and flush' into 'drop and treatment'. This leads to ecological sanitation becoming a part of the school system, as it is the most cost-effective way to utilise the human waste in the school garden. The toilet norm is changing slowly to a more acceptable standard, where the flush toilet is mindless, and more attention is being paid to mindful Ecological sanitation toilets. Also, humanure use displaces the excessive use of chemical fertilisers.

Impact of COVID-19 pandemic in the study. The COVID-19 pandemic has affected my PhD research. This is mostly because it took more than three years to get them to work collaboratively, but collaborative work was disrupted due to the lockdown. I have put several data collection methods on hold and there was a delay in writing and conducting intervention on time.

My research uses field-based method which required face-to-face data collection. So, I have had problems with data collection. However, the needs assessment phase, or the first phase of PAR, was completed without any adverse effects of the COVID-19 pandemic. After conducting a needs assessment results sharing workshop and conducting various intervention activities along with needs prioritization, the COVID-19 started in Nepal. Because of that, I shifted my focus a little to my PhD research plan. Qualitative data were collected after intervention through online mode/ virtual mode. However, the post-intervention questionnaire survey was impossible as it needed all the basic-level students. The intervention phase was affected as the students were less in the class, and collaboration was complex due to personal protection. Thus, the sensitization part of the study was weak due to the pandemic.

The cultivation experiment conducted using urine fertilizer in the school's Eco-garden could not remain untouched by the effects of the pandemic. During the school closure, urine was unavailable as the students were at home. Thus, the urine fertiliser cultivation experiments in the school's Eco-garden were adversely affected. Because the parents were empowered, cultivation continued regularly in the school's eco-garden, albeit using animal fertiliser. After the lockdown and school started, urine started flowing again. Then I completed the re-cultivation experiment using urine fertiliser. Also, the participatory curriculum was prepared, and due to the lockdown, class engagement based on the designed curriculum was interrupted. Furthermore, participatory preparation of IEC materials was delayed due to the lockdown; thus, I prepared the manuscript and thesis chapters during that time. When things were back to normal, and then I continued my research.

Chapter Summary

This chapter synthesised the overall research findings of the study and interpreted the conclusions. Students did not know enough PAR knowledge, especially about handwashing and ecological sanitation. Students were unaware of ecological sanitation, but very few understood human excreta not as waste but as a resource. The school curriculum does not incorporate human urine and excrement as a fertilizer. It was found that there was no practice of washing hands with soap and water before eating and after using the toilet at school. Before the intervention, teaching and learning were teacher-oriented, over-relying on the lecture method. The school teachers rarely practised lesson plan preparation. After identifying such a situation, intervention sessions (sensitisation/awareness sessions, technological/infrastructure development sessions, behavioural sessions, and activity-based teaching-learning activities) were conducted with the full participation of the learning community or stakeholders for more than three years. The study applied a multiphase-mixed method participatory approach and went through research and fieldwork side by side.

Furthermore, research participants (students, teachers, SMC/PAR committee members, students' clubs, and parents) had an amazing role in participation and collaboration during the PAR interventions. I claimed the PAR transformed the status of passive classroom pedagogy into activity-based learning and enhanced students' performance by implementing a participatory local curriculum and teacher manual. It is also found that the participatory action research methodology helps students to develop collaboration and sharing culture. Similarly, students developed the habit of washing hands with soap and water, especially before a meal and after toilet use and cleaning toilets, classroom and school compound. More importantly, the students improved their health by using eco-san technology, producing organic vegetables from the school garden, cooking them in their school canteen and eating them as a midday meal. Even more interesting is that under social enterprise, the students have managed soap at the school's handwashing stations and in toilets and toilet cleanliness materials (detergents, brushes, gloves, etc.) by selling more vegetables in the market than they need in the canteen.

Chapter 9. Conclusions and Implications

This chapter draws the conclusions and implications of the participatory action research on sanitation and hygiene through urine diversion or Eco-san toilet in a public school in Nepal.

Conclusions

The present study concludes that public schools in Nepal are capable of inculcating healthy habits among the members of school community and educating children in sanitation and hygiene through a sustainable Eco-san toilet and Eco-garden. This means schools could construct Eco-garden as a resource for learning and earning and the garden could be maintained through the urine as a fertilizer. Eco-garden, as it yields green vegetables that can be supplied in the school canteen and is a good source of income for the school, can contribute to provide nutrition to the children and the surplus could be used to generate income for the school. Teachers and students understand that Eco-garden activities play an important role in sharing the content knowledge in actual field for lifelong learning.   At the community level, the Eco-garden could also be a source of income for economically poor parents. It was also found that the perceived benefits of UDT and Eco-garden and the application of human urine as an agricultural fertiliser in the school garden shifted from traditional farming and classroom pedagogy into the students' engagement practices.

If the urine collected from UDT could replace chemical fertiliser, the money spent buying chemical fertiliser would be saved and it could be used for other essential activities in schools. Eco-garden activities provide opportunities for active learning, focusing on students' and teachers' engagement and interaction instead of excessively using lectures in basic-level public schools.

Human urine is used in the Eco-garden following certain steps and the urine is a source of nutrition for the vegetables in the garden, students can practically learn how plants are grown through experiential learning. In this study, the entire school family was enthusiastic about garden pedagogy and everyone learned through collaboration participating in various activities. Teachers developed skills in participatory teaching and implemented activity-based learning. Eco-san-based sanitation and hygiene pedagogy, including cultivation practices such as identifying the effectiveness or benefits of urine fertiliser and promoting sanitation and hygiene behaviour through UDT, is memorable and skill-based. Engaging in garden activities helped all co-researchers teach and learn different activities, such as handwashing with soap skills and developing guidelines on using UDT and urine fertiliser. It was a reach learning opportunity for all the co-researchers.

The study found that using urine fertiliser for school gardening could also produce an entrepreneurship model because of the production of greater organic products (vegetables, for example) than using other fertilisers.

Further, the urine diversion toilet has improved the school's sanitation behaviour and condition. Also, urine fertiliser produced from UDT was employed as nutrients for vegetables planted in the school garden without any issues in school sanitation. The students' and teachers' meaningful engagement in sanitation and hygiene behaviour change activities inculcated awareness of school sanitation and the importance of personal hygiene. It was also found that reflections and insights from the Eco-san activities provided input to obtain the effective outcomes like using the model urine-diverting toilet and urine fertiliser to be used in the school garden. Such an innovative solutions to sanitation could emrge through collaborative actions in school.

As the findings of the study illustrate, knowledge co-creation, personal and interpersonal learning, mutual understanding, democratic participation of all co-researchers, balancing research and actions, and minimising the top-down initiation are the key parameters of the PAR activities for collaborative learning. Students' engagement in garden activities proved that such a learning is productive and it contributes to better learning experience. Additionally, gardening activities increase awareness of seasons, insects and other animals among school students.

Moreover, participatory action research activities related to sanitation and UDT to contextualise teaching and learning through indoor and outdoor sessions were effective in this study. It was found that the study was a critical and emancipatory approach to conveniently implementing hand hygiene and urine-diverting toilets in the public school setting for the research participants. Implementation of the PAR was mainly designed for educational, technological and behavioural interventions. The students happily accepted the innovations due to the co-creation of knowledge through sensitisation and observing handwashing skills and Eco-san on the school premises.

This study incorporated features such as participatory and activity centered teaching methods, building trust and collaboration, and co-creating knowledge by observing the Eco-san innovations in the school. The pedagogical approaches mainly focused on handwashing with soap and urine-diverting toilet use interconnected in the classroom teaching. The interventions used a variety of strategies to promote handwashing with soap and sanitation behaviour of students, including songs and drama. Also, drawing, sanitation fair, sanitation campaign, infrastructure development and demonstration were conducted effectively. This indicated that learning can take place anywhere and anytime, if a connection is built between what to learn and how to learn in context. This study provided a platform for learning in real-life situations.

Motivational videos show was organised and different behaviour change activities were implemented. IEC materials were used, and they were made available for the teachers and students for classroom teaching and learning in the school. Both teachers and students found them exciting. Co-researchers were encouraged to draw lessons from what we have learned from teachers and seniors through the child-to-child approach. The overall sensitisation/awareness sessions were practical due to the participatory tailor-made course developed keeping in view the urgent need of students and using IEC materials constructed collaboratively. However, continuation of all these innovations in health education still needs to be worked out for a sustained impact.

Implications

This research has several implications for transforming the mode of school teaching into the meaningful engagement of students through sanitation and hygiene practices. First, it is critical to focus on students' engagement in learning activities. Direct involvement in sanitation, solid waste management and using urine as a fertiliser in the school garden provides the context for meaningful learning experience. Second, to increase the student’s learning and engagement, it is crucial to encompass schoolteachers in these activities to transform pedagogical practices.

The major implications of this study are discussed here:

Implications to practice related to sanitation and hygiene. Sanitation and hygiene in public schools in Nepal is a major issue and this study has tried to address that issue through an intervention. This study offers the techniques and knowledge of sanitation and hygiene through the intervention in the action school which improved the access to handwashing facilities and school toilets. As the Eco-san concept promotes the hygienic behaviours of basic-level students and teachers and it enhances the well-being of students, teachers, their families, and neighbours, such a model could be replicated in other schools of Nepal.

As the study demonstrated, Eco-san toilet contributes to healthy and secure school environments that protect children from illness, abuse and exclusion. The knowledge generated from this research could be used to educate and inform head-teachers and teachers about the environment-friendly Eco-toilet and its contributions to school health, sanitation and building healthy behaviours among the students nd teachers. More importantly, experiential learning through sanitation and hygiene education (SHE) and garden pedagogy could be incorporated into teachers' professional development packages.

Integration of life skills and soft skills in school education is a highly talked topic among the school stakeholers in Nepal. Curriculum Development Center (CDC) has also emphasized including life skills and soft skills in the curriculum of all subjects as cross-cutting skils. As this study demonstrated, such skills could be fostered and nurtured through experiential learning in a school setting by engaging them in school garden activities. Thus, concept of Eco-garden could be included in the health education curriculum to promote awareness about the life skills, collaborative inquiry, and gardening skills. that

This study finds that Eco-garden activities provide opportunities for active learning, focusing on students’ and teachers’ engagement and interaction instead of excessive lectures in basic public schools. This finding helps to transform the pedagogical resource as a powerful strategy to change school practices and link formal education with a sustainable community with the long-term aim of meeting SDGs. However, the garden concept needs to be scaled-up, independent and comprehensive. As a participatory action researcher, I recommended that the collaboration among the students, teachers, and parents work together for joint practices needed to transform teaching and learning in the public schools in Nepal.

Sanitation and hygiene programme in the action school contributed to expressively decreases hygiene-related diseases. The intervention increased school attendance and contributed to students’ dignity and inclusion. SHE in schools promotes equity. These activities improved hygiene practices promoted by sanitation and hygiene in school activities. based on this finding, as a PAR researcher, I recommend that every school in Nepal launch hand hygiene and ecological sanitation activities so that students maintain hygiene.

This Participatory Intervention (PI) model needs to be replicated in Nepal's public-school setting. But the school should have enough running water and land available for Eco-san system installation. Since the main component of the local curriculum prepared during this study has been incorporated into the mainstream curriculum of Nepal, this project model is to be scaled up nationwide. The local curriculum prepared during this study, related IEC materials, teacher manual/guidelines, and urine application guidelines can be supporting materials in the scaling-up of the program.

Knowledge co-creation, personal and interpersonal learning, mutual understanding, democratic participation of all co-researchers, a way of balancing research and actions, and minimising the top-down initiation of the PAR activities for the collaborative work are the study's major highlights. This implies that students' engagement in real-life activities including in the Eco-garden activities is productive. In this study, Eco-gardening activities increased awareness of seasons, insects, and other animals among the basic public-school students. Thus, teachers could provide opportunities for students' meaningful engagement in activities to facilitate improved health habits.

