A Comparative Study of Blended Learning vs. Traditional Classroom Instruction in Secondary Level ICT Education.

A thesis submitted to the Central Department of Education, Tribhuvan University for the partial fulfilment for Master of Education in ICT

Submitted by:

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Exam Roll No: 7528265

TU Reg. No.:5-2-13-155-2014

Submitted To:

University Campus

Central Department of Education

Department of Information and Communication Technology (ICTE)

Faculty of Education, Tribhuvan University

Kirtipur, Kathmandu

2023

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(24-Dec-2023) (.....)

Thesis Viva Date: Submitted Date:

Letter of Certificate

This is to certify that Mr. Dharmendra Prasad student of academic year 2075/2078 with Exam Roll No.7528265, Thesis No....., T.U. Regd. No. 9-2-13-155-2014 has completed this thesis under the period prescribed by the rules and regulation of Tribhuvan University, Nepal. This thesis entitled "**A Comparative Study of Blended Learning vs. Traditional Classroom Instruction in Secondary Level ICT Education.**" embodies the result of his investigation. It is record of independent research work carried out by researcher which has been previously submitted for of the award of any degree and other similar purpose. I hereby recommended and forward that this thesis submitted for partial requirements to award the degree of Master in ICT Education.

…..……

Asst. Prof. Romakant Pandey

(HoD of ICT Education)

27-Dec-2023

Letter of Approval

This thesis entitled "**A Comparative Study of Blended Learning vs. Traditional Classroom Instruction in Secondary Level ICT Education.**" submitted by Mr. Dharmendra Prasad in partial fulfilment of requirements for the Masters degree in ICT Education has been approved.

Viva Voice Committee	Signature
Asst. Prof. Romakant Pandey (Head of Department)	……..……..
..... (External)	……..……..
Asst. Prof Arjun Singh Saud (Supervisor)	……..……..
……. (Member)	……..……..

27-Dec- 2023

Recommendation for Acceptance

This is certify that Mr. Dharmendra Prasad has completed his Master thesis entitled "**A Comparative Study of Blended Learning vs. Traditional Classroom Instruction in Secondary Level ICT Education.**" under my supervision during the period prescribed the rules and regulation of Tribhuvan University, Kirtipur, Kathmandu, Nepal. I recommend and forward his thesis to the Department of ICT Education to organize final viva.

.....

Supervisor
Asst. Prof. Arjun Singh Saud
(Department ICT Education)

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Defence Date:

Dedication

This thesis is

Hearty Dedicated to

My ç, Guru, Grand Parents, Parents, beloved dear Friends, Students and Directly or Indirectly loving and caring Person who find their happiness in my success and my teacher who made their endeavour to make me literate. I will always be so kinds of their love, affection and inspiration.

Dharmendra Prasad

Declaration

I hereby declare that to the best of my knowledge this thesis is original; no part of it was earlier submitted for the candidature of research degree to any university. To the best of my knowledge and belief, this dissertation contains no material previously published by any authors except if acknowledgement has been made.

Date.....

Dharmendra Prasad

Acknowledgement

I would like to express my gratitude to my assistant professor of M.Sc. CSIT and Visiting Faculty of M.Ed. ICT thesis supervisor, Mr. Arjun Singh Saud sir, T.U., for his continuous support and assistance to complete the research as well as creative suggestion for research, who have shared his precious time during the process of research.

Similarly, I am grateful to Assoc. Prof. Romakant Pandey, Head of Department ICT, T.U, Kirtipur, Kathmandu for his inspiration, guidance and support during the research.

Furthermore, I would like to thank the Department of ICTE, faculty of education, T.U. Kirtipur for providing this big opportunity to conduct the research from which I have collected valuable knowledge which are precious for my upcoming future.

Finally, I like to thank teachers, principals and all the students, who have shared their time during the research, friends, who inspired me to study further study as well as I like to thank my family members, who provided support and encouragement to me to do every work during my study.

Abstract

Blended learning over traditional learning is online and chalk-Duster combined strategy to teach to the student physically and remotely using the online tools and technology throughout the world.

This research entitled **"A Comparative Study of Blended Learning vs. Traditional Classroom Instruction in Secondary Level ICT Education"**. Its main objectives were to find out the differences of using blended learning over traditional learning and student's perceptions of +2 students of Computer Science. Kirtipur municipality's community schools were in the procedure of random sampling. Researcher divided students in two groups Traditional & Blended. Pre & post Test were conducted for data collection after teaching for 15 days. Along with principal, teacher were selected for challenges and students their perception of while using ICT in class room. Two-tailed test was used to evaluate it at a significance level of 0.05 using Excel v2007 program.

Finally, the experimental group performed better over the control group by a wide margin. As a result, the study found that using blended learning to teach students in a classroom setting or at a different location due to illness or other significant events can be beneficial. Student perception found positive to apply. As per the principals & teachers respectively of both schools, a small shortage of computers and internet access, a lack of time restrictions, a need for some training in knowledge and abilities, and a progressive lack of financial support from the SMC were problems for instructors using ICT tools.

Keywords: *Blended Learning, Traditional Classroom Instruction (chalk-Duster), ICT Education, Comparative Study, Technology*

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List of Abbreviation

A.D.: Anno Domini (English Date).

CCNA (Cisco Certified Network Associate)

COVID-19: Corona Virus Disease-2019 A.D.

CS: Computer Science

CSIT: Computer Science in Information Technology

CTML: Cognitive Theory of Multimedia Learning

Govt.: Government

ICT: Information and Communication Technology

LMS: Learning Management System

MoE: Ministry of Education

PTA: Parents Teacher Association

SMC: School Management Committee

TU: Tribhuvan University

Chapter: 1. Introduction

1.1. Background

The development of the internet and online education is a story of how new technology has changed the face of learning. The U.S. Department of Defence developed ARPANET in the 1960s, a forerunner to the current internet, which is where the internet got its start. The World Wide Web was founded in 1991 by the work of Tim Berners-Lee as a result of the internet's subsequent international expansion over the following few decades. This was a turning point that made the internet widely usable.

According to Bergmann & Aaron, (2012), "introduce the concept of flipping the classroom, emphasizing the use of technology to deliver instructional content outside of class and promoting active, collaborative learning during class time. This approach, which gained prominence in the field of blended learning, aims to personalize education and improve student engagement, making it a pivotal resource in redefining pedagogical practices". It consist the students engaged with instructional content at home through online materials, videos, or readings and then using class time for active learning, discussion, and problem-solving.

According to Garrison & Kanuka, (2014), delve into the changing face of higher education. Their research examines the idea of blended learning, a pedagogical strategy that seamlessly combines in-person education with online components, and its potential to significantly alter the way that people learn. Blended learning has increased student involvement, flexibility, and the successful incorporation of technology in education to adapt and improve the modern educational experience.

In the disciplines of teaching and learning, the use of blended learning has grown in popularity. It has been utilized for scientific researches, education-related conferences, workshops, and trainings effectively including multimedia contents in same place or different location stay connected with online tools and technology. It has another essential resource for teachers in the current teaching coordination. Teachers of all grade levels and specialties now accept slides, website

references presentations. With its beautiful design and multimedia projection equipment, this tool has improved learning.

It was also found that online classes were beneficial for the students to develop four language skills, social skills and personal skills. It was also found that online classes engaged the students in meaningful interaction for sustaining their speaking skill from regular feedback of their group members to their performance and also found that student had a positive attitude towards online classes to learn. (Dahal, 2022).

The improvement learning outcomes; blended learning has attracted a lot of attention in the field of education. This strategy blends conventional classroom instruction with online components (Hrastinski, 2019), emphasizes in his research, providing students with a flexible and interesting learning environment. To accommodate different learning styles and paces, customised learning paths can be created by combining digital resources, forums, and multimedia assets. Additionally, blended learning promotes student engagement and collaboration, deepening their comprehension of the subject. It is a useful tool for fitting various student demands and schedules because of the flexibility it offers in terms of time and location, which eventually leads to better educational outcomes.

The use of digital contents in the classroom has gradually risen to popularity in education (Gillespie, 2022). To improve the learning experience, teachers are choosing multimedia instructional materials over static or hardcopy resources. However, educators must not only be familiar with the content of these materials before integrating them into the classroom, but also prepare relevant teaching resources, which can be time-consuming (Weng, Yang, Ho, & Su, 2018). This shift toward interactive instruction is consistent with blended learning, which makes use of both offline and online resources to accomplish educational objectives. Although the use of ICT tools and multimedia projectors might be advantageous for teaching and learning, it can also provide difficulties for teachers.

The history of computer Nepal was nearby 1930s in establishment of Technical Training Institute. (Giri, 2017). The "One Laptop per Child" (OLPC) program, which aims to offer accessible laptops to students in Nepal, is one

outstanding project. The program focuses on rural and remote regions with insufficient access to technology and high-quality education. The Teachers and students having access to digital resources, they can improve their learning. Open Learning Exchange Nepal (OLE-Nepal) is an organization which enhances the access the education through the joining of ICT in classroom. It has given laptops to 15000+ students of government school especially in far-western students of 34 districts (OLE-Nepal, 2023). ICT labs, computers in schools, computers for teachers, a suitable number of computers, and multimedia projectors in each RC and training facilities are all included in the ICT master plan of Nepal 2013-2017's policy (MoE, 2013). By creating an environment that is ICT-enabled learning, including institutional and professional capability of managers and implementers, and based on need and context, it is possible to improve classroom delivery (MoE, 2016).