Ensuring gender-friendly and inclusive UDT and hygiene facilities to all the schools in Nepal is needed for equitable access to education and MOEST needs to identify strategies to create gender-friendly and inclusive environment in schools by introducing the innovative practices such as Eco-san toilet. Also, it is recommended to improve hand hygiene and Eco-san practices in schools, households and communities through training, encouragement and communication for development.

Further, the capacity upgrading of local people, headteachers, teachers and students by incorporating Eco-san and handwashing programmes through local education policies is needed. It is also recommended that the public schools launch campaigns on Eco-san and handwashing activities to change social norms and increase awareness of the importance of good sanitation and hygiene. Further, the dissemination of knowledge of the use of human urine as a fertilizer and capacity upgrading for public schools on improving the condition of mid-day meals for sustainable school development could promote healthy behaviour among people.

Research findings inform that the development of change-oriented teacher identity occurs within schools, which creates a strong learning environment allowing experiential learning and provides a communicative space that enables students to reflect on their experiences. The teachers of the action school now understand that proper planning is important and should consider a broader view of the curriculum for enhanced learning experience. In situations where the curriculum is highly prescribed, universalised and rigid, as in Nepal, we found that practitioners need to understand the curriculum contents from a broader perspective to transform the pedagogies. Exercise in conducting syllabi analysis broadens the understanding of the curriculum content and thus introduces broader themes in planning outdoor tasks. Teachers' capacity development in analysing the curriculum and contextualize the pedagogy in their working context is something that could be done in the future capacity building programs of the teachers.

Considering the overall assessment of the sanitation and hygiene sensitisation sessions, the sensitisation model was good in this study, and thus such activities need to be implemented in schools and community. The continuity of tailor-made participatory curriculum, classroom practice using IEC materials, course preparation lesson plan before class, and theoretical and practical demonstration classes meed to be promoted in schools. The TPD model of teacher training could integrate PAR to promote these activities as a part of the professional development activities.

Theoretical implications. Several contextual, psychosocial and technological factors influence the use of handwashing stations at five aggregate levels, from habitual to societal/structural. From the beginning of developing infrastructure-based interventions, the technical aspects such as the height of water taps, soap cases and distance between HWSs and toilets affect the handwashing behaviour of students. Likewise, poor hygiene practices seen due to the small number of water taps and HWSs, the unavailability of soap, uneasiness about opening water taps at HWSs, and cleanliness materials were the issues related to the contextual and technology factors of IMB-WASH. Using the construct outlined in IBM-WASH helped us identify key components of behavioural, technological and contextual interventions influencing the behaviour change in the school setting. Though the intervention mapping was considered during the implementation of the PAR intervention, the implication of three domains, including five levels of the IBM-WASH framework, is required for appropriate handwashing facilities and improvement of the handwashing rate among the school students.

It is clear from the study findings that a reliable source of soap management is needed to keep handwashing behaviour sustainable and effective. IMB-WASH's theoretical construct states that whatever intervention model is adopted, the different domains of IBM-WASH (psychosocial, contextual and technical) must be addressed. The research findings showed that despite social enterprise was developed through the income from the school's garden, the regular soap availability of soap and detergents at HWSs and toilets was remarkably poor. Therefore, multilevel (habitual, intrapersonal, interpersonal, school/community and societal) interventions, including another entrepreneurship, must be implemented.

Intended beneficiaries were often made aware through classroom lessons, Ecosan messages, sensitisation workshops, excursions to the Eco-san project implemented area, and demonstration of model UDT and Eco-garden in the school. Then, acceptance of Eco-san made by intended beneficiaries was affected most by perceived relative advantages over other sanitation options and observability of transformed human urine into agricultural fertiliser.

Regarding Eco-san in particular, we used participatory methodology to demonstrate the importance of Eco-san in ensuring the utilisation of UDT and urine fertiliser in the school's Eco-garden. As a researcher, I suggest that based on recent observations in the intervention school's Eco-san implementation, Eco-san promotion to a bottom-up approach rather than a top-down approach is recommended. This is because the participants expressed willingness to accept the Eco-san system if they get knowledge and possibilities to observe the idea. Then they saw the advantages and adopted innovation in the school setting. Therefore, to sustainably diffuse the innovation i. e. acceptance and utilisation of Eco-san in this case, the implication of diffusion of innovation theory's construct is required.

Research implications. The participatory action research provides students and teachers a credible solution to ecological sanitation and hand hygiene. It allows co-researchers to examine their teaching and reflect upon their instructional strategies to improve best practices. Schools and higher-education research institutions and research practices in Nepal often follow traditional ways of teaching and learning. PAR is best positioned to create research-informed evidence in school and university education. As a participatory action researcher, I experienced that PAR has the potential to bring together research participants like teachers, parents, local leaders and community people from different sectors and perspectives to collaborate to transfer pedagogy. Collaborative research has the potential to break up dogmas and stereotypical pedagogical orientation and transform them into activity-based learning. The PAR study allows students and teachers to build trustworthy relationships and unites for a common understanding. They might collaboratively design, research, and integrate various perspectives through such processes. Hence, the chances are that research results will be meaningful and valuable to community improvement.

Participatory action research is an ongoing, cyclical process in which the teacher has the autonomy and authority to change their classroom significantly. It is important to reminisce that PAR is not as formal as traditional research as it is conducted for a certain duration, allows for more flexibility, and usually includes qualitative and quantitative data. This type of research enables the practitioner to make effective changes in literacy instruction. In such research, reflections drive inquiry, and the positive or negative results foster insight into the dynamics of teaching and learning. Based on this, it is recommended that it would be better to apply such research to address educational issues in the public schools of Nepal. It is necessary to conduct further participatory action research to understand teaching and learning through students' engagement.

Future research should involve many teachers and students, additional grade levels, additional subjects, and additional environments. This additional research might further help to answer how the school's Eco garden helps in activity-based learning in different contexts. In addition, further research is needed to understand the perspectives on the relationship between theoretical understanding and real field experiences.

Likewise, student and teacher participants are not only aware of the contents of the textbook but also the hand hygiene and Ecological sanitation-based curriculum.

In addition, learners could have more chances to learn more in-depth knowledge related to hygiene and Eco-san activities blended into the curriculum to better implement theoretical knowledge into the actual field. This study suggests that research needs engagement in the field with the co-researchers. Findings demonstrate that teachers and students are interested in activity-based engaged pedagogy that could be implemented from the policy level. Curriculum designing, conducting the teachers' professional development and policy formulation concerning the pedagogy in the schools would be beneficial. Policy-level people, subject experts, Ministry of Education, Science and Technology, Curriculum Development Centre, National Health Education Information Communication Centre, etc., can encourage this kind of research to improve educational practices. Another implication could be reframing the health curriculum, textbooks, teacher professional development programmes, test formats, tools, and activities through collaborative research. The findings of this study recommend that learning through activities in the school related to sanitation and hygiene helps adapt the recent pedagogies. Students, teachers, the SMC/PAR committee, and parents should be involved in constructing an Eco-san toilet alongside government and non-government organizations in a school setting. The development of participatory teaching and learning methods and long-term behaviour change following HWWS intervention must be developed. Future research could be geared towards these areas.

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Appendix A

A Participatory Action Research in Transforming Hygiene Behaviour of Students through Ecological Sanitation Toilet

Tool 1: Situational Analysis of Schools

General Information

Name of the School: ____

District: ____
_

Municipality: ____

Ward number: ____

Name of School Head teacher: _______________________________

Telephone Number of Head teacher: __________________________

Researcher's name: ______________________________________

Date (mm/dd/yyyy): ____

Is the consent provided? 1. Yes   2. No

1. School description
1.1 Type of school a) Government b) Private
1.2 Number of buildings:
1.3 Number Toilets
1.4 Number of Handwashing stations
1.5 Number of taps at all handwashing stations
1.6 Availability of soap at HWSs and toilets a. Yes b. No
1.7 Availability of soap cases a. Yes b. No
1.8 Does the school have enough space for all the students to assemble at once? a. Yes b. No

1.9 Alumni Association/ Students clubs a. Yes (If yes give name b. No
1.10 Enough running water at HWSs and Toilets a. Yes b. No
1.11 Waste segregation Practice a. Yes b. No
1.12 Eco-san system a. Yes b. No
1.13 Detergent/Harpic available in toilets and HWS a. Yes b. No
1.14Safe Drinking water a. Yes b. No
2 Services
2.1 Electricity? a) Yes b) No
2.2 Telephone? a) Yes b) No
2.3 Internet? a) Yes b) No
2.4 Use of computer room by the students: a) Used every day. b) Used once a week. c) Used once a month. d) Used once in a term.
2.5 Whiteboards? a) Yes b) No
2.6 Library? a) Yes b) No
2.7 Use of library by the students: e) Used every day. f) Used once a week g) Used once a month h) Used once in a term.
2.8 Science lab a) Yes b) No
2.9 Use of science lab by the students:

a. Used every day. b. Used once a week c. Used once a month d. Used once in a term.

3 Staff Population			
	Female	Male	Total
5.1 Teachers			
5.2 Basic level teachers			
5.3 Secondary teachers			
5.4 ECD teachers			
5.5 Supporting staff			
5.6 Accountant			
5.7 Other: specify			
5.8 No. of Teachers Quota			
Government permanent			
Government Rahat			
School source/internal			

4. Total number of students in each class			
Grade	Female	Male	Total
ECD			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
Total			

5. Water, Sanitation				
5.1 Total number of toilets	Boys	Girls	Teachers	Total
5.2 Number of urinal toilet				
5.3 Type of toilet facilities in use	a) Pit latrine slab (slab can be shifted/relocated b) Pit latrine cement floor (slab cannot be shifted) c) Pit latrine with a mud floor d) Latrine with lined pits e) Pour flush toilet f) Urine diverting toilet g) Septic tank h) No toilet facility i) Other: (specify……………)			
5.4 Child- friendly situation of toilets	a) The toilet facility is easy for children to use. b) Children can use the toilet facility properly c) Toilet facility is safe for children to use d) The height of the door is appropriate for students' height e) Children have difficulties to lock the door f) Height of commode is reachable to the children			
5.5 Disabled- friendly situation of toilets	a) Disabled children can use the toilet facility properly b) The toilet facility is easy for disabled children to use. c) Toilet facility is safe for disabled children to use d) The toilet is not suitable for children e) Lock of the door is not reachable f) Height of commode is reachable to the children			

5.6 Permanency of current toilet facility	a) Toilet building is earthquake resistant b) Toilet facility is permanent c) Can use toilet facility for many years. d) It is constructed on sloppy land e) It can be used for many years. f) It will fill up within a short time g) It looks like semi-permanent h) It looks completely temporary i) Other (specify……………………..)
5.7 Water facility in toilet	**a)** Line/pipe water goes into the toilet b) Water in a bucket inside the toilet c) There is piped water on the yard and needs to carry water from there d) There is a hand washing facility at the toilet e) Flush is in toilet **f)** No water management in toilet
5.8 Faeces observed in the toilet	a) Yes b) No
5.9 Cleanliness objects observed in toilet	a) Toilet cleaner (Harpic) b) Phenyl c) Toilet brush d) Others (specify………………………)
5.10 Superstructure of toilet	a) The current toilet facility has a roof b) Toilet facility built using bricks c) The toilet facility has a cement/slab floor d) The floor/slab can be shifted and reused on another spot e) There is vacant space inside the toilet f) There is proper lighting g) There is ventilation h) Toilet has a strong door i) Toilet has functional luck j) Toilet has wall

5.11 Cleanliness of toilet	a) Floor of the toilet is clean b) Pan of the toilet is clean c) Wall of the toilet is clean d) Flies not seen in the toilet e) No bad smelling f) No visible urine and feces in the toilet g) Others (specify……………………)
5.12 Availability of specific hand washing area/station	a) Basic b) Limited c) No facility *(If no please go to no…….)*
5.13 Location of hand washing station	a) Within 10 steps from the classroom b) Inside the school compound c) Outside the school compound d) Others (specify……………………..)
5.14 Hand washing facility	a) Hand washing station with soap and water b) Hand washing station without soap c) Hand washing station with ash and water d) Hand washing station with water only e) Hand station without enough water f) Hand washing station without water
5.15 Availability of soap and water in the hand washing station	a) Only soap b) Only water c) Both soap and water are available d) Both soap and water are unavailable e) Ash and water f) Others (specify………………………..)
5.16 Main sources of water in school	a) Piped water in school b) Piped water tap in yard /plot c) Tube well with the hand pump d) Protected spring e) Surface water f) Water vendor g) Other (specify……………………………..)