By creating an environment that is ICT-enabled learning, including institutional and professional capability of managers and implementers, and based on need and context, it is possible to improve online delivery (MoE, 2016). The option to study computer science as an elective topic is still available in the school curriculum, and the first SLC graduates with computer science degrees started to appear in the SLC examinations in 1995 and afterwards. The efforts to incorporate ICT into programs for teacher preparation and professional development, however, they only extend to programs for trainer development and the provision of multi-media labs in training centres under the auspices of the Ministry of Education's (MOE) four National Centres for Educational Development (NCED) systems (Dhital, 2018). According to the DoE final report on the use of ICT and its sustainability in school education, 49.01% of respondents identified computer use in schools as a means of learning with audio/video programs, compared to 29.21% for administrative tasks and 20.30% for both 0.99%, (DOE, 2016).

The 2007 Provisional Constitution of Nepal recognized the right of all persons to an education as a fundamental human right. The 10th Plan (2002-2015), the Three Years Interim Plan (TYIP, 2007-2010, 2010-2013), and the School Sector Reform Plan (SSRP, 2009-2015) are just a few of the policies and initiatives that Nepal has established and put into place that place an emphasis on ICT in education. The Ministry of Education (MOE) of the Government of Nepal (GON) has implemented a

number of measures to help Nepal accomplish its educational objectives. One of the ways to improve education is through the use of information and communication technologies (ICT). Despite these numerous initiatives, there has not been any appreciable advancement in school-based computer education. Despite several initiatives to improve teaching and learning, the majority of schools continue to reach the complete learning with real and virtual learning anywhere and whenever.

The primary objective of this study was to evaluate the comparative effectiveness of blended learning, incorporating multimedia contents with internet connectivity for making comparison to traditional classroom teaching methods. Additionally, the study sought to investigate the effectiveness that what is the outcome of making it in broader way of using it. Several crucial aspects related to educational advancement, teaching methodology, and learning activities patterns warranted investigation. Consequently, the researcher was inspired to assess the impact of blended learning on classroom teaching for finding the outcome.

1.2. Statement of the Problem

In Secondary level ICT education, Teachers and students of computer science are looking for new methods of instruction nowadays. Due to the flexibility of the location and time in online learning, traditional face-to-face pedagogy is changing to e-pedagogy and, specifically, online learning. However, some instructors and students doubt the value of learning computer science using various online resources. Different universities, including TU, KU, and some other institutions, are providing online education utilizing synchronous tools even to teach CS in the context of Nepal. Due of the Covid-19 epidemic, secondary schools in Nepal are required to teach CS via an internet approach. Computer instructors, students, and stakeholders are becoming aware of the effectiveness of online instruction.

In order to teach computer science in his school, the researcher has been using the web program Zoom. However, fewer students are logged into the Zoom class at first because of not able to use it. Similar difficulties were encountered by the researcher when implementing online instruction in his school, including issues with accessibility, efficacy, the need for ICT expertise, modalities, etc. The researcher has observed that while some instructors and students are supportive of online learning,

others are not. Therefore, it was unclear what the actual attitudes of teachers and students were about adopting online technologies to teach and learn computer science. In order to better understand how teachers and students feel about using online resources to teach and learn computer science, the researcher set out to conduct a study.

The following research questions are the major focus of the study:

- What is the overall effectiveness of blended learning in comparison to traditional learning methods across various subjects and grade levels?
- What are the attitudes of teachers towards the implementation of blended learning as opposed to traditional teaching methods?
- Are there significant differences in student satisfaction and motivation when using blended learning as compared to traditional learning?
- What are the challenges and barriers faced by educators in transitioning from traditional teaching to blended learning?
- Does the effectiveness of blended learning vary across different subject areas or age groups of students?

1.3. Rationale of the Study

In essence, the relational component of the study informs the reader about how the studies contribute to future research. But it is important to be clear about what the study may provide and who will profit from it.

The purpose of this study was to determine how secondary level students of twelve class's Computer Science actually felt about blended learning. When this research is finished, the researcher and other stakeholders will have a grasp of the undergraduate students of Kirtipur Municipality in Kathmandu's district attitude toward e-learning. The use of blended learning strategy can help students' academic achievement in multiple manners. Although technology has a significant impact on the teaching and learning environment in the classroom, there are still certain challenges with the use of ICT in the classroom. This study has looked at important data on technology-integrated classrooms, which is seen to be an essential element of today's teaching.

The study will provide a thorough review of the advantages and disadvantages of blended learning. This study focuses on the fundamentals of Kathmandu undergraduate students' attitudes regarding blended learning. The conclusions, concepts, and approaches may be useful for the particular field. This study will be helpful for all educators, subject matter specialists, students, undergraduate institutions, and the government.

1.4. Objectives

1. To compare the academic performance of Secondary level students in ICT education under blended learning and traditional classroom instruction settings.
2. To find perception of students towards blended learning.

1.5. Research Questions

1. To what extent are students satisfied with the blended learning approach compared to traditional classroom instruction in ICT education?
2. What are the main reasons behind students' preferences for one instructional method over the other?
3. What the challenges will be faced under the Blended Learning implication in the schools?

1.6. Significance of the Study

This study is very important since it aims to demonstrate the most effective methods for teaching ICT in secondary schools. This is crucial because technology is changing the way we learn, and we need to know how to use it effectively. The study's conclusions can provide instructors and those in charge of making decisions regarding how schools are managed with clear guidelines. Traditional classroom instruction or blended learning, which mixes in-person and online learning, is also options available to them. This choice can keep students' attention, boost their enthusiasm for studying, and help them achieve higher test results.

What we learn here has the potential to immediately affect how educators use technology in the classroom and how teachers instruct. Additionally, it can provide a learning method that accommodates each student's speed. Finding the best approach will help us improve secondary school teaching and learning. Additionally, the worldwide impact of this research is significant given how technology is altering education globally. What we discover here can assist educators worldwide in determining the most effective ways to teach in the digital age. In the end, this research can enhance student learning outcomes and ensure that they are adequately prepared for the future.

1.7. Delimitation of the Study.

The research study's scope and methodology were affected by a number of delimitations. First, the study focused on two public schools in the Kirtipur Municipality of Kathmandu district. For the purpose of gathering quantitative data, it specifically selected twelve class Computer Science students from Jansewa Secondary School and Mangal Secondary School. A total of forty participants were sampled for the study, which also included two computer teachers and two principals from these schools

The study focused on the twelve class's computer science syllabus and tried to evaluate the challenges teachers have while implementing ICT technologies at the secondary level. Forty students were divided into two groups 15 and 25 for the study's as number of students available in the schools in ratio 2a control group and an experimental group. A collection of 40-mark questions covering a range of topics, including knowledge, understanding level, skill level, and ability to solve problems, was generated by the researcher. The study's usage of the blended learning and traditional learning was the primary focus, it is important to highlight. The research used achievement assessments and open-ended interviews to collect data.

1.8. Hypothesis of the Study

A hypothesis is the tentative assumption which can be explored through observation and empirical testing, and leads us onto more sophisticated ways of

collecting data and deeper interpretation of research results. A hypothesis is a statement about an expected relationship between one or more independent variables and one dependent variable. (Gupta & Pandey, 2007). It is an assumption that is put to the test during the research process in order to examine the study's findings.

1.8.1. Null Hypothesis

Null hypothesis of this study is the proposition that implies no effect or no relationships between populations. There was no significant difference between the students' achievements in blended learning or Traditional Learning.

i.e.H_0:$\mu_1 = \mu_2$ (μ is a symbol named as 'mu' for statically representation)

Where,

H_0 = Null hypothesis

μ_1= mean score of blended learning group

μ_2 = mean score of traditional learning group

1.8.2. Alternative Hypothesis

An alternative hypothesis is one that demonstrates differences between the final results of two test variables. The significant outcome of the students when utilizing a blended learning in comparison to tradition learning was different.

i.e.H_1: $\mu_1 \neq \mu_2$

Where,

H_1 = Alternative hypothesis,

μ_1= mean score of blended learning group

μ_2 = mean score of traditional learning group

1.9. Definition of the Key Terms

Blended Learning: Blended learning combines in-person teaching with online activities to create a mixed approach to education.

Traditional Classroom Instruction (Chalk-Duster): Traditional classroom instruction refers to the conventional method of teaching where teachers interact directly with students in a physical classroom setting.

ICT Education: ICT education focuses on teaching Information and Communication Technology skills to students.

Comparative Study: A comparative study involves analyzing and contrasting different approaches or methods to understand their differences and similarities.

Technology: The collections of tools, ideas and methods making easy to learn and understand.