5.17 Waste management at school	a) Practice of separating decomposable and non-decomposable waste in school b) Collect waste in color bin placed in each and every class c) Dispose traces/wastes everywhere (inside and outside of school compound) d) Garbage in compost pit and use it as fertilizer e) Throw in open field outside of school f) Collect waste and burn them in separate place g) Reuse it (reusable waste only) h) Collect traces in public container day by day i) Other (specify…………………………)
5.18 Is there a dustbin in the toilet to throw the sanitary pads?	a) Yes b) No c) Not sure
5.19 If no, where do the students dispose the sanitary pads?	a) Throw out in the open field of the school b) Throw out in the open field outside the school c) In the dustbin in their classroom d) Outside the toilets
5.20 Situation of playground and school compound.	a) School compound b) Grazing cattle inside school compound c) Well equipped, managed playground d) Separately for girls and boys e) Common for girls and boys f) School building g) Functioning all h) Destructed/cracked
5.21 First aid and emergency care management	a) Availability of separate room for first aid and emergency care b) Availability of first-aid equipment and medicine c) Accessibility of medical personnel for health check-up in school

6. School Garden	
6.1 School garden	a) Yes b) No

6.2 If yes, land for school garden	a) Ropani b) Biga c) Dhoor d) Aana e) Others ………..
6.3 If no, land allocated for the school garden	Sq. meter ………….
6.4 Location from the main school building	a) Eastern side b) Western side c) Northern side d) Southern side
6.5 Provision of a fence in the proposed garden side	a) Yes ( ) b) No ( )
6.6 Distance from the eco-san toilets	.... Meters
6.7 Number of trees in the school surrounding	………
6.8 Storage room for tools	a) Yes ( ) b) No ( )
6.9 Type of soil	a) Sandy b) Loamy c) Humus
6.10 School canteen	a) Yes b) No
6.11 If yes, what types of food are available in the school canteen	a) Samosa b) Bread c) Noodles d) Tea e) Green vegetables f) Fry rice g) Sweets h) Beaten rice
6.12 Fruits used in the school canteen	a) Banana b) Mango c) Pineapple d) Mango e) Apple f) Others (specify……………)

Thank you

Appendix B

A Participatory Action Research in Transforming Hygiene Behaviour of Students through Ecological Sanitation Toilet

Framework for Observation of the Classroom Teaching

The observation of the classroom will be done in a participatory approach. The researchers will go in group with *Observation Protocol for Researcher*. Observing the overall activities of the classroom, one of the co-researchers will fill out the *Observation Protocol.* After the class ends, the researcher will make reflective discussion with the teacher. Thereafter, the researchers will prepare the reflective note, which later will be shared with the concerned teacher.

All classrooms from grade 4 to 8 will be observed. Attempts will be made to observe the classrooms when teachers are teaching different subjects. This observation protocol is applied in classroom learning environment according to the need of the study.

A Participatory Action Research in Transforming Hygiene Behaviour of Students through Ecological Sanitation Toilet

Tool 2: Classroom Observation Protocol for Researcher

General Information

Date (mm/dd/yyyy):

Is the consent provided? 1. Yes   2. No

Observer's name:

Grade:

Subject:

Number of students:

1. **Contextual Background and Activities**

Classroom, furniture, whiteboard/blackboard, light, fan…………….

2. **Methods Applied in Classroom Teaching**

Lecture/presentation	Cooperative learning
Problem modeling	Learning center/station
Student presentation	Teacher/faculty interacting w/ student
Lecture with discussion	Utilizing digital educational media or technology
Demonstration	Discussion
Administrative tasks	Writing work
Out-of-class experience	Hands-on activity/materials
Small group discussion	Others (if any………………….)

Lesson Design and Implementation		
1. The instructional strategies and activities respected students' prior knowledge and the preconceptions inherent therein.		
2. The lesson was designed to engage students as members of a learning community.		
3. In this lesson, the student's exploration proceeded formal presentation.		

4. This lesson encouraged students to seek and value alternative modes of investigation or of problem solving.		
5. The focus and direction of the lesson was often determined by ideas originating with students.		
6. Propositional knowledge		
7. The lesson involved fundamental concepts of the subject		
8. The lesson promoted strongly coherent conceptual understanding.		
9. The teacher had a solid grasp of the subject matter content inherent in the lesson.		
10. Symbolic representations were encouraged when it was important to do so.		
11. Connections with other content disciplines and/or real-world phenomena were explored and valued.		
a. The curriculum is interesting, engaging and relevant.		
b. The curriculum places emphasis on student participation.		
c. The curriculum allows students to relate to the community.		
12. The curriculum provides developmentally appropriate learning experience for the children.		
13. The curriculum allows students to work together in activities.		
14. Classroom engagement		
a. The students paid attention to the teacher		
b. The students asked question to the teacher		
c. Majority of the students participated in the class		
15. The students spent time copying lessons from textbook		
16. The students spent time listening to teacher lecture.		
17. The students discussed in the classroom		
18. Students were involved in the communication of their ideas to others using a variety of means and media.		
19. There was a significant amount of conversation between and among students.		
20. Students' questions and comments often determined the focus and direction of the classroom discourse.		
21. There was a climate of respect for what others had to say.		
22. Active participation of students was encouraged and valued.		
23. Students were encouraged to generate alternative solution strategies.		
24. In general, the teacher was patient with students		

25. The teacher acted as a resource person, working to support and enhance student performance.		
26. The metaphor "teacher as listener" was very characteristics of this classroom.		

Thank You

Appendix C

A Participatory Action Research in Transforming Hygiene Behaviour of Students through Ecological Sanitation Toilet

Tool 3. Students' Survey

General Information

Name of the School: ____

District: ____

_

Municipality: ____

Ward number: ____

Enumerator's name: ____

Date (mm/dd/yyyy): ____

Student's code: ____

(Students' Code for anonymity: First letter of the school's name, Grade, First letter of the first name, middle name and last name.)

Is the consent provided? 1. Yes ☐ 2. No ☐

Part I: Education

SN	Questions	Response	Code	
			Yes	No
1.1	What is your date of birth?	___ /_____ /______ day/month/year		
1.2	What is your age?			
1.3	What is your sex?	Male	1	
		Female	2	
1.3	Education level: Which class are you in?			
1.4	What is your caste/ethnicity? (Write the SUR Name)	…………………………… (SUR Name)		

1.5	What is your religion?	a) Budhism b) Hinduism c) Muslim d) Christian e) Others (Specify…...)	1 2 3 4 98
1.6	What language do you speak at home?	a) Nepali b) Newari c) Tamang d) Gurung e) Tharu f) Magar g) Darai h) Chepang i) Others (specify……………….)	1 2 3 4 5 6 7 8 98
1.7	What is your home made with?	a) Mud//stone/brick/wood b) Cement, brick and iron rod c) Wood/bamboo d) Others (specify……………)	1 2 3 4
1.8	Who do you live with?	a) Parents, grandparents and siblings b) Parents and siblings only c) Others (specify……………...)	1 2 3
1.9	What is your mother's main occupation?	a) Agriculture b) Business c) Regular job at govt/pvt. sector d) Service work e) Labour work/Daily wages f) Others(specify)	
1.10	What is your father's main occupation?	a) Agriculture b) Business c) Regular job at govt/pvt. sector d) Service work e) Labour work/Daily wages Others(specify)	
1.11	How do you come to school?	a) On foot b) By bicycle c) By bus	1 2 3
1.12	In the last 30 days, how many days were you absent from school?	a) Write days you were absent from school........	

		b) I have not been absent from school in the last 30 days	
1.13	Why were you absent from the school in the last 30 days?	a) I became sick b) I had to take care of my siblings c) I had to look after cattle d) I had to support my parent in household chores, farm activities e) Others (specify…………......)	1 2 3 98
1.14	Do you enjoy studying in your school?	a) Yes b) No *(If no, go to question no. 1.16.)*	1 0
1.15	If yes, why do you enjoy studying in your school? *(Multiple responses are possible)*	a) I perform well, b) My teacher encourages me to ask questions. c) My teacher comes with remedial. d) My teacher answers my questions e) When my teachers teach, I enjoy the class. f) My teacher listens to what I say. g) My teachers care about me in the school. h) I like my school environment very much	1 2 3 4 5 6 7 8
1.16	If not, why do not you enjoy studying in your school?	a) I perform poor b) Teacher discourages me c) My parents do not support my study d) Nobody cares about me in school e) I feel alone f) My school environment is not enjoyable	1 2 3 4 5 6

2.	**Classroom Environment (Tick (✔) on your choice)**			
SN	How much do you agree with these statements?	None of my classes	In some of the classes	In all of the classes
2.1	I worked independently in the class.			

2.2	I worked in pairs with my friends.			
2.3	I worked in a group of 5-6 friends.			
2.4	The whole class worked as a group.			
2.5	I shared my work with the whole class.			
2.6	I did project work in my class.			

3.	**Soft Skills** **Tick (✔)** on your choice.			
	How much do you agree with these statements about your teacher?	Strongly disagree	I don't know	Strongly agree
3.1	We need to keep our classroom clean and tidy.			
3.2	We have to look after our books and other materials.			
3.3	We have to be kind and friendly with each other.			
3.4	We need to help each other.			
3.5	We need to share.			
3.6	We want the school and playground to be safe.			
3.7	We need to sit and discuss with each other.			
3.8	We need to listen to our friends.			
3.9	We need to raise questions in the classroom.			

4.	**Parental Involvement**	
SN	Questions	Code
4.1	How often do your parents meet with the head teacher? 1. Once a week 2. Once a month 3. Once a term 4. Once a year 5. Never	 1 2 3 4 5
4.2	How often do your parents meet with the subject teacher(s)? 1. Once a week 2. Once a month 3. Once a term 4. Once a year 5. Never	 1 2 3 4 5
4.3	Do your parents provide time for your study? Yes No	 1 0

4.4	Do your parents prepare snacks for school? Yes No	 1 0
4.5	Do your parents take you to their workplace? Yes No	 1 0

Part II. Sanitation and Hygiene

SN	Questions	Response	Code
1.1	Where do you drink water at your school?	a) Water taps in school	1
		b) Water taps near school	2
		c) Hand pump/tube well in school	3
		d) Water stored in the jar	4
		e) Water from filter	5
		f) Water brought from home	6
		g) Others (specify……….........)	98
1.2	How often do you drink water from the water source at school?	a) Daily/Always	1
		b) Sometimes/Occasionally	2
		c) Rarely	3
		d) Others (Specify…………….)	98
1.3	Do you think impurified drinking water causes harm or diseases?	a) Yes	1
		b) No	0
1.4	What diseases/harm has occurred if untreated water is consumed?	a) Diarrhoea	1
		b) Cholera	2
		c) Pneumonia	3
		d) Abdominal pain	4
		e) Intestinal worm	5
		f) Typhoid	6
		g) Hepatitis A/Jaundice	7
		a) Others (Specify……………)	98
		b) Do not know	99
1.5	How often do you carry drinking water with you from home?	a) Daily/Always b) Sometimes/Occasionally c) Never d) Others (Specify……………)	1 2 3 98
1.6	Do your brush your teeth?	a) Yes b) No	1 0
1.7	Which of the following do you often use to brush and clean teeth?	a) Toothbrush only	1
		b) Toothpaste and brush	2
		c) Water only	3
		d) Charcoal and water	4
		e) Fresh twigs of neem and other trees	5
		f) Other (specify..............................)	98

<table>
<tr><td rowspan="6">1.8</td><td rowspan="6" colspan="1">How often do you brush your teeth?</td><td colspan="4">a) Twice a day</td><td>1</td></tr>
<tr><td colspan="4">b) Once a day</td><td>2</td></tr>
<tr><td colspan="4">c) Alternate day</td><td>3</td></tr>
<tr><td colspan="4">d) Once a week</td><td>4</td></tr>
<tr><td colspan="4">e) Rarely</td><td>5</td></tr>
<tr><td colspan="4">f) Never</td><td>6</td></tr>
<tr><td rowspan="4">1.9</td><td rowspan="4">What time do you brush your teeth?</td><td colspan="4">a) Early morning before eating breakfast</td><td>1</td></tr>
<tr><td colspan="4">b) The evening before going to bed</td><td>2</td></tr>
<tr><td colspan="4">c) After eating lunch</td><td>3</td></tr>
<tr><td colspan="4">d) After eating dinner</td><td>4</td></tr>
<tr><td rowspan="5">1.10</td><td rowspan="5">What are the benefits of hand washing with soap?</td><td colspan="4">a) Kills germs</td><td>1</td></tr>
<tr><td colspan="4">b) Keeps clean</td><td>2</td></tr>
<tr><td colspan="4">c) Prevents from disease</td><td>3</td></tr>
<tr><td colspan="4">d) Do not know</td><td>4</td></tr>
<tr><td colspan="4">e) Other (specify……………….….)</td><td>98</td></tr>
<tr><td rowspan="8">1.11</td><td rowspan="8">When should you wash your hands with soap?

(Multiple responses are possible)</td><td colspan="4">a) Before eating</td><td>1</td></tr>
<tr><td colspan="4">b) After using toilet</td><td>2</td></tr>
<tr><td colspan="4">c) After playing on the ground</td><td>3</td></tr>
<tr><td colspan="4">d) After touching dirt/dust</td><td>4</td></tr>
<tr><td colspan="4">e) Anytime when hands are dirty</td><td>5</td></tr>
<tr><td colspan="4">f) After cleaning the toilet</td><td>6</td></tr>
<tr><td colspan="4">g) Do not know (DK)</td><td>99</td></tr>
<tr><td colspan="4">h) Other (specify…………………….)</td><td>98</td></tr>
<tr><td rowspan="8">1.12</td><td rowspan="8">When do you usually wash your hands with soap?
(Multiple responses are possible)</td><td>Options</td><td>Always</td><td>Some times</td><td>Never</td><td>Code</td></tr>
<tr><td>Before eating</td><td></td><td></td><td></td><td></td></tr>
<tr><td>After using toilet</td><td></td><td></td><td></td><td></td></tr>
<tr><td>After playing</td><td></td><td></td><td></td><td></td></tr>
<tr><td>After touching dirt/dust</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Anytime when hands are dirty</td><td></td><td></td><td></td><td></td></tr>
<tr><td>After cleaning the toilet</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="4">Other (specify……………………….)</td><td>98</td></tr>
<tr><td rowspan="3">1.13</td><td rowspan="3">Where do you wash hands at your school?</td><td colspan="4">a) At hand washing station (basin or improvised station)</td><td>1</td></tr>
<tr><td colspan="4"></td><td>2</td></tr>
<tr><td colspan="4">b) Open space outside the school</td><td>3</td></tr>
</table>

		c) Do not wash hands at school d) Others (Specify……………)	98
1.14	Do you feel comfortable washing hands at your school's hand washing station?	a) Yes b) No	1 0
1.15	Do you have enough water to wash your hands at your school?	a) Yes b) No	1 0
1.16	Is there soap at the hand washing station at your school?	a) Yes b) b) No	1 0

2. Urine Diversion Toilet (UDT)

2.10	Have you ever heard about stool and urine being diverted/separated toilet?	a) Yes b) No	1 0	 If no, go to no 2.13
2.11	If yes, is there a provision for your school's toilet that collects urine and faeces separately?	a) Yes b) No	1 0	
2.12	Have you ever heard of using human urine and faeces as fertilizer?	a) Yes b) No	1 0	 Skip to 2.16
2.13	If yes, where did you learn about using urine and faeces as fertilizer?	a) School/Teacher b) Parent c) Neighbour d) Friends e) Radio/TV f) Other	1 2 3 4 5 6	
2.14	Do your parents use urine fertilizer in your school garden and agriculture farm?	a) Yes b) No	1 0	
2.15	Do you practice separating decomposable and non-decomposable wastes before disposing them in schools?	a) Yes b) No	1 0	
2.16	Do you collect/dispose of wastes in different colour bins?	a) Always b) Sometimes c) Never		
2.17	Where do you dispose of traces/wastes in your school?	a) Dustbin/bucket b) Corner of the classroom c) Anywhere around the school d) Not sure e) Other specify…….	1 2 3 4 98	

2.18	Where do you deposit garbage (kitchen waste, skin of fruits, leaves, etc.) at school?	a) Open field b) Compost pit c) Anywhere around school	1 2 3	
2.19	How do you dispose non decomposable wastes such as plastic, wrappers of biscuit chocolate, noodle etc.?	a) Collect and burn them b) Reuse it c) Not sure/No idea	1 2 3 98	
2.20	Do you reuse wastes such as papers, plastic bag, cover of noodles, chocolate and biscuit, bicycle tire etc.	a) Yes b) No	1 0	

Thank you for your participation

Appendix D

A Participatory Action Research in Transforming Hygiene Behaviour of Students through Ecological Sanitation Toilet

Tool 4: In-depth Interview Guide for Headteacher

General Information

Name of the School: ____

District: ____
_

Municipality: ____

Ward number: ____

Head teacher's name: ____________________________

Co-researcher's name: ____

Date (mm/dd/yyyy): ____

Is consent provided? 1. Yes, 2. No

Head Teacher's Background Information

Head teacher's age…………
Gender……………
Educational qualification……………………
Experience working as a head teacher. ………… years.
Experience years are working as a head teacher at this school?..................... years.
How many years did you spend as a subject or class teacher before becoming a head teacher?............................years.
The grade you teach………………………….
The subject you teach. ……………………….

1. School Environment

2.1 Describe what you like the most and what you don't want in this school?
2.2 What can be done to change what you don't like?
2.3 What is your ideal school environment?
2.4 How would you encourage that kind of culture?
2.5 What constitutes a child-friendly school in your perspective?
2.6 What is your role in making this school a child-friendly school?

2. Teaching and Learning Environment

3.1 What is quality education for you?

3.2 What advice do you give to teachers to have such kind of quality education in this school?
3.3 How often do teachers use participatory and innovative teaching strategies in the classroom? Use group discussion, cooperative learning, problem-solving, inquiry-based, or experiential learning?
3.4 What are current practices using available school resources, teaching materials, school compound, garden, and community resources?
3.5 What can be done to create learning opportunities that provide students with life skills, practical knowledge and hands-on experience?
3.6 How do you organise your day to meet the demands required as a head teacher?

3. School Development

3.1 In which school areas or facilities do you think the school needs improvement?
3.2 What is your five-year plan for developing those areas or facilities?
3.3 Where do you wish to see this school after five years?
3.4 What are some challenges have you faced regarding school development?
3.5 How would you facilitate local resource allocation?
3.6 How have you mobilised local resources?

4. Parental Involvement

4.1 How would you define parental involvement?
4.2 How is parents' participation in this school?
4.3 To what extent does the school engage parents and the community in school teaching and learning activities?
4.4 How would you describe the community (in terms of the inhabitants' living conditions) where your school is situated?
4.5 How would you improve the school-community relationship?
4.6 Does your school have a Teacher-Parent Organization? If yes, describe the functions of PTA.
4.7 How often does the school organise parent-teaching meeting conferences in a year?
4.8 What roles in children's education do you think should be the responsibility of families and why?
4.9 How do you communicate with parents about students' activities and progress in school?
4.10 What obstacles do you experience in promoting parental involvement in school activities and children's learning?
4.11 How do you overcome those obstacles?

5. Ecological Sanitation (Eco-san) System in School

Knowledge

1. Have you ever heard of / seen/ used Eco-san systems: Urine Diversion Toilet (UDT), human urine or faecal fertiliser etc.?

    a. If 'yes'

    i) Have you ever heard/ seen/used these Eco-san systems, including the use of UDT and humanure/human fertiliser

    ii) When did you first hear of/ see/use the Eco-san, including UDT, humanure, and Eco-garden?

    iii) What are the major differences between Eco-san toilets and other toilets (pit toilets, flush toilets) that you used earlier?

    iv) What do you think are the major benefits of using UDTs over pit latrines)?

    Probe for

    - ➢ Lack of flies, odours, permanent structures, treated faeces and urine are used as nutrients and organic matter for plants which are consumed by humans and animals
    - ➢ Natural resource protection
    - ➢ The permanent solution to controlling environmental pollution
    - ➢ Other (Specify…………………………….)

    v) What are the major disadvantages and advantages of using UDT over pit latrines?

    - ➢ Getting sufficient desiccent
    - ➢ Bothersome to add desiccant after every use
    - ➢ Collection of urine
    - ➢ Treatment/sanitise and dilution of urine
    - ➢ Supply urine fertiliser using the drip-irrigation system

    vi) What are the different steps taken in the operation of the Eco-san system?

    - ➢ Initial operation

- ➢ Treatment processes
- ➢ Drip- irrigation process
- ➢ Nutrient reuse

b) If 'No,'

Provide some minimal education at this point, and then follow up with perception or attitude related to the Eco-san system in school.

Perceptions of Eco-san

2. What are your thoughts and feelings about the whole process of utilising urine in the Eco-san system?

Probe for:

- ➢ Risks and disgust
- ➢ Beneficial uses
- ➢ Potential value

3. Do you think if introduced, the students, teachers and other concerned people in school will be receptive to installing UDTs instead of different ordinary types of toilets?
4. What are the anticipated challenges in installing and operating the Eco-san system, including UDTsand application of urine fertiliser in the school's Eco-garden?

- ➢ Do you think people in school will be willing to learn about the principles of the system?
- ➢ Will they be willing to follow procedures?
- ➢ Will they be willing to use human urine as agricultural fertiliser after treatment/ sanitisation?

Probe for:

- ✓ Potential effects on vegetables
- ✓ Benefits and risks
- ✓ Willingness to handle urine use and supply system like drip-irrigation system

5. What do you think would be people's thoughts about vegetables grown using urine fertiliser?

6. Will they take as an essential value of the urine fertiliser?

7. Will they consider the consumption of fertilised vegetables/crops using urine fertiliser to be risky?

8. Will they be willing to consume these vegetables/crops fertilised with urine?

9. What are your thoughts about what can be done to overcome the challenges of using Eco-san in the school setting? In what year was the Eco-san system installed in your school?
10. Why was your school chosen an Eco-san system instead of a conventional pit toilet or other sanitation systems?
11. Who or what organisation installed this Eco-san system in the school?
12. Did you get any information about Eco-san when the facility was installed?
13. Is the Eco-san system only used in your school or by schools located in the adjoining community?
14. Do students of all grades use Eco-san toilets or UDTs in your schools? If yes, what challenges do they experience when using the facility?
15. Would it be acceptable to use treated urine for agriculture in your school garden?
16. Have you ever used treated urine as an agricultural fertiliser in your school's Eco-Garden? Probe how and why urine fertiliser is more essential than other fertiliser.
17. Do the students, teachers, parents, and SMC/PAR committee members of your school prefer Eco-san toilet/UDTs over other types of toilets and sanitation systems?
    - Why
    - Advantages of UDTs and Eco-san system
    - Disadvantages of UDTs and Eco-san system
18. What challenges have been experienced in using the Eco-san facilities? What has been done to address those problems? What suggestions do you give as a way of addressing these challenges?
19. Could you please explain the changes in Eco-san's perception before and after intervention?