Chapter: 2. Literature Review

2.1. Introduction

The integration of Information and Communication Technology (ICT) in education has been recognized as a promising approach to enhance learning experiences and improve students' academic performance. In recent years, the pedagogical landscape has witnessed the emergence of blended learning as an innovative instructional model that combines traditional face-to-face teaching with online learning activities. Blended learning offers the potential to leverage digital technologies and personalized learning experiences, while traditional classroom instruction maintains a long-standing role in education, providing direct interaction between teachers and students. In this literature review, we explore existing research and studies related to blended learning and traditional classroom instruction in the context of Secondary level ICT education, aiming to understand the differing potency of these two methods of instruction.

2.2. Definition Blended Learning in ICT Education

Blended learning has gained increasing attention in the educational domain due to its potential to cater to diverse learning styles and preferences. Studies by Hew & Brush, (2007) & Graham, (2006) highlighted the benefits of blended learning in enhancing student engagement and providing flexibility in ICT education. The flexibility of online learning materials allows students to access content at their own pace, fostering self-directed learning and allowing teachers to focus on more personalized instruction and support (Pilgrim & Bledsoe, 2012). Additionally, researchers like Garrison & Vaughan, (2008) argued that blended learning environments can promote collaborative learning through online discussions and group activities, which can positively impact students' understanding of complex ICT concepts.

Blended learning is playing a great role in the secondary level for the best outcome in the result of understanding the topic and its concept for the better learning (Paudel, 2020).

2.3. Theory of Traditional Classroom

Traditional classroom instruction, with its direct teacher-student interaction, remains the most common mode of teaching in educational institutions. In the context of ICT education, studies by Yelland, N. & Masters, J. (2007) as well as Means & et. all, (2010) acknowledged the role of traditional classroom instruction in providing structured learning experiences and promoting social interaction among students. The immediate feedback and clarification from teachers in face-to-face settings can address students' queries and misconceptions more efficiently Oliver & Herrington, (2001) Moreover, Zainuddin & Attaran, (2016) noted that the physical classroom environment encourages active participation and immediate discussions, leading to better retention of ICT knowledge.

2.4. Comparative Studies

Several comparative studies have investigated the effectiveness of blended learning and traditional classroom instruction in Secondary level education. For instance, Clark, R. C. & Mayer, R. E., (2011) conducted a meta-analysis and concluded that blended learning environments tend to yield superior learning outcomes compared to purely face-to-face or online instruction. However, other research, such as that by Bernard, et al., (2009) found mixed results, with no significant difference in academic achievement between blended learning and traditional instruction.

2.5. Engagement and Satisfaction

Student engagement and satisfaction play pivotal roles in the learning process. In a study by Garrison & Kanuka,(2004) students reported higher levels of satisfaction with blended learning in comparison to traditional classroom instruction. However, Kahu, (2013) found that engagement levels can vary depending on factors such as instructional design, teacher-student interaction, and the nature of online activities.

2.6. Implication of the Review for the study

The literature on blended learning and traditional classroom instruction in Secondary level ICT education highlights the potential benefits of both approaches.

Blended learning appears to offer advantages in terms of flexibility, personalization, and collaborative learning experiences, while traditional classroom instruction excels in immediate feedback, social interaction, and active engagement. However, the effectiveness of each approach may vary depending on the context, instructional design, and student preferences. The proposed research study aims to contribute to this body of knowledge by conducting a rigorous comparative analysis to ascertain the most effective instructional approach in enhancing students' academic performance, engagement, and satisfaction in Secondary level ICT education.

2.7. Review of Related Literature

A literature review is an overview of the previously published works on a topic. The term can refer to a full scholarly paper or a section of a scholarly work such as a book, or an article. Either way, a literature review is supposed to provide the researcher/author and the audiences with a general image of the existing knowledge on the topic under question. A good literature review can ensure that a proper research question has been asked and a proper theoretical framework and/or research.

2.8. Cognitive Theory of Blended Learning

According to Norcross, Donald, & Gary, (2016), Cognitive theories are characterized by their focus on the idea that how and what people think leads to the arousal of emotions and that certain thoughts and beliefs lead to disturbed emotions and behaviours and others lead to healthy emotions and adaptive behaviour. The goal of this theory's development was to enable teachers to portray their teaching strategies in a variety of ways and promote meaningful learning. A meaningful teaching and learning environment that enables teachers to include various multimedia contents like audio, video, graphics, animation, interactive video and simulation technologies into their classes is supported by cognitive theory of multimedia learning. Three major premises underlie the cognitive theory of multimodal learning. This theory looks at how learning with multimedia tools affects the mental processes that go on during learning.

According to Mayer & Moreno, (1999), Cognitive Theory of Multimedia Learning, information delivered in both text and visuals can lead to deeper learning

than text alone. The assumption that there are two learning channels auditory and visual is the foundation of the multimedia learning theory. Both of these pathways are employed to transfer information into working memory.

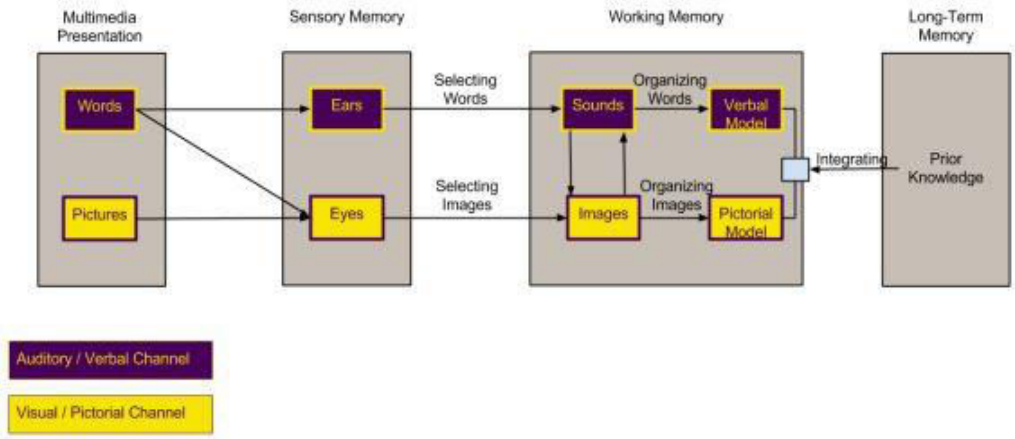

Figure 2.1. Cognitive Theory of Multimedia Learning

According to Clark & Mayer, (2003), definition, the seven following concepts can be used to analyze the multimedia theory of learning:

a. Multimedia principle: words and graphics are better than words alone
b. Contiguity principle: align words to corresponding graphics
c. Modality principle: present words as audio narration, instead on-screen text
d. Redundancy principle: explain visuals with words in audio or text, not both
e. Coherence principle: adding interesting material can hurt learning
f. Personalization principle: use conversational style and virtual coaches
g. Segmentations and Pertaining principle.

To make learning more efficient and effective, the cognitive theory of multimedia can be illustrated. With this learning theory, several learning abilities are linked.

When creating instructional narrative messages to increase learning satisfaction and achievement, the CTML as a conceptual framework has a great deal of potential to become the main direction for best practices. A coherent presentation is represented by the organization of words and images, while the integration of words

and images represents the association of the presented material with prior, pertinent knowledge stored in long-term memory (Shamim, 2018). CTML illustrates various cognitive processes that contribute to learning. The setting of various media kinds, which ties learning to the cognitive process, is the main focus of the cognitive theory of multimedia learning. The idea places a lot of emphasis on choosing, arranging, and integrating instruments for teaching and learning in a systematic way.

Cognitivists support for the study of people's cognitive development processes and models, hold that humans possess natural techniques of receiving, processing, and utilizing information at various cognitive development stages, and create several educational plans based on a person's demands for cognitive growth at various stages of development Ouyang & Stanley, (2014) cited as in (Acharya, 2019). According to this view, Students can use a variety of resources to further their learning, including the long-lasting encounters for them.

Blended learning combines a variety of delivery methods for efficient instruction. When new information temporarily enters sensory memory, active processing is required for learning. It promotes the use of multimedia projectors, smart board connected with internet to link instruction and course material. The principle of cognitive multimedia learning must be followed while choosing, organizing, and integrating technologies for blended learning. In order to illustrate the theory's central idea that multimedia tools can be used to create effective learning environments this study investigates the effectiveness of integrating multimedia projectors in education.

2.8.1. Anchored Instruction Theory

John Bransford and his colleagues created the instructional design paradigm known as "Anchored Instruction Theory" in 1983. It is predicated on the idea that learning works best when it takes place in real-world situations. According to the Anchored Instruction Theory, knowledge is better learned and maintained when it is embedded within a problem-solving scenario, or "anchor," which offers a relevant context for learning. The theory's main tenet is that students ought to be given issues or difficulties that call for the application of information in a manner that simulates real-world situations (Bransford, Sherwood, J.Vye, & Rieser, 1986). The Anchored

Instruction Theory utilizes organized video materials stay connected with online learning to teach complex content through narrative-based stories presented in a hierarchical manner. This approach promotes problem-solving in a video-based, interactive learning model known as "anchor instruction". The pandemics started two years ago, we have seen an increase in alternative learning approaches. Most of them run well in areas with good internet networks, allowing for proper online course-based blended learning. However, there are still few studies focusing on rural areas with poor internet connectivity (Prahmana, 2021).