Thank you

Appendix E

A Participatory Action Research in Transforming Hygiene Behaviour of Students through Ecological Sanitation Toilet

Tool 5: Focus Group Discussion with teachers

Part I: General Information

Name of the School: ____

District: ____

_

Municipality: ____

Ward number: ____

Co-researcher's name: ____

Date (mm/dd/yyyy): ____

Is consent provided? 1. Yes 2. No

Attendance

Code	Participants Name	Gender	Caste	Experience (in years)	Grade(s) taught	Subject(s) taught

Teacher's Code for anonymity: First letter of the school's name, letter of the subject name, First letter of the first name, middle name and last name.

Phase I: Before Implementing the PAR Interventions

Part II: Ecological Sanitation (Eco-san) System

Introduction

20. What is the importance of using toilets in our environment (school, community, public places)?

21. What different types of toilets exist in this community? Which ones have you heard exist in other places around?

Knowledge

22. Have you ever heard of / seen/ used Eco-san systems: Urine Diversion Toilet (UDT), human urine or faecal fertiliser etc.?

    b. If ‘yes’

    vii) Have you ever heard/ seen/used these Eco-san systems, including the use of UDT and humanure/human fertiliser

    viii) When did you first hear of/ see/use the Eco-san, including UDT, humanure, and Eco-garden?

    ix) What are the major differences between Eco-san toilets and other toilets (pit toilets, flush toilets) that you used earlier?

    x) What do you think are the major benefits of using UDTs over pit latrines)?

    Probe for

    - Lack of flies, odours, permanent structures, treated faeces and urine are used as nutrients and organic matter for plants which are consumed by humans and animals
    - Natural resource protection
    - The permanent solution to controlling environmental pollution
    - Other (Specify…………………………….)

    xi) What are the major disadvantages and advantages of using UDT over pit latrines?

    - Getting sufficient desiccent
    - Bothersome to add desiccant after every use
    - Collection of urine

- ➢ Treatment/sanitise and dilution of urine
- ➢ Supply urine fertiliser using the drip-irrigation system

xii) What are the different steps taken in the operation of the Eco-san system?

- ➢ Initial operation
- ➢ Treatment processes
- ➢ Drip- irrigation process
- ➢ Nutrient reuse

b) If ‘No,’

Provide some minimal education at this point, and then follow up with perception or attitude related to the Eco-san system in school.

Perceptions of Eco-san

23. What are your thoughts and feelings about the whole process of utilising urine in the Eco-san system?

Probe for:

- ➢ Risks and disgust
- ➢ Beneficial uses
- ➢ Potential value

24. Do you think if introduced, the students, teachers and other concerned people in school will be receptive to installing UDTs instead of different ordinary types of toilets?

25. What are the anticipated challenges in installing and operating the Eco-san system, including UDTsand application of urine fertiliser in the school’s Eco-garden?

- ➢ Do you think people in school will be willing to learn about the principles of the system?
- ➢ Will they be willing to follow procedures?
- ➢ Will they be willing to use human urine as agricultural fertiliser after treatment/ sanitisation?

Probe for:

- ✓ Potential effects on vegetables
- ✓ Benefits and risks
- ✓ Willingness to handle urine use and supply system like drip-irrigation system

26. What do you think would be people’s thoughts about vegetables grown using urine fertiliser?
27. Will they take as an essential value of the urine fertiliser?
28. Will they consider the consumption of fertilised vegetables/crops using urine fertiliser to be risky?
29. Will they be willing to consume these vegetables/crops fertilised with urine?
30. What are your thoughts about what can be done to overcome the challenges of using Eco-san in the school setting?

Phase III

Evaluate Changes in Knowledge and Attitudes/perception of the Eco-san System after the PAR Interventions in the school

Note: Most issues are discussed in PAR phase I or pre-implementation phase, but in the post-intervention phase or impact evaluation of the PAR intervention, those issues are asked about by changing the tense.

31. Do students, teachers, and SMC/PAR committee members better understand the concepts and procedures of the Eco-san system in the school?
    - ➢ The nutrient value of the urine fertiliser
    - ➢ Sanitisation/treatment of urine
    - ➢ Benefits of Eco-san (permanent superstructure, health perspectives, reduction of flies and odour, comfortable use of UDTs and Economic gain)
32. Do the school community feel that Eco-san toilet/UDTs are an appropriate and beneficial sanitation option in school? How?
33. Has seeing the Eco-san toilets / UDTs at the school changed their perception of this technology?
34. What benefits have members of the school community (Eco-san users) seen as a result of Eco-san toilets/UDTs?
35. What disadvantages have research participants/ co-researchers perceived?

36. Have any problems and challenges been identified regarding using Eco-san toilets/UDTs and applying human urine as fertiliser?

    - Cleanliness of Eco-san/UDTs
    - Storage, treatment, dilution and supply of urine fertiliser into the school's Eco-garden using the drip-irrigation system

37. How does the use of UDTs generally compare with other toilets in school earlier?

38. What changes could be made to address any issue with UDTs?

39. Would members of the school community recommend that scaled-up to the other schools in Nepal?

40. Do school community members/ Co-researchers perceive any cultural, technical, psychosocial and contextual barriers while using the Eco-san system in school? Probe as per necessity.

Thank you.

Appendix F

A Participatory Action Research in Transforming Hygiene Behaviour of Students through Ecological Sanitation Toilet

Tool 6: Student Focus Group Discussion Guidelines

General Information

Name of the School: ____________________

District: ____________________

Municipality: ____________________

Ward number: ____________________

Co-researcher's name: ____________________

Date (mm/dd/yyyy): ____________________

Is the consent provided? 1. Yes   2. No

Attendance

Code	Students Name	Grade	Gender	Caste/ethnicity

Students' Code for anonymity: First letter of the school's name, Grade, First letter of the first name, middle name and last name.

A. Sanitation and Hygiene Behaviour of the Students

1. How often do you participate in sanitation activities?
2. How often do your parents talk to you about health, sanitation, and hygiene behaviour?

3. Have you ever participated in any activities on hand washing with soap promotion?
4. What was involved? Name some of the activities.
5. How were the activities conducted?
6. Was it fun? Did you find it easy to participate in the activities?
7. Can you remember what messages were communicated?
8. When do you wash your hands with soap?
9. Do you think it is important to wash hands with soap? Why?
10. What improvement do you have with hand hygiene in your school?
11. What is your plan to sustainably manage soap at handwashing stations and toilets in your school?

B. Ecological Sanitation in School

Phase I: Before Implementing the PAR Interventions

Part II: Ecological Sanitation (Eco-san) System

Introduction

41. What is the importance of using toilets in our environment (school, community, public places)?

42. What is the situation of toilet facilities in school? Probe, child, girl and disabled friendly, cleanliness.
43. What different types of toilets exist in this community? Which ones have you heard exist in other places around?

44. What aspects of the toilet facility need to be improved by the school?

45. If the school constructed an Eco-san toilet and started using urine and faeces in the garden, how would you communicate the importance of such a toilet to your parent?

Knowledge

46. Have you ever heard of / seen/ used Eco-san systems: Urine Diversion Toilet (UDT), human urine or faecal fertiliser etc.?

    c. If 'yes'

    xiii) Have you ever heard/ seen/used these Eco-san systems, including the use of UDT and humanure/human fertiliser

    xiv) When did you first hear of/ see/use the Eco-san, including UDT, humanure, and Eco-garden?

    xv) What are the major differences between Eco-san toilets and other toilets (pit toilets, flush toilets) that you used earlier?

xvi) What do you think are the major benefits of using UDTs over pit latrines)?

Probe for

- Lack of flies, odours, permanent structures, treated faeces and urine are used as nutrients and organic matter for plants which are consumed by humans and animals
- Natural resource protection
- The permanent solution to controlling environmental pollution
- Other (Specify…………………………….)

xvii) What are the major disadvantages and advantages of using UDT over pit latrines?

- Getting sufficient desiccent
- Bothersome to add desiccant after every use
- Collection of urine
- Treatment/sanitise and dilution of urine
- Supply urine fertiliser using the drip-irrigation system

xviii) What are the different steps taken in the operation of the Eco-san system?

- Initial operation
- Treatment processes
- Drip- irrigation process
- Nutrient reuse

b) If ‘No,’

Provide some minimal education at this point, and then follow up with perception or attitude related to the Eco-san system in school.

Perceptions of Eco-san

47. What are your thoughts and feelings about the whole process of utilising urine in the Eco-san system?

    Probe for:

    - Risks and disgust
    - Beneficial uses
    - Potential value

48. Do you think if introduced, the students, teachers and other concerned people in school will be receptive to installing UDTs instead of different ordinary types of toilets?

49. What are the anticipated challenges in installing and operating the Eco-san system, including UDTsand application of urine fertiliser in the school’s Eco-garden?

    - Do you think people in school will be willing to learn about the principles of the system?
    - Will they be willing to follow procedures?
    - Will they be willing to use human urine as agricultural fertiliser after treatment/ sanitisation?

    Probe for:

    - ✓ Potential effects on vegetables
    - ✓ Benefits and risks
    - ✓ Willingness to handle urine use and supply system like drip-irrigation system

50. What do you think would be people’s thoughts about vegetables grown using urine fertiliser?

51. Will they take as an essential value of the urine fertiliser?

52. Will they consider the consumption of fertilised vegetables/crops using urine fertiliser to be risky?

53. Will they be willing to consume these vegetables/crops fertilised with urine?
54. What are your thoughts about what can be done to overcome the challenges of using Eco-san in the school setting?

Phase III

Evaluate Changes in Knowledge and Attitudes/perception of the Eco-san System after the PAR Interventions in the school

Note: Most issues are discussed in PAR phase I or pre-implementation phase, but in the post-intervention phase or impact evaluation of the PAR intervention, those issues are asked about by changing the tense.

55. Do students, teachers, and SMC/PAR committee members better understand the concepts and procedures of the Eco-san system in the school?
    - The nutrient value of the urine fertiliser
    - Sanitisation/treatment of urine
    - Benefits of Eco-san (permanent superstructure, health perspectives, reduction of flies and odour, comfortable use of UDTs and Economic gain)
56. Do the school community feel that Eco-san toilet/UDTs are an appropriate and beneficial sanitation option in school? How?
57. Has seeing the Eco-san toilets / UDTs at the school changed their perception of this technology?
58. What benefits have members of the school community (Eco-san users) seen as a result of Eco-san toilets/UDTs?
59. What disadvantages have research participants/ co-researchers perceived?
60. Have any problems and challenges been identified regarding using Eco-san toilets/UDTs and applying human urine as fertiliser?
    - Cleanliness of Eco-san/UDTs
    - Storage, treatment, dilution and supply of urine fertiliser into the school’s Eco-garden using the drip-irrigation system
61. How does the use of UDTs generally compare with other toilets in school earlier?
62. What changes could be made to address any issue with UDTs?
63. Would members of the school community recommend that scaled-up to the other schools in Nepal?

64. Do school community members/ Co-researchers perceive any cultural, technical, psychosocial and contextual barriers while using the Eco-san system in school? Probe as per necessity.

C. Closing Discussion

1. Summarises the impressions or critical points of the discussion
2. Allow Participants to reconfirm or clarify some issues.
3. Is there anything else you want to share with us?
4. Ask how they have felt about taking part in the focus group.
5. What do you suggest we ask you next time we have such a discussion?