Anchor instruction leverages technology to facilitate learning with video aids. It's particularly useful when traditional methods fall short in problem-solving scenarios. Technology-driven activities motivate learners to develop problem-solving skills by presenting content through storytelling via videos, connecting learners to real-world challenges. This theory underscores the efficacy of multimedia projectors in addressing complex problems within the teaching and learning process.

2.8.2. Constructivism Theory and Blended Learning

The constructivism learning theory is a way of thinking that values fresh encounters and useful knowledge. Jean Piaget is credited as being the creator of constructivism. This theory, which mainly focuses on learning the results of actions from prior experiences, is used to explain how people know and what they know. Additionally, because cooperation with others is the most crucial component of a constructivist classroom, learners can take an active role in their learning. Constructivism is a theory about knowledge and learning; it describes both what "knowing" is and how one "comes to know." based on work in psychology, etc (Fosnot, 2015).

According to Machumu & Zhu, (2017), it is expected that the study provides useful and new understanding into students' conceptions of constructivist learning that could be considered when designing relevant learning activities to be engaged in CBLE because their real constructivist engagement depends on conceptions such as active participations, self-directed inquiry and shareable learning experiences. Furthermore, it is anticipated that students' 270 H. Machumu and C. Zhu

constructivist conceptions and their engagement in CBLE empower successful student constructivist learning Blended and constructivist learning are distinct educational approaches, each with unique benefits. Blended learning, combining online and in-person teaching, enhances constructivist principles for a robust learning environment:

a. Flexibility: Blended learning empowers students to access materials at their own pace, fostering in-depth exploration of topics.
b. Active engagement: Constructivism values active learning and blended approaches integrate interactive online resources, simulations, and multimedia to encourage students to construct their understanding actively.
c. Personalization: Blended learning allows tailored instruction, aligning with the constructivist view that learning is a personal and individualized process.
d. Collaboration: Blended learning platforms facilitate social interaction and collaborative learning, whether in person or online.

According to constructivist theory, students actively construct their understanding by interacting with and articulating what they already knows. In the learning process, active engagement that is driven by thinking and doing produces worthwhile outcomes. In classrooms, a variety of instructional technologies are used, including multimedia projectors that integrate audio, video, and animations, online learning tools like Zoom, and teams. This method improves teaching and learning by assisting students in synthesizing prior information. Modern education is heavily reliant on technology, and constructivist multimedia learning makes extensive use of a variety of technical instruments to promote deep learning.

The comparative study of blended learning versus traditional classroom instruction in secondary level ICT education served as the foundation for this study. From the perspective of constructivism, the usefulness of using a multimedia projector and online communication tools in classroom instruction may be seen. The use of online videos, audio files, and texts, real-time video conferencing software (such as Zoom, Teams, etc.), digital content displayed on a multimedia projector, and a smart board can all help to engage students in the teaching and learning process and encourage an interactive environment for them. After the audio and video discussions, teachers and students can discuss their ideas, which may inspire them to participate in

this kind of educational process. Additionally, the active engagement in knowledge construction during interactions with the aid of technology tools might result in successful outcomes in comparison to traditional teaching and learning methods. This philosophy enables the pupils to solve complicated problems collaboratively and by sharing ideas. This study therefore has a constructivism base, which holds that information is created by participation in the learning process while using classroom resources and which unquestionably improves teaching. In conclusion, blended learning can be a successful teaching strategy.

2.8.3. Connectivism as Learning Theory

According to Kilag & et all, (2023), Connectivism-based instruction can be a viable approach to enhance student learning and engagement in the 21st -century learning environment. The study contributes to the existing literature on Connectivism theory and blended learning, particularly in the Philippine setting, and provides implications for educators and policymakers in designing and implementing effective instructional strategies that integrate technology and social networks. It can be defined as " Connectivism is the thesis that knowledge is distributed across a network of connections, and therefore that learning consists of the ability to construct and traverse those networks." (Hendricks, 2019).

This theory has given rise to a brand-new method for expanding information in the internet world. The introduction of the Connectivism paradigm has greatly revived modern pedagogy. Its applicability is demonstrated by the fact that the idea describes online learning practices more effectively than constructivism, behaviourism, and cognitive theories. The life of knowledge is assessed in months and years due to the rate at which the criteria for measuring it are changing as a result of technological creation. According to Center, (2022), 81% of US teenagers say they use the internet for schoolwork. A 2023 report by the International Telecommunication Union (ITU) found that 67% of the world's population now uses the internet, and that this number is growing rapidly in developing countries.

The nodes in the conceptual network act as archives for concepts, ideas, and thoughts within the connectivist framework. During cognitive processes including

thinking, dreaming, visualizing, and daily life, information, life experiences, and events move across this mental landscape (Smith, Johnson, & Davis, 2014).

According to Connectivism, the conceptual network operates independently of the physical universe, with information flowing both consciously and subconsciously roughly 98 percent of it subconsciously. This learning theory is based on the idea that learning is a continuous process, and it is defined by the interaction between information sources and practical knowledge, which creates knowledge networks. Additionally, it highlights the crucial role that internet technologies play in the distribution of knowledge in our contemporary scientific milieu and acknowledges the dynamic character of ideas and knowledge. Connectivism explains how new learning opportunities provided by technological improvements encourage diversity by connecting people through multiple social networks.

So, finally, the theory mentioned earlier is supported by this research because blended learning is a component of contemporary instruction. It can also be utilized to access internet technologies while lecturing. Connectivism thesis serves as the study's theoretical foundation.

2.9. Review of Empirical Literature

Dr. Johnson, (2022), Studies comparing blended learning and traditional learning had some important results. Students in the blended learning group did better academically than those in the traditional learning group. This was because blended learning allowed students to use online resources at their own pace, making learning more effective. Moreover, the blended learning students were more engaged in their studies. Online tools in blended learning helped students collaborate and stay motivated, which was not as common in traditional classes. This improved engagement had a positive impact on learning, even more so than in traditional classes. In terms of the overall learning experience, students in blended learning were happier. They liked the flexibility of blended learning, which suited different learning styles and preferences. This made their educational experience more positive and enriching. In conclusion, shows that blended learning is a better choice than traditional learning. It improves academic performance, boosts student engagement, and increases satisfaction suggests by schools and teachers.

Al-Nofaie, (2018), numerous studies consistently demonstrate that blended learning surpasses traditional teaching across various subjects and grade levels. Blended learning presents several distinct advantages. Firstly, it offers flexibility by allowing students to learn at their own pace and in alignment with their individual learning preferences, which can be especially advantageous for those needing extra time to grasp concepts or having diverse learning styles. Secondly, it broadens students' access to a wide array of learning resources that go beyond what traditional teaching can provide. Online materials enable exploration of topics not covered in the classroom and offer additional support for challenging concepts. Lastly, blended learning tends to be more engaging for students, as it incorporates diverse learning activities such as hands-on experiences, simulations, and online games. This multi-faceted approach captures students' interest and maintains their motivation.

Shah, (2020), conducted the research entitled "Student's Perception towards the Relevance of Blended Learning." His main objective was to explore the student's perceptions towards the relevance of blended learning in English language teaching. He selected the students of Central Department of English Education, Tribhuvan University, Nepal as the sample of his study. He conducted the questionnaire to collect data. The obtained data were tabulated, analyzed and interpreted. He found that blended learning was better which would enhance the quality of education.

Acharya, (2019), an investigation titled "Effectiveness of Using Multimedia Projector in Classroom" was undertaken. Her main goal was to determine whether a multimedia projector was beneficial for classroom instruction. She chose one of the two community schools' Kapilvastu district students. She divided her class into traditional and blended learning groups and conducted an experiment with them, analyzing and interpreting the results of pre- and post-tests. She discovered that a multimedia projector may be a useful tool for classroom instruction and that it can be used in conjunction with online courses to create blended learning.

Chauhan, (2021), a research project titled "Use of Information and Communication Technology" was undertaken. His main goal was to look at the ICT resources used in English language instruction and to pinpoint their functions. He

chose the fourth-semester M.Ed. students at T.U. at the Central Department of Education. For data collection, he used both closed- and open-ended questionnaires. The gathered data were examined and explained. According to their opinions, using ICT tools to learn English helps students become motivated, engaged, and independent which assist as online learning and remotely as blend of learning method.

Tamang, (2022), a study on titled "Perceived Learning and Satisfaction with Online Learning among Management Students during COVID-19 Pandemic" was conducted. His main goal was to successfully implement online learning in Covid-19 pandemic classrooms in a way that would change students' perspectives on learning and their level of satisfaction with it. From both urban and rural areas, he recruited a variety of college students. Using IBM SPSS 25, descriptive and correlation analysis were conducted. Using the SmartPLS 3, the data were confirmed, and the mediation impact was examined. Learning served as a sort of mediating factor in the relationships between learner-interface contact, teacher-student interaction, course design, and learning enjoyment.

Thapa, (2022), started up the research entitled as "Integrating information communication technologies (ICTs) in learning English at bachelor level". Her primary objective was to explore how people felt about using ICT tools for English language acquisition. She chose B.Ed students and instructors from T.U.'s component campuses. She created a closed-ended questionnaire to collect data. She also conducted data gathering interviews with teachers. Data were gathered, examined, and both statistical and descriptive interpretations were made. They believed that using ICT tools to learn English helped students become motivated, involved, active, and autonomous.

Bashyal, (2021), conducted research entitled on "Undergraduate Student's Attitude Towards E-Learning". The primary objective was to learn what people thought about the Kathmandu Valley's undergraduate students' attitudes about e-learning. For the purpose of gathering information from Kathmandu Colleges via an online Google Form, open-ended questions were created. Positive attitudes among students toward e-learning have been observed.

Karki, (2021), performed the research entitled on "Undergraduate Student's Attitude towards Challenges of English Language Teaching and Learning through Digital Connectivity during COVID-19 Crisis". His primary goal was to learn how people felt about online learning as opposed to face-to-face instruction. In order to gather data, six teachers and students were chosen to complete an open-ended questionnaire. Simply put, ICT-friendly students are effectively transitioning to the online as blended learning platform from the offline world.

Badaila, (2021), attempted to do research on "Relevancy of Online Classes in Mathematics Education". Conducted to find out what students thought about the value of online math classes. This study's major goals were to examine the potential that students consider while enrolled in online mathematics classes in Nepal as well as the barriers that prevent students from learning mathematics online. During the academic year 2077 at Tribhuvan University, the sample consisted of 100 students for the questionnaire and 10 students for the interview. They were enrolled in the first and fourth semesters of a master's program in mathematics instruction. Closed-ended and open-ended questions were included in the questionnaires and interviews used to collect the data. They concluded by saying that students might benefit from online teaching if it were combined with traditional classroom lectures on some subjects.

Chhetri, (2022), completed the research on "Students' Perception of Online Learning during Covid-19: A Cross Sectional Study in University Campus, Kirtipur" attempted to evaluate the efficacy of online courses. The study's titled "Students' Perception of Online Learning during Covid-19: A Cross Sectional Study In University Campus, Kirtipur". This study used a cross-sectional survey and a quantitative approach to gather the necessary data from 306 students using trustworthy (Cranach's Alpha of 0.86) self-administered questionnaires. According to the survey, the majority of respondents (58.2%) are male, nearly two-fifths of them are Brahmins, and agriculture accounts for half of their family's occupations. Over three-quarters of respondents received B+s (3.3/First Division) in MA, while about half of them received B+s (3.3/First Division) in BA. More than three-fifths of them (68%) had never taken a PCR/Antigen test, and just over half (51.3%) had remained in home quarantine. Most students are happy with the accessibility, cognitive and

behavioural effort, teaching techniques, extrinsic motivation, advantages, drawbacks, and efficiency of online learning. The final recommendation was that blended learning was successful adorable in COVID-19.

Tharu, (2023), performed the research on "Bachelor Level Students' Perceptions towards Learning English through Virtual Learning Modes and Their Current Practices". It was intended to discover more about how bachelor-level students now see and use virtual learning environments. A survey design was used for the investigation. Students at the Bachelor's level completed surveys with Likert scales to provide the data. Using simple random sampling, 100 students from the Banke district were chosen as the sample size. Five different campuses provided participation. The results indicate that a sizable majority of participants gave using Zoom for virtual class's top priority. Similarly, a large percentage of the participants agreed that Zoom provides lots of opportunity for learning. Because it saves time, the majority of participants also chose virtual learning methods. Virtual learning environments are beneficial for learning, according to the vast majority of respondents.

Nepal, (2018), did the research on "Use of ICT in English Language Teaching at Secondary Level". This study's major goals were to investigate how ICT is used in English language instruction and to evaluate how it affects English language learning. This study employed a qualitative descriptive research design. In addition to reviewing some associated documents, the studies principal data gathering methods included an observation diary and semi-structured interviews. Five teachers from Kathmandu Valley public schools were purposefully chosen and interviewed in order to meet the goals. Twenty courses were similarly monitored to gather the necessary data. The study's conclusions demonstrated how using ICT in the classroom aided pupils in learning more effectively. It inspired and encouraged students to actively participate in teaching and learning activities.

Tamang H. , (2018), did the research on "Perception and Use of Information and Communication Technology by Tamang Students in Learning English". Information and communication technology is rapidly being used in Nepalese schools

for English language teaching and learning. This study also looked that how secondary-level (Grades 11 & 12) students used ICT to learn English. In order to complete this study, I combined a quantitative and qualitative approach, and I used the descriptive method to collect field data. Forty Tamang students were chosen as a sample for this study using a non-probability sampling approach in order to ensure their involvement in the study. He also created a questionnaire and interview procedures to collect data from the field. Forty Tamang kids from the Kathmandu Valley who were in grades 11 and 12 were subjected to preliminary tools that had not yet been constructed. To study the role of ICT in English language learning, he also led concentrated group discussions. Additionally, it was discovered that they are utilizing ICTs to improve their English language proficiency by participating in a variety of activities with the aid of mobile, computer, and audio-video devices, such as speaking, listening, reading, and writing exercises. Finally, they proposed that students learn the English language in their own way, using ICTs wherever they go and live, including inside and outside of the classroom.

2.10. Conceptual Framework

The conceptual framework of this research is represented as:

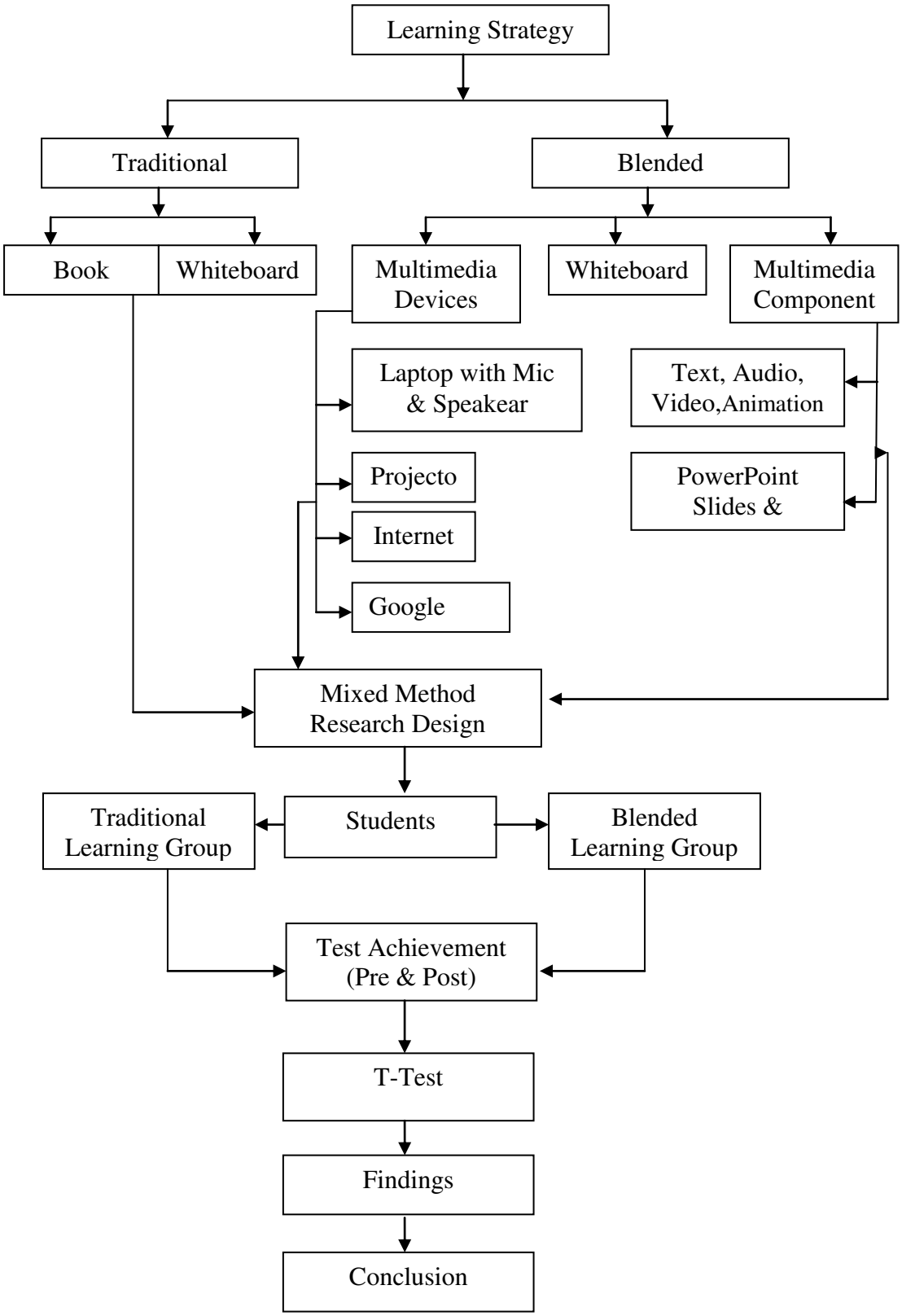

Figure 2.2. Conceptual Framework of Traditional & Blended Learning

Chapter: 3. Research Methodology

According to Creswell & Clark, (2018), research methodology is "the process of designing and conducting research studies in a way that is rigorous, systematic, and ethical".