Thank You.

Appendix G

A Participatory Action Research in Transforming Hygiene Behaviour of Students through Ecological Sanitation Toilet

Tool 7:

Focus Group Discussion guidelines with SMC, PAR, PTA and Parents

Part I: General Information

Name of the School: ____

District: ____

Municipality: ____

Ward number: ____

Co-researcher's name: ____

Date (mm/dd/yyyy): ____

Is the consent provided? 1. Yes   2. No

Attendance

Code	Participant's Name	Gender	Caste	Position	Duration	Remarks

For anonymity: First letter of the school's name, PTA/SMC (write in which group they belong), First letter of the first, middle (write 'x' if the participant does not have a middle name) and last name.

Part II: Ecological Sanitation in school

Knowledge

65. Have you ever heard of / seen/ used Eco-san systems: Urine Diversion Toilet (UDT), human urine or faecal fertiliser etc.?

   d. If 'yes'

      xix) Have you ever heard/ seen/used these Eco-san systems, including the use of UDT and humanure/human fertiliser

      xx) When did you first hear of/ see/use the Eco-san, including UDT, humanure, and Eco-garden?

      xxi) What are the major differences between Eco-san toilets and other toilets (pit toilets, flush toilets) that you used earlier?

      xxii) What do you think are the major benefits of using UDTs over pit latrines)?

      Probe for

      - Lack of flies, odours, permanent structures, treated faeces and urine are used as nutrients and organic matter for plants which are consumed by humans and animals
      - Natural resource protection
      - The permanent solution to controlling environmental pollution
      - Other (Specify…………………………….)

      xxiii) What are the major disadvantages and advantages of using UDT over pit latrines?

      - Getting sufficient desiccent
      - Bothersome to add desiccant after every use
      - Collection of urine
      - Treatment/sanitise and dilution of urine
      - Supply urine fertiliser using the drip-irrigation system

      xxiv) What are the different steps taken in the operation of the Eco-san system?

      - Initial operation

- ➢ Treatment processes
- ➢ Drip- irrigation process
- ➢ Nutrient reuse

b) If ‘No,’

Provide some minimal education at this point, and then follow up with perception or attitude related to the Eco-san system in school.

Perceptions of Eco-san

66. What are your thoughts and feelings about the whole process of utilising urine in the Eco-san system?

Probe for:

- ➢ Risks and disgust
- ➢ Beneficial uses
- ➢ Potential value

67. Do you think if introduced, the students, teachers and other concerned people in school will be receptive to installing UDTs instead of different ordinary types of toilets?

68. What are the anticipated challenges in installing and operating the Eco-san system, including UDTsand application of urine fertiliser in the school’s Eco-garden?

- ➢ Do you think people in school will be willing to learn about the principles of the system?
- ➢ Will they be willing to follow procedures?
- ➢ Will they be willing to use human urine as agricultural fertiliser after treatment/ sanitisation?

Probe for:

- ✓ Potential effects on vegetables
- ✓ Benefits and risks
- ✓ Willingness to handle urine use and supply system like drip-irrigation system

69. What do you think would be people’s thoughts about vegetables grown using urine fertiliser?

70. Will they take as an essential value of the urine fertiliser?

71. Will they consider the consumption of fertilised vegetables/crops using urine fertiliser to be risky?

72. Will they be willing to consume these vegetables/crops fertilised with urine?

73. What are your thoughts about what can be done to overcome the challenges of using Eco-san in the school setting?

Phase III

Evaluate Changes in Knowledge and Attitudes/perception of the Eco-san System after the PAR Interventions in the school

Note: Most issues are discussed in PAR phase I or pre-implementation phase, but in the post-intervention phase or impact evaluation of the PAR intervention, those issues are asked about by changing the tense.

74. Do students, teachers, and SMC/PAR committee members better understand the concepts and procedures of the Eco-san system in the school?

    - The nutrient value of the urine fertiliser
    - Sanitisation/treatment of urine
    - Benefits of Eco-san (permanent superstructure, health perspectives, reduction of flies and odour, comfortable use of UDTs and Economic gain)

75. Do the school community feel that Eco-san toilet/UDTs are an appropriate and beneficial sanitation option in school? How?

76. Has seeing the Eco-san toilets / UDTs at the school changed their perception of this technology?

77. What benefits have members of the school community (Eco-san users) seen as a result of Eco-san toilets/UDTs?

78. What disadvantages have research participants/ co-researchers perceived?

79. Have any problems and challenges been identified regarding using Eco-san toilets/UDTs and applying human urine as fertiliser?

    - Cleanliness of Eco-san/UDTs
    - Storage, treatment, dilution and supply of urine fertiliser into the school's Eco-garden using the drip-irrigation system

80. How does the use of UDTs generally compare with other toilets in school earlier?

81. What changes could be made to address any issue with UDTs?

82. Would members of the school community recommend that scaled-up to the other schools in Nepal?

83. Do school community members/ Co-researchers perceive any cultural, technical, psychosocial and contextual barriers while using the Eco-san system in school? Probe as per necessity.

Part III: School Improvement Plan (SIP)

1. What is your understanding of the school development plan (SIP)? Who prepares it?
2. What are the key components of SIP?
3. Are the following things included in SIP? Improvement of the physical environment, Improvement of classroom environment, Improvement of Sanitation facilities, Lab and library facilities, and teaching and learning materials provisions?
4. In your opinion, how is the school's overall performance?
5. What are the areas that have been improved in the last three years?
6. What are the areas that need to be improved?
7. What has been done to improve those areas?
8. What is your observation about a child-friendly environment? What efforts are made by the school to create a safe and child-friendly learning environment?
9. What policies and plans must be made to improve the school learning environment?

Part IV: Closing Discussion

1. Summarise the impressions or key points of the discussion.
2. Allow Participants to reconfirm or clarify some points.
3. Ask how people have felt about taking part in the focus group.
4. Ask the participants if they want to share anything else with us?

Thank you.

Appendix H

Tool 8: Observing Handwashing Practice of Students

(After toilet use/before meal)

IDENTIFICATION

- Name of Observer____
- Date of visit__________________________ Day ______________________
- Name of school: ____
- Observing student
  Girls ☐
  Boys ☐
  Other ☐
- Time start…………………Time end_.........................
- Obtained consent
  Yes ☐
  No ☐

FACILITIES

- Location of HW facility
  Inside ………… _________
  Outside ……………
  Separate from toilet_____________________
  If separate from the toilet, approximate distance (in meters)

____

- Type of HW facility
  Sink____
  Tank with sink_____
  Tank with tap___
  Water bucket/basin _____
  Other (specify)____
- Soap availability
  Yes ……………______________
  No ………………
  Other (specify) ………__________________________________
- Availability of enough water in the hand washing facility when you were there

  Yes____

  No____

- Record Other Key Observations to include the following:
  Hygiene status of the toilets

  Hygiene status of the hand washing facilities. How is handwashing done?

Number of toilets

Distance from the toilet to hand washing area and classrooms.

Observations of Students' Handwashing Practice
After Toilet Use/ Before Meal
(During Break Time)

SN	Sex B/G	Washed Hands		Followed Correct HW Techniques		Time Taken (Seconds)	Did not Wash
		With Soap	Without Soap	Yes	No		
01							
02							
03							
04							
05							
06							
07							
08							
09							
10							
11							
12							
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50							

Thank you.

Appendix I

A Participatory Action Research in Transforming Hygiene Behaviour of Students through Ecological Sanitation Toilet

Tool 9:

Group Discussion Guidelines (Virtual mode)

Use of Urine Diversion Toilet

1. How do you feel about using Ecosan toilets, especially urinals? Can you tell us something about its effectiveness?

2. What do you think of the method of converting human urine into urine fertilizer that is collected with the use of urinals?

3. What is your view on the use of human urine as agricultural fertiliser?

4. Did urine fertilizer use make a difference in the production from the school garden?

5. Did you and your community readily accept vegetables produced using human urine as fertilizer? If not, why not?

6. What are the challenges of using urine fertilizer and what can be done to increase its effectiveness in the coming days?

Practice of Hand Washing with Soap

7. Have students developed the habit of washing their hands with soap and water after using the toilet, before eating lunch and after working in Eco- Garden/school garden?

8. Have students used hand washing skills as per World Health Organization guidelines or how do they wash their hands?

9. Is there soap and enough running water in the school's hand washing stations?

10. If so, how do you manage soap?

11. What are your plans for long-term hand soap management in school?

Sanitation and hygiene in the Classroom Teaching

12. Are there any theoretical and experimental classes on Ecosan toilets/Urine diverting toilet use and changing urine into fertilizer, use it in school garden and hand washing skills for hygiene?

13. What is the cooperation of teachers, students' club, school management committee and other stakeholders for sanitation and hygiene behavioural change of students?

14. How has the use of Ecosan toilets/ urine diversion toilet and sanitation activities in collaboration with the *Rupantaran* /NORHED project changed the sanitation and hygiene behaviour of the students?

15. If you have any suggestions for this study, please let me know.

Thank You

Appendix J

Session Plan/ Intervention Mapping

Session I : Hygiene Education (Sensitization Session) Time : 6 periods (45X 6=270 minute)							
Grade	Activity	Theme	Performance objectives	Materials	Methods	Activities	Expected Outcomes
1-3	1st	Personal hygiene (hand washing)	-define hygiene education -tell six steps of handwashing with soap -Sing a song titled *Michi Michi*	Posters, Pictures Charts, multi-media	Exhibition, Demonstration, storytelling, singing. Video-displaying	Sing songs. Storytelling related to Hand hygiene Picture, posters show.	Children can define hygiene. Children can name the six steps of HWWS. They can list daily and weekly good personal hygiene habits.
4-5	2nd	Hygiene Education: HWWS	Describe Health and Hygiene education. Explain the importance of hygiene education	Posters, Pictures Charts, multi-media	Singing, drawing, pair work, Demonstration, Video playing,	Sing a song Demonstration posters and charts Participative pair work Video playing	Children can name the parts of the human body and link them to hygiene habits. They can list daily and weekly good personal hygiene habits.
6	3rd	Hygiene Education: HWWS	Explain the importance of hygiene education Maintenance of proper sanitation and hygiene facilities Share the knowledge	Posters, Pictures Charts, multi-media	Video- jingle pair work, Demonstration, Video playing,	Displaying video jingle Demonstration posters and charts Participative pair work like drawing of HWWS Video playing	Children can name the parts of the human body and link them to hygiene habits. They can list daily and weekly

			about water borne diseases and benefits of HWWS			Oral presentation of the steps of HWWS	good personal hygiene habits. Present the steps of HWWS Make simple drama and video of HWWS
7	4th	Hygiene Education: HWWS	Illustrate the correct and appropriate method of washing hands Convince Juniors to wash hands after every key times Advocacy on HWWS and Eco-san in school.	Posters, Pictures Charts, multi-media	Video- jingle pair work, Demonstration , Video playing,	Displaying video Demonstration posters and chart Ask the children to form pairs and match the pictures with the parts of the body. Participative pair work on HWWS	Children can name the parts of the human body and link them to hygiene habits. They can list daily and weekly good personal hygiene habits. Present the steps of HWWS Make simple drama and video of HWWS
8	5th	Hygiene Education: HWWS	Awar water borne diseases and benefits of hand washing Illustrate the correct and appropriate method of washing hands Advocate for sanitation and hygiene	Posters, Pictures Charts, multi-media	Video- jingle pair work, Demonstration , Video playing,	Displaying video jingle Demonstration posters and charts Participative pair work like drawing of HWWS Oral presentation of HWWS	Children can name the parts of the human body and link them to hygiene habits. They can list daily and weekly good personal hygiene habits.