3.1. Research Design

According to Kerlinger, (1978), Research design means an overall framework or plan for the collection and analysis of data "Research design is a plan, structure and strategy of investigation conceived so as to obtain answer to research question and to control variances". According to Paul & Jeanne, concise definition of research design in "Practical Research: Planning and Design," research design is the structured strategy that specifies how a research study will be carried out, from developing research questions to gathering data, analyzing it, and presenting the results. It acts as a guide for doing research, guaranteeing methodological soundness and precision in addressing study objectives.

A framework for finding the answers to research questions is known as research design. The embedded technique was used to finish the research process in this study, which was based on a mixed-methods research design. The researcher used an achievement test to gather quantitative data, while an interviewing tool was used to gather qualitative data. Two groups; a control group and an experimental group were created from the sample populations. Traditional learning strategies were used to teach the control group, whereas blended learning strategies were used to teach the experimental group.

Groups	**Pre-Test**	**Strategies**	**Post-Test**
Traditional (A)	A_1	Teaching with Traditional Learning (T1)	A_2
Blended (B)	B_1	Teaching with Blended Learning (T2)	B_2

Table 3.1 Group of the Students

Where,

A_1= Pre-test average marks of Traditional Group,

A_2= Post-test average marks of Traditional Group,

B_2= Pre-test average marks of experimental Blended Group,

B_2= Post-test average marks of experimental Blended Group,

T_1= Teaching with Traditional Learning Strategy,

T_2= Teaching with Blended Learning Strategy,

Before the procedure, the student groups were comparable in nature. Procedure T1 was taught to the traditional group (A1), while Procedure T2 was taught to the experimental blended group (B1). A welcoming environment was established for the test, and their movements were closely monitored.

3.2. Source of Data

Different techniques are employed during the research process to gather data, which is then used as a main and secondary source of data. These two approaches had thus been used in the research process. The researcher used data from both primary and secondary sources.

3.2.1. Primary Source of Data

The students' pre-test and post-test results in computer science for grade 12 served as the primary sources of data for this experimental research. In addition, two students for perception additionally, teachers and principals provided qualitative information through the interview method.

3.2.2. Secondary Source of Data

Data from past studies that are gathered and used to interpret the current study are referred to as secondary sources of data. **:** It was also collected from published and unpublished documents. Journals, online library, tucl library, Google scholar, research reports, journal articles, magazines, books, the internet, blogs, and the DEO website.

3.3. Population and Sample of the Study

The researcher selected the secondary level schools of Kirtipur Municipality in Kathmandu District as a random selection of schools, and only twelve class students studying computer science were taken as a sample for the research. One computer and one other teacher as randomly selected with blended learning training achieved and the principal from both of the schools were selected to collect qualitative data through an interview tool. So, altogether, forty students and four teachers constituted the representative sample of the population for this study.

3.4. Data collection Tools

The primary data collection tools used in this study to conduct the research were the multiple choice performance evaluation and the open-ended questionnaire tool.

3.4.1. Performance Evaluation

First of all, Test papers with 40-mark questions were created for the study's initial phase on the basis of linked computer-related subject matter. To control the level of difficulty in the question paper, test items were developed through the pilot test. Additionally, the same test questions were given to both groups to administer. The pupils received the necessary information about the test. To compare student grades, the pre-test and post-test were used. Pre-test results were first compared between the two groups, and records were kept for the post-test comparison. Both groups took a post-test with the identical question structure after 15 days. In the test environments, the right instructions were given.

3.4.2. Open-Ended-Questionnaire

An interview is a useful way to gather detailed information about people's opinions, thoughts, and experiences. In this research, we conducted open-ended interviews to find out the effectiveness, perceptions and success over blended learning and challenges that teachers found when using available ICT tools and technologies. To get the best information, it's important to create a comfortable environment during the interview. By exploring these topics, we aimed to understand the effectiveness,

outcomes and challenges that teachers encounter when introducing ICT tools at the secondary level.

At the beginning of the interview, we built a good connection with the interviewees to encourage open and honest communication. We focused on asking questions about specific areas, such as:

A. Challenges

1. ICT Usage Success
2. Time and Tool Effectiveness
3. Knowledge and Skill Achievement
4. Economic Challenges Conquered

B. Students Perception

3.5. Testing Procedure Tool

Ensuring the legitimacy and dependability of the data gathering technologies was essential to ensuring the study's originality and integrity. The tools were created during this phase by the researcher under the guidance of their supervisor. Research got the help form professionals evaluated these instruments, and the researcher made the necessary adjustments in response to their recommendations by them. The supervisor then reviewed, approved, and validated the tools to make sure they were unique.

3.6. Data Collection Procedure

The process of gathering important information that serves as the basis for the research is known as the data collection procedure. This study's major objective was to compare blended learning with traditional classroom instruction in secondary-level ICT education.

First of all, In order to conduct the research, the researcher first went to the sample schools and asked permission from the school administration. The school administration, computer teachers, and students were all told of the study's objectives by the researcher before it was started. Before beginning the research process, the researcher notified each sample student about the teaching lesson plan and procedure as well as test-related material. The study had then been conducted for 15 days in order with the research objectives.

The students of schools were split into two groups by the researcher: one school students as control group and another as an experimental group. Pre-tests were given to both groups at the start of the data collection process, and post-tests were given afterward while controlling the additional variables. To ensure that the test took place in a relaxed environment, the researcher explained the rules and directions to every student regarding the pre-test and post-test. In the meantime, this study also included qualitative data. The open-ended-questionnaire tool was used by the researcher to gather qualitative data. Prior to the open-ended-questionnaire, the researcher briefed the students and teachers about the topic of interviews and set up a comfortable setting to gather more qualitative data.

3.7. Data Analysis and Interpretation Procedure

After collecting the quantitative data from the pre-test and post-test, the data were analyzed through various procedures with the help of tabulation, calculation, and graph using Microsoft Excel 2007. The test-items as pre-test and post-test were calculated, analyzed, and interpreted, and finally interpreted in a descriptive way. Quantitative data from academic assessments were analyzed using appropriate statistical methods. A comparative analysis of mean scores was conducted to identify any significant differences in academic performance between the two instructional groups.

Qualitative data from open-ended survey questions and students, teachers as well as principal's interviews were analyzed thematically to gain insights into students' experiences, satisfaction, and perceptions of blended learning and traditional classroom instruction. As a result, the degree of difference between the controlled and experimental groups due to the application of a blended learning was determined by applying a t-test with a two-tailed test and an acceptable level of significance of 0.05. Additionally, researcher looked at the qualitative data by using thematic methods. And coded and summarized the data and then discussed the findings.

3.8. Ethical Considerations

All of the participants' parents or guardians and the researcher were notified. Participants received information about the study's goals, their rights. The data privacy ware preserved, student data were anonymized and securely archived. Before starting study, permission from the school authorities was requested to proceed.

Chapter: 4. Data Analysis and Interpretation

In this chapter, the analysis and interpretation of the data gathered during the study process using the accomplishment test and interview instrument are covered in these topics. Using Microsoft Excel v2007 software, quantitative data were evaluated based on mean, standard deviation, variance, and a two-tailed t test with a significance threshold of 0.05. Then, using the information gathered from four instructors in two sampled schools, qualitative data were examined, and the key findings were categorized and developed into topic. The qualitative data were then discussed under various areas. Under the following headings, quantitative and qualitative data were evaluated and interpreted.

1. Pre-test Result Analysis
2. Pre-test and Post-test Results Analysis
3. Post-test Result Analysis

4.1. Pre-test Result Analysis

Pre-test mean value, S.D. (Standard Deviation), Variance, along with T-Tests value acquired by the control (traditional learning) and experimental (blended learning) groups have been calculated for the data that has been given for analysis and are depicted below.

Groups(Pre)	N	Mean($\bar{x}$)	Std.Dev(σ)	variance	T-value	Remarks
Control	29	15.86	4.138	17.123	2.039	2.039<2.871
Experimental	11	18.90	5.890	35.151		
df =31, P=0.007						Insignificant value at 0.05 level

Table 4.1 Pre-test Result Scores of Control & Experimental Group Table

In this study, there were two groups: the "Control" with 29 and the "Experimental" with 11 students respectively. The Control group had an average value of 15.86, while the Experimental group had 18.90, showing a slightly higher average. The Control group had a standard deviation of 4.138, and the Experimental

group had 5.890, indicating that the Experimental group's data was more spread out. The T-value, which helps determine if the groups are significantly different, was 2.039. This T-value is less than 2.871, suggesting no strong evidence of a significant difference. With 31 degrees of freedom, the P-value was 0.007, considered significant at the 0.05 level.

However, the label "Insignificant at 0.05" highlights that the difference in means between the two groups is not statistically significant, meaning it might be due to chance rather than a real effect. As a result, the null hypothesis (H_0: $\mu 1 = \mu 2$) was supported and the alternative hypothesis was rejected. It demonstrated that there was little difference in the pupils' academic performance before and after treatment.

The average scores, how spread out the scores are, and how scores differ between the two groups was all very similar. This tells us that before any changes or treatments, the students in both the Experimental and Control groups within each school were on a level playing field. It means they had a similar understanding of the lessons. We can see this similarity in the figure below, which compares the scores of the two groups.

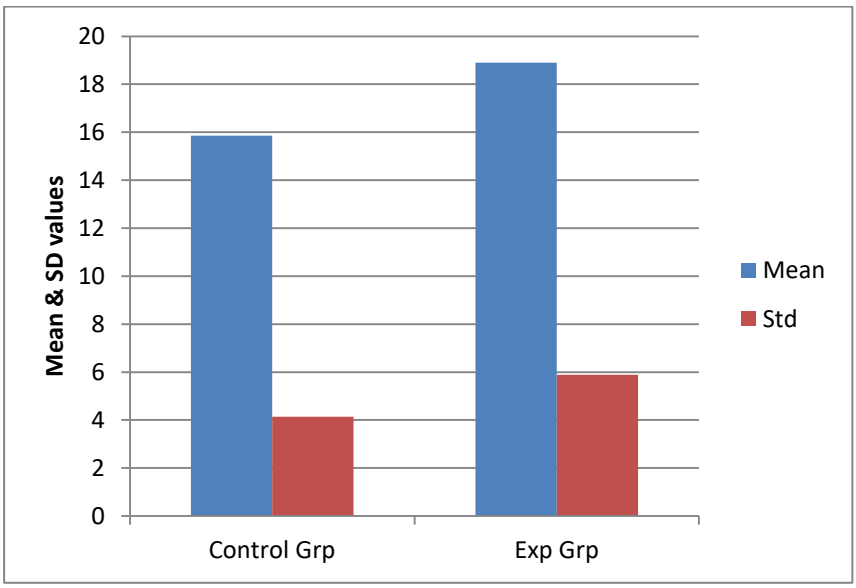

Figure 4.1.Pre-Test scores of students as Mean & SD Bar Diagram

4.2. Analysis of Pre-test and Post-test Score Comparison

The comparison of the pre-test and post-test findings with mean, standard deviation, variance, and t-value is given below in the table.

4.2.1. Control Group Pre-Post Test Achievement

Groups	N	Mean($\bar{x}$)	Std.Dev(σ)	variance	T-value	Remarks
Control Pre	29	15.86	4.138	17.123	2.003	
Control Post	29	16.24	3.521	12.403		
df =56, P=0.708						Insignificant value at 0.05 level

Table 4.2 Pre-Tests of Control Groups

In this paired samples t-test comparing "Control Pre" and "Control Post" data, we aimed to assess whether there was a significant difference between the two groups. The average value of "Control Pre" was found to be approximately 15.86, while "Control Post" had an average of about 16.24. The calculated t-value, which quantifies the difference between these averages, was 2.003, with 56 degrees of freedom. However, what's crucial here is the p-value, which was determined to be 0.708. This p-value represents the likelihood of obtaining a t-statistic as extreme as 2.003 under the assumption that there's no substantial difference between the two groups. The result is that the p-value is notably greater than the conventional significance level of 0.05. Consequently, the observed difference between "Control Pre" and "Control Post" is considered statistically insignificant at the 0.05 level. In simpler terms, the data does not provide sufficient evidence to conclude that there is a significant change between the two time points.

4.2.2. Experiment Group Pre-Post Test Achievement

Groups(Post)	N	Mean($\bar{x}$)	Std.Dev(σ)	variance	T-value	Remarks
Exp_Pre	11	18.90	2.427	5.890	2.085	
Exp_Post	11	19.90	5.327	28.378		
df =20, P=0.577						Insignificant value at 0.05 level

Table 4.3 Experience Group Pre & Post Achievement

In a comparison between "Exp_Pre" and "Exp_Post" data, it was found that "Exp_Pre" had an average value of 18.90, while "Exp_Post" had an average of 19.90. The calculated t-value was 2.085, with 20 degrees of freedom. However, the p-value associated with this t-value was 0.577, considerably higher than the common significance level of 0.05. This indicates that the observed difference between the two groups is not statistically significant at the 0.05 level. In simpler terms, the data does not provide enough evidence to conclude that there is a meaningful change between "Exp_Pre" and "Exp_Post." Therefore, the result is appropriately described as "Insignificant at the 0.05 level." This suggests that, based on the data and the chosen level of significance, there is no strong evidence of a significant difference between the two time points.

Based on the post-test findings, it becomes evident that employing a blended learning for teaching in twelve computer science grade proves to be significantly more effective than teaching without this technology as traditional learning.

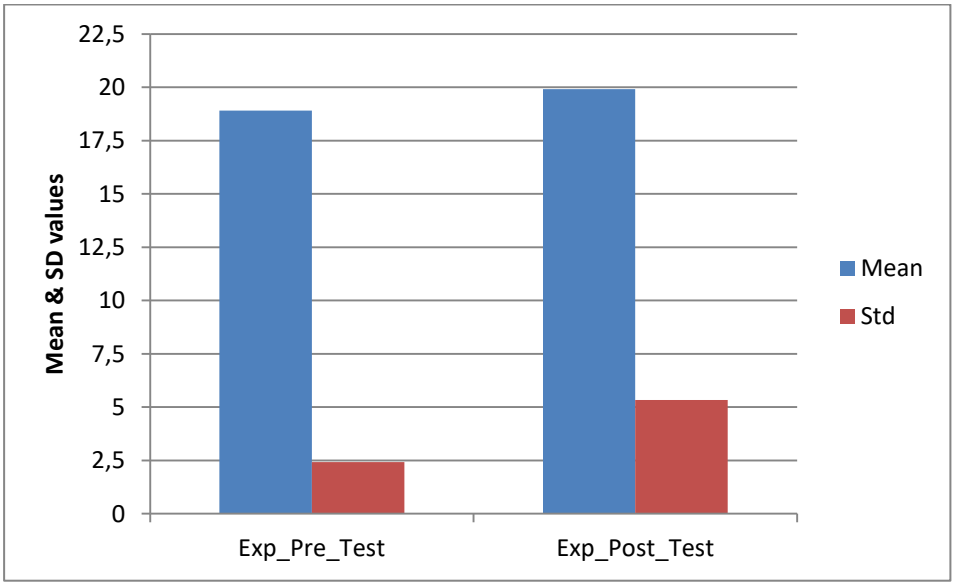

Figure 4.2. Bar Chart of Pre-Test & Post-Test

4.3. Post-test Result Analysis

Post-test mean value, S.D. (Standard Deviation), Variance, along with T-Tests value acquired by the control (traditional learning) and experimental (blended learning) groups have been calculated for the data that has been given for analysis and are depicted below.

Groups(Post)	N	Mean($\bar{x}$)	Std.Dev(σ)	variance	T-value	Remarks
Control	29	16.24	3.521	12.403	2.114	2.114 < 2.160
Experimental	11	19.90	5.327	28.378		
df =13, P=0.054						Insignificant value at 0.05 level

Table 4.4. Post-Test Result Scores of Control & Experimental Group Table

In this study, two groups were compared: the "Control" group with 29 and the "Experimental" group with 11 students respectively. The Control group had an average value of 16.24, while the Experimental group had a slightly higher average of 19.90. The standard deviation (measure of data spread) was about 3.521 for the Control group and 5.327 for the Experimental group. The variance, which indicates data spread, was 12.403 for the Control group and 28.378 for the Experimental group. The T-value, used for group comparison, was 2.114 for the Control group. However, the remarks emphasize that this T-value is less than a critical value (2.160), indicating no significant difference between the groups. With a degree of freedom of 13 and a p-value of 0.054, the results are not statistically significant at the 0.05 level, suggesting that any observed differences between the Control and Experimental groups may be due to chance rather than a meaningful distinction.

This statement suggests that there is a significant difference between the post test achievement and the pre-test achievement. As a result, the null hypothesis (H_0:$\mu 1=\mu 2$), which posited that the two achievements were equal, was rejected, and the alternative hypothesis (H_1: $\mu 1 \neq \mu 2$), which suggested that the achievements are not equal, was accepted. In other words, it indicates that there is evidence to conclude that the post test achievement is different from the pre-test achievement.

Therefore, it is found that using blended learning in the classroom is more effective than using traditional learning, which can result in big variations in students' accomplishment scores. It can improve student academic performance and increase the effectiveness of teaching and learning. Finally, compared to traditional classroom teaching methods, blended learning makes it easier to learn effective stay connected

to the internet and its resources while learning. The table below compares the post-test mean scores of the experimental group to the control group.