							Present the steps of HWWS Make simple drama and video of HWWS
7 & 8	6th	The six Fs	Describe transmission routes for diarrheal disease. Mention the ways by which transmission of diarrhea can be prevented. Practice sanitation and hygiene	Chart, Newsprint paper, pencil, color, a glass with clean water.	Demonstration, Discussion, field visit,	Draw 'F' Diagram and depicts all six F's with accurate connections. the healthy child. Organizes an environmental walk to find the six F's in school.	Students can explain what the F diagram shows and what each F stands for. They can demonstrate and explain fecal dehydration and ORT.
Session II: Practical Activities/ Demonstration: HWWS Time :3 periods (45 x 3= 135)							
1-3	7th	HWWS	Able to demonstrate proper hand washing	Soap, water, Posters	Demonstration, Presentation/ role play	Demonstrate HWWS practice step by step Tell students to participate HWWS systematically	Students can apply the correct process of hand washing and maintain their health hygiene.
4-5	8th	HWWS	Able to demonstrate proper hand washing Promote health by maintaining proper sanitation	Soap, water, Posters	Demonstration, Presentation/ role play	Take students to hand washing station Demonstrate HWWS practice step by step by the teachers first	Students can advocate the correct process of hand washing. Students make aware on correct method of washing hands.

6-8	9th	HWWS	Able to demonstrate proper hand washing Promote health by maintaining proper sanitation	Soap, water, Posters	Demonstration, Presentation/ role play	Take students to hand washing station Demonstrate HWWS skills Tell students to participate HWWS.	Students can understand the correct and appropriate method of washing hands and try to take leadership to teach others.
Session III: Sensitization on Ecological Sanitation (Eco-san) Toilet (Theoretical/based on classroom pedagogy) Time: 6 Periods							
1-3	10th	Introduction of Eco-san /UDDT	Increase knowledge and understanding about UDT. Introduce UDT	Posters, Pictures and videos	Displaying video related to different models of toilets, especially UDDT. Drawing. Exhibition	Sharing picture of Eco-san toilet/ UDT. Displaying video having message of Eco-san and UDT Telling story about UDT and its advantages.	Students can describe UDT. Students will be able to understand the difference between normal and urine diversion toilets. Students can be used UDDT appropriately
4-5	11th	Introduction of Eco-san /UDDT	Increase knowledge and understanding about UDT. Understand importance of UDT. Draw the different models of UDT Illustrate the methods of using UDT	Posters, booklet, Video Pictures	Exhibition, Group work for drawing, Video-displaying	Ask children about their pre knowledge of Eco-san and UDT Sharing video Drawing picture of Eco-san toilet/UDT	Students can describe UDT. Students will be able to understand the difference between conventional toilet and UDT. They can be able to make the rough sketch of the

							urine diversion toilets.
4-5	12th	User' s guidelines of UDDT and application of human urine as manure.	Increase knowledge and understanding about UDT. Explain the value of human urine as agriculture fertilizer. Share their knowledge on UDT and its value to others.	Posters, booklet, Video Pictures	Exhibition Group work for drawing, Video-displaying	Ask children about their pre knowledge of Eco-san and UDT * Sharing video Drawing picture of Eco-san toilet/UDT	Students can describe UDT. Students can understand the appropriate ways of using UDT. They understood how urine works as a fertilizer.
6	13th	Ecological sanitation toilet (Eco-san) / Urine diversion toilet (UDDT)		Sample figure of eco san toilet/ UDT, Chart paper, multi-media,	Demonstration, drawing, video display related to eco-san toilet/ UDT	-Ask children about their pre knowledge of Eco-san and UDT -Discuss on use, merits and demerits of Eco/san toilet UDT with group division -Display video related to UDT.	Students can describe UDT. They learn the components of urine and learn about its various uses. They will gain the general idea about the process of using urine in the agricultural fields. Students can clean the toilets and keep it hygienic.
7-8	14th	Introduction of Eco-san /UDDT,	Increase knowledge and understanding about UDT.	Pictures, Videos, Posters, Booklets, Leaflets related to UDDT	Video display Drawing Group work Presentation	Displaying Videos. Drawing pictures. Reading booklets.	Students can describe UDT. Students can understand the appropriate

			Introduce UDT Increase knowledge and understanding about UDT. Draw the different models of UDT Explain the value of human urine as agriculture fertilizer.	and its use		Making posters	ways of using UDT. They learn the components of urine and learn about its various uses. Students can clean the toilets and keep it hygienic. They will be able to take initiative in teaching junior students
Session IV: Practical Activities about Eco-san/UDT Time: 3 Periods							
1-3	15th	Use of UDT & urine application in school	Use of Eco-san toilet/UDT Participate with seniors while they apply human urine as manure in school garden.		Observation	Take students to the UDT and share them about the techniques of its use. Participate them with their seniors in school garden.	
4-5	16th	UDT & urine application in school garden	Use of UDT Participate to apply urine fertiliser in school garden Participate to clean toilet		Observation	Take students to the UDT and share them about the techniques of its use. Participate them for urine fertiliser in school garden.	
6-8	17st	UDT & huma	Use UDT Participate to apply human urine as		Observation	Take students to the UDT and share them about	

		n urine	manure in school garden Advocate Human urine could be better nutrient for vegetable, and plants.			the techniques of its use. Participate them for urine fertilizer garden.	

Session V: Workshop with Teachers **Time: A whole day**
Activity 18th: Teacher training /workshop **Objectives:** To teach students from grade 1 to 8 (Basic level) To widely present Theory and practice of WASH and Eco-san specially Urine Diversion Toilet (UDT) among students To establish and demonstrate Eco-san /UDT in different models, are both economically and technically viable, as well as culturally acceptable options for agricultural fertilizer and sanitation Increase knowledge and understanding about toilets and its types and forwards the knowledge to students Understand and spread the importance/necessity of Urine diversion toilets (UDT) to the students and also wider community **Participants** Participants of the workshop/ training are all teachers at the school **Agendas/ Issues to be discussion in the workshop /training** Wrap-ups need assessment A brief review of national sanitation polices and strategies A brief introduction of handwashing with soap (HWWS) linking with health, sanitation and hygiene Sharing some innovations/ models of Eco-san and UDT applied in Nepal and worldwide User guide of Eco-san and UDT Nutrient value of human feces and urine as agricultural fertilizer and linking it with human health. Group work and consolidation Commitment with signature in flex board Wrap up with thanks **Proceeding through *Train- The- Trainer* model** **Methods:** Video- displaying, poster presentation, group work
Session VI: Workshop with SMC/ PTA members, Parents, PAR Committee and Local Leaders

Activity 19th: Workshop with SMC/ PTA members, Parents, PAR Committee and Local Leaders

In this workshop SMC/ PTA/ PAR committee members, local leaders, parent's representatives were invited to attend in workshop. The workshop was divided into 3 sub- session named opening session, interaction, presentation and discussion session, and finally, closing session. SMC chairman was chaired the opening and closing session of the workshop. The detail work plan of the workshop was as follows:

The workshop was facilitated by Mr Govinda Prasad Devkota and Mr Kamal Prasad Achraya

- Registration
- Inauguration/ opening
- Tea break
- Pre-test.
- Video and Power point related to Eco-san/ UDT and nutrient value of human urine for agriculture will be displaying
- Values and perception regarding Eco-san/ UDT and application of feces and urine as better agriculture fertilizer
- Lunch
- User's guideline and sanitation of UDT
- Application techniques of human urine in agriculture
- Group Discussion and sharing group findings and Post- test Closer

Session VII: Sanitation and hygiene Fair

Activity 20th: The sanitation fair

Session VIII: Field Trip to Eco-san Project Site (Surkhet)

Activity: 21th

Objectives:

- To put theory of UDDT in schools into practice.
- To see the 'reality' of using UDDT and application of human urine as manure

Time and date:

Whole day with traveling.

Procedure:

- Teachers, SMC/PTA/PAR committee members, and students' representatives will visit the UDT project site (Surkhet)
- Participants can assess the situation by administering a monitoring checklist related to eco-san/UDT and application of human urine as manure in the

vegetable garden. They can develop their own checklist before returning from the field. The participants will prepare the learning activities which they will try out with children in school.

- The debriefing, after the field visit, can be an excellent learning experience. Participants may tend to give purely descriptive reports, reading out the data they will be collected without comment. They will not usually comment on which findings might be most important or what might be done to improve some of the crucial challenges that will be observed.

They can then reflect and think of possible solutions regarding use of UDT and application human urine into the school garden and community setting as well.

Session IX: Workshop on sharing using guidelines of Eco-san/UDT

Activity: 22nd :

- Opening
- Presentation on using guidelines of Eco-san/Urinal toilet
- Sharing the previous experiences and cleanliness model/ practices of Eco-san toilet
- Group presentation on using guidelines of Eco-san toilet (what should we do, and should not we do)
- Group observation of Eco san toilet/ urinal (status, cleanliness)

Closing with develop using guidelines of Eco-san/ Urinal

Session X: Human Urine supply with drip-irrigation system

Activity: 23rd

- An iron ladder was made to go to the top of the Eco-san toilet.
- 3 water tanks with the capacity of 1000 liter each were managed at the top of the toilet.
- A motor was connected to pump the human urine from the storage chamber to the tank placed on top of the Eco-san toilet.
- Pipe fitting was done with 3 tanks to collect only urine, water mixed with urine (diluted urine) and water only at the top of the Eco-san toilet.
- A drip-irrigation system was installed in the school garden to supply human urine as fertilizer.

The End

Appendix K

Teacher's Manual

Part I
Introduction

Background of the teacher manual

Every child has the right to a safe and healthy learning environment, including adequate water, sanitation and hygiene (WASH). Among its many benefits, WASH in Schools significantly reduces hygiene-related disease, increases student attendance and contributes to dignity and gender equality. WASH in schools is increasingly recognised as a critical component of sustainable development (UNICEF, 2014). Providing safe water and sanitation facilities in schools is a first step (UNICEF, 2010) towards a healthy physical learning environment, benefiting learning and health. However, the mere provision of facilities does not necessarily make them sustainable or produce the desired impact. The use of latrines and the related appropriate hygiene behaviour provides health benefits (IRC, 2007). In schools, hygiene education aims to promote those practices that will help prevent water and sanitation-related diseases and encourage healthy behaviour in the future generation of adults (Burgers, 2000).

The combination of adequate facilities, correct behavioural practices, and education is meant to positively impact the health and hygiene conditions of the community as a whole, both now and in the future (Khanal et al., 2005). Therefore, the success of a school hygiene programme is not determined only by the number of latrines constructed and the number of hand pumps installed, or water connections built. Nor is the success of a programme determined simply by what children know. The knowledge not applied to hygiene behaviour in practice has no impact on health.

In this manual, water sanitation and hygiene education (WASHE) refer to the combination of technological and educational components necessary to produce a healthy school environment and develop or support safe hygiene behaviour. The technological components include the supply of drinking water and facilities for hand washing and safe disposal of excreta and solid waste in and around the school compound. Moreover, applying a Urine diversion toilet and optimum use of human urine as manure in the school garden will ultimately scale up to the broader community. The educational components are the activities that promote school staff and children's conditions and practices that help prevent water and sanitation-related diseases and parasites (UNICEF and IRC, 1998). (See next file)

Appendix L

Ethical Approval Letter

Government of Nepal

Nepal Health Research Council (NHRC)

Estd. 1991

Ref. No.: 1960

Date: 18 January 2019

Dr. Bhimsen Devkota
Principal Investigator
Tribhuvan University
Kathmandu

Ref: **Approval of research proposal** entitled **Assessment of personal transformation on water, hygiene and sanitation, nutrition, life skills and student learning in Chitwan and Kavre Districts of Nepal**

Dear Dr. Devkota,

It is my pleasure to inform you that the above-mentioned proposal submitted on **22 November 2018 (Reg. no. 733/2018)** please use this Reg. No. during further correspondence) has been approved by Nepal Health Research Council (NHRC) Ethical Review Board on **16 January 2019.**

As per NHRC rules and regulations, the investigator has to strictly follow the protocol stipulated in the proposal. Any change in objective(s), problem statement, research question or hypothesis, methodology, implementation procedure, data management and budget that may be necessary in course of the implementation of the research proposal can only be made so and implemented after prior approval from this council. Thus, it is compulsory to submit the detail of such changes intended or desired with justification prior to actual change in the protocol. Expiration date of this proposal is **March 2020.**

If the researcher requires transfer of the bio samples to other countries, the investigator should apply to the NHRC for the permission. The researchers will not be allowed to ship any raw/crude human biomaterial outside the country; only extracted and amplified samples can be taken to labs outside of Nepal for further study, as per the protocol submitted and approved by the NHRC. The remaining samples of the lab should be destroyed as per standard operating procedure, the process documented, and the NHRC informed.

Further, the researchers are directed to strictly abide by the National Ethical Guidelines published by NHRC during the implementation of their project proposal and **submit progress report in between and full or summary report upon completion.**

As per your research proposal, the total research amount is **NRs 20,32,800** and accordingly the processing fee amounts to **NRs 60,984.** It is acknowledged that the above-mentioned processing fee has been received at NHRC.

If you have any questions, please contact the Ethical Review M & E Section at NHRC.

Thanking you,

Prof. Dr. Anjani Kumar Jha
Executive Chairperson

Tel: +977 1 4254220, Fax: +977 1 4262469, Ramshah Path, PO Box: 7626, Kathmandu, Nepal
Website: http://www.nhrc.org.np, E-mail: nhrc@nhrc.org.np

Appendix M

Information Sheet

I, a research student at Tribhuvan University, is conducting my PhD research in a public secondary school in the Chitwan district of Nepal in support of the NORHED/*Rupantaran* Project entitled **'Ecological Sanitation in changing Sanitation and Hygiene Behaviour of the Students** using participatory action research.

Since this is one of the schools that invited to do participatory action research, I have come here to conduct research among the basic level students, teachers, SMC/PAR committee, and school parents. You are requested to participate in this research. Your responses are very important as they help identify the school's current situation. Please be truthful when you answer the questions.

This is an invitation to participate in a study about sanitation systems where I would like to hear your thoughts and how you relate to implementing an ecological sanitation system.

The purpose of this study is to follow the process of building an Eco-san toilet and handwashing stations at Jana Jiwan Public Secondary School. You are invited because your thoughts and input about the topic can give useful information regarding this subject and the implementation process.

Participation in this study is voluntary, and you do not have to participate; nothing will happen if you don't participate in this research; your participation should be of your own free will. There will be no risk of participating in the study and no kind of disadvantage under or after the discussion. However, this topic might be sensitive to talk about. Some questions will be asked in a group, and you will not get comments on your thoughts or behaviours, only discuss these issues with the others who will participate.

Benefits from this study might be improved sanitation and hygiene behaviour for the students in Jana Jiwan Secondary School. The study might, therefore, not benefit you personally. However, you will learn about the system, the implementation process and how to convert human urine into nutrients to be returned to the soil, which can benefit future private investment in the sanitation system.

All information from the discussions will remain confidential, which means that no other people outside the study will take part in the information you give, which means that your name will not appear in the result. The recorded material will not be distributed to anyone outside the study team and will eventually be destroyed.

The result of the study will be written as a PhD thesis. It can be used for future possibilities for implementing sanitation systems in the school setting of Nepal or other similar settings and to find a good way of implementing an ecological sanitation system.

Nepal Health Research Council (NHRC), Ministry of Health and Population has reviewed the ethical considerations for the study. The research process will be held to ensure that everything in the study will be performed ethically.

If you have any questions about the study, please contact:

………………………

Govinda Prasad Devkota
PhD students, Graduate School of Education
Faculty of Education, Tribhuvan University
Kathmandu, Nepal
Phone: +9779841301544
E-mail: devkotagovinda11@gmail.com

Consent form for Headteacher

Transformative Pedagogy in Changing Sanitation and Hygiene Behaviour of Basic level Students

I confirm that I have read and understood the Information Sheet for the above study. I have had the opportunity to ask questions and know what I am expected to do as a volunteer. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my rights being affected.

I agree that audio recordings during the study will be used to collect the information for further analysis of the material. This is on the understanding that all efforts will be made to preserve my anonymity.

I agree that transcripts of the discussion completed during the study may be stored beyond the study duration for further research. I understand that these transcripts will be made anonymous and not traceable back to me.

This study has been cleared to proceed by Tribhuvan University, Nepal. If you have any concerns over the conduct of the study, you may contact Govinda Prasad Devkota, and you can find contact information on the Information Sheet.

When I sign this form, I agree with all the statements above.
Thank you!

………………………..	……………………………..
Signature of Headmaster	Researcher Signature
Gopal Prasad Sharma	Govinda Prasad Devkota
Jana Jiwan public secondary school, Chitwan	Date……………………..
Date:	

If you are 18, the Headmaster needs to give their consent that you can participate
Headmaster Signature

Date:………………………….

Consent form for Teacher

Title of study: Ecological Sanitation in Changing Sanitation and Hygiene Behaviour of the Students

I confirm that I have read and understood the Information Sheet for the above study. I have had the opportunity to ask questions and know what I am expected to do as a research participant. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my rights being affected.

I agree that audio recording during the focus group discussion will be used for collecting the information for further analysis of the material. This is on the understanding that all efforts will be made to preserve my anonymity.

I agree that transcripts of the discussion completed during the study may be stored beyond the study duration for further research. I understand that these transcripts will be made anonymous and not traceable back to me.

This study has been cleared to proceed by a PhD student from the Tribhuvan University of Nepal. If you have any concerns over the conduct of the study, you may contact Govinda Prasad Devkota, and you can find contact information on the Information Sheet.

When I sign this form, I agree with all the statements above.
Thank you!

........................………	....
Signature	Signature
Name of the teacher	Name of the Researcher
Date:	Date: ....

Consent form for Parents/Guardian

I have read the Information Sheet concerning this study and understand what it is about. I have also read a copy of my child's information sheet and consent form. All my questions have been answered to my satisfaction. I understand that I am free to request further information at any stage.

I know that:

My child's participation in the research is entirely voluntary.

I can withdraw my child from the study at any time without any disadvantage to the child.

I understand that the research data on my child (audio tapes and transcript) will be in insecure storage, and all personal information (names and consent forms) will be destroyed at the end of the study.

I understand that my child will be part of a group discussion with other children and a survey interview.

I understand that the results of the project may be published, but my anonymity and my child's

anonymity will be preserved.

I give consent for my child to take part in this research project.

....

Signature of parent or guardian

Date.....................

Thumbprint

Appendix N

Handwashing skills recommended by WHO.

1. Wet hands with warm water
2. Apply enough soap to cover the entire surface of the hands
3. Vigorously rub soap palm to palm
4. Washback each hand with the palm of another hand
5. Clean your wrists, space between fingers, thumbs and fingertips
6. Rinse all aspects of hands under running water
7. Dry hands with a disposable paper towel, then use a towel to turn off the faucet

Appendix O

Quantitative Data

Table 7. Sources of information about hand sanitation and hygiene

Main Information Sources	Responses	
	N	%
School/teacher	155	69
Parents	27	12
Neighbours	14	6
Friends	10	4
Radio/TV	19	9
Total	225	100.0

Table 7. *Knowledge of the importance of handwashing with soap*

Indicators	**Response**			
	Yes		**No**	
	N	**%**	**N**	**%**
Kill germs	197	88	28	12
Keep clean	208	92	17	8
Prevents diseases	217	96	8	4
Total	225	100.0		

*Multiple responses

Table 7. *Knowledge of Hygiene-related Diseases (n=225)*

Hygiene related diseases	Responses			
	Yes		No	
	N	%	N	%
Typhoid	210	93	15	7
Diarrhoea	191	85	34	15
Worm Infestation	215	96	10	4
Skin diseases	212	94	13	6

*Multiple responses so number and percentage exceed hundred

Table.7 *Association between Educational Qualification/grade and Hand Washing Knowledge*

Grade	Advantages of washing hands with soap (Kill germs)			χ 2	P-Value
	Yes	No	Total (Column)		
4,5	30 (16.0)	12 (32.4)	42 (18.7)	5.527	.021*
6,7,8	158 (84.0)	25(67.6)	183 (81.3)		
Total (Row)	188 (100.0)	37 (100.0)	225 (100.0)		
	Keeps clean				
4,5	29 (14.6)	13 (50.0)	42 (18.7)	19.010	.000***
6,7,8	170 (85.4)	13 (50.0)	183 (81.3)		
Total (Row)	199 (100.0)	26 (100.0)	225 (100.0)		
	Prevents from diseases				
4,5	32(15.5)	10(55.6)	42 (18.7)	17536	.000***
6,7,8	175 (84.5)	8 (44.4)	183(81.3)		
Total (Row)	207 (100.0)	18 (100.0)	225 (100.0)		

***=p<0.001, **=p<0.01 and *=p<0.05

Table 5. *Association between demographic variables and comfortable use of school toilet*

Variables	Comfortable use of school toilet			χ 2	df	P-Value
	Yes N %	No N %	Total N %			
Grade						
4 & 5	0 (0.0)	42 (100.0)	42	91.985	1	.000***
6- 8	133(79.6)	34 (20.4)	167			
Total	133(63.6)	76 (36.4)	209			
Caste/ethnicity						
Dalit	30 (55.6)	24(44.4)	54	2.399	2	.301
Janajati/ indigenous	76 (67.9)	36(32.1)	112			
Brahmin/Chhetri	27(62.8)	16(37.2)	43			
Total	133(63.6)	76 (36.4)	209			
Age (years)						
≤12	52(49.1)	54(50.9)	106	19.758	1	.000***
>12	81(78.6)	22(21.4)	103			
Total	133(63.6)	76 (36.4)	209			

Sex						
Male	57(57.6)	42(42.4)	99	2.986	1	.057
Female	76(69.1)	34(30.9)	110			
Total	133(63.6)	76(36.4)	209			

***=p<0.001, **=p<0.01 and *=p<0.05

Table 7.8 *Association between Sex and Knowledge on Handwashing with Soap*

Sex	Advantages of washing hands with soap			χ 2	P-Value
	Yes	No	Total (Column)		
Kill germs					
Male	82 (43.6)	26(70.3)	108 (48.0)	8.799	.003*
Female	106(56.4)	11(29.7)	117(52.0)		
Total (Row)	188 (100.0)	37 (100.0)	225 (100.0)		
Keeps clean					
Male	91(45.7)	17 (65.4)	108 (48.0)	3.559	.046*
Female	108 (54.3)	09 (34.6)	117 (52.0)		
Total (Row)	199 (100.0)	26 (100.0)	225 (100.0)		
Prevents from diseases					
Male	95 (45.9)	13 (72.2)	108 (48.0)	5.527	.021*
Female	112 (54.1)	5 (27.8)	117 (52.0)		
Total (Row)	207 (100.0)	18 (100.0)	225 (100.0)		

***=p<0.001, **=p<0.01 and *=p<0.05

Table 5.9. *Association between Caste/Ethnicity and Knowledge in terms of HWWS*

Advantages of washing hands	Caste/Ethnicity						χ 2	df	P-Value
	Dalit		Janajati		Brahmin/Chhetri				
	N	%	N	%	N	N %			
Kill germs	30	62.5%	46	52.9%	23	65.7%	5.665	6	.462
Keeps clean	28	58.3%	48	55.2%	23	65.7%			
Prevents from diseases	20	41.7%	25	28.7%	12	34.3%			