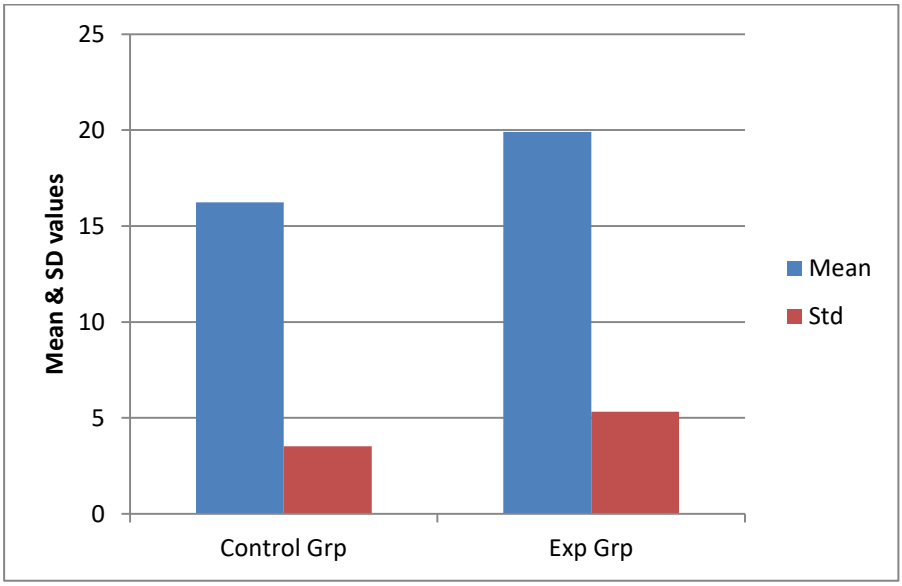

Figure 4.3. Post-Test scores of students as Mean & SD Bar Diagram

4.4. Analysis of Challenges for ICT Tools at secondary Level

Qualitative data analysis was a part of the research because this study used a mixed technique research design. To ascertain the difficulties teachers have when utilizing ICT technologies at the most secondary level, the researcher gathered qualitative data through the use of an interview technique. The study was carried out in the municipality of Kirtipur, Kathmandu at two government schools. First, the researcher established a friendly atmosphere by getting to know the teachers, and then they conducted open-ended interviews to get useful data. Four teachers, one for each school's computer program and one for the principal, were chosen by the researcher. In schools, ICT tools are used for both teaching and learning. Although computer education is taught in all schools these days, there are still particular problems that need to be solved for the teachers.

In this study, the researcher discovered that teachers had multiple challenges when utilizing ICT resources at a secondary level. These difficulties included a lack of computers and weak internet connectivity, a lack of time, a lack of training and skills, and a lack of funding. Additionally, the researcher processed the data in accordance with the teachers' responses, and the concept that resulted from that

coding process helped to simplify the huge amount of data. The information was then divided into the following headings for conversation.

4.4.1. Limitation of Computers and weak internet services

Connectivity to a computer and the internet are essential components of the current educational system, particularly when it comes to computer science; these components serve as the framework for teaching students useful skills and knowledge. These two components have grown to be a passion that is essential to all school teachers and students. Only when a school has a sufficient number of computers and high-speed internet connectivity can ICT tools be implemented successfully. During the interview for this study, participants shared a variety of opinions regarding the computers and internet access in their school.

When employing ICT tools at a secondary level, computer teachers T1 and T2 reported nearly the same problems citing "it is not accessible for students and, used for administration works only, too weak internet connectivity " Furthermore, computer instructor T1 stated that there are "not many computers in the school, so we adjust rule is adopted for teaching and learning." Likewise, computer instructors T1 and T2 said that ICT technologies are "difficult to use for all students with few computers."

Based on the responses from computer teachers, it was discovered that the lack of internet access and a small number of computers made it difficult for teachers to maintain each student's computer use. Students were not given the chance to experience using internet connectivity for technology instruction. There were more pupils enrolled than there were computers available for use in the classroom. On the one hand, there was poor internet access, and on the other, the plan was limited to official tasks and school administrative operations. These answers highlighted the insufficient application of ICT tools in secondary computer instruction.

The IT Policy, (2067), promotes expanding internet connectivity to every school. The development of ICT infrastructure, an ICT laboratory, and internet access for schools was the goal of the ICT Master Plan (2013–2017), (MoE, 2013).

According to UNESCO, (2023), only 40% of primary, 50% of lower secondary, and 65% of upper secondary schools are connected to the internet globally,

despite the fact that 85% of countries have policies in place to improve school or learner connectivity. The policy wanted to bring technology into classrooms in all schools, but it hasn't been done properly. This means teachers are struggling because schools don't have enough computers and internet. So, using technology in the classroom is difficult, and teachers are dealing with computer and internet problems.

4.4.2. Limitation on Time and ICT Tools Training.

Incorporating ICT tools creatively into computer subjects is a crucial aspect of technical education in schools. Teachers shared their experiences regarding the use of ICT tools and their classroom teaching practices.

The computer teachers said that their biggest challenges were managing their time to prepare lessons and deal with technology, as well as their confusion about using the right tools for the job. Similarly, "difficulties to define all types of learners like internet configuration and online software as tools to learn" were reported by computer teachers T1 and T2. Similarly, "limited time to prepare the lesson plan including ICT tool for teaching and finishing the lesson on time within given times is tough," asserted computer teachers. The computer teachers mentioned that they weren't comfortable with using ICT tools as described in the textbook. They also had limited time to prepare lessons and create materials for each student, which made teaching and learning more challenging. Additionally, completing lessons using ICT tools in the classroom was a major challenge for them.

These ideas are supported by the cognitive theory of blended learning. Learning is an active process and should be well-organized. With tools like Zoom and Teams, students can use multimedia materials on the internet to customize their learning. Cognitive learning involves using different types of multimedia to process information systematically. This approach helps students develop meaningful knowledge and skills that they can remember for a long time. This research aligns with the principles of the cognitive theory of multimedia learning in the context of blended learning.

4.4.3. Lack of proficiency in Skill and Training

A person's competency or ability is indicated by their lack of skill and training expertise, which is usually the consequence of inadequate training and experience. To close the gap between their existing competency and the requirements of their roles or goals, they must invest in education, training, or skill development. Regarding the above subject, computer teachers T1 and T2 had nearly identical opinions, with the respondents asserting that "basic average knowledge about computers and ICT tools." Likewise, computer instructor T1 said that there was "insufficient support from the school to enhance the abilities and understanding of ICT tools." In a similar manner, both of computer teachers explained that their selection was based on their proficiency with computers and educational qualification. And none of them have received training from the school or other govt. or non-govt. agencies.

Teachers had basic knowledge of ICT tools and weren't familiar with new teaching tools. Their schools didn't help them improve their teaching skills. The teachers were chosen based on their basic knowledge, which led to issues with using ICT tools in teaching. They also didn't receive government training. Although policies aimed to improve computer teaching skills, this research found that there was little support for teachers to develop the necessary knowledge and skills because they weren't part of training programs. According to SSDP, (2016), one of its ICT objectives is to facilitate the development of access to learning materials and provide professional development packages and guidelines to ensure that there is enough capacity to integrate these materials into the curriculum.

4.4.4. Limitation on Economic Investment and Contribution

Introducing technology into teaching and learning requires funding. ICT resources in schools are only made available when there is significant funding available. The financial condition of their school and the availability of additional supplies to support the use of ICT tools were discussed by both of the Principals remarked as P1 and P2 respectively. Research asked that how do you handle the money required to avail the Computer buy, manage and maintenance for the students and teachers for computer science students at level twelve?

Both of the principals, P1 and P2, respectively said that they received some funding from school income the local government, few as state govt and central govt and others from regional groups. They added that they lacked any other electrical power sources. They also agreed to have some of the donation from the foreign aids like Desktop, Laptop computer, projector and printers. According to the principals of the schools there is no extra backup support to avoid power failure and continue to the ICT tools enabled of class for the students. They are fully dependent on govt. electricity.

As per The SSRP, (2015), has its influence continues to shape Nepal's education system. The government maintains several key reforms, including free education up to grade 12, improved teacher training, curriculum enhancements, infrastructure development and a focus on equity and inclusion. Finally it was found that govt has these all in policies not in the implementation. Therefore, schools are facing the difficulties in blended learning via online medium of class and overall maintenance of ICT lab and its resources for successful result.

4.5. Student Perception

According to Pokharel, (2019), "the students had positive perceptions towards the use of ICT in learning English language writing". The research first of all prepare the list of questions to asked about that how they feel to study with the blended learning in this modern world. Because of using and more demand of internet and mobile device as well as laptop for spreading the knowledge, there are more opportunities in this era. There were two students selected to ask the questions based on blended learning regarding the past, current and future scope of the blended learning as well as the recommendation to use regarding the blended learning.

Both of the students reply that we need the blended learning as this modern world because of having its advantage as effectively and easily. So that we cal re-learning whenever and wherever we want to study as per our schedule as their convenience. In our school there was no previously available of the internet sources while we were studying in class ten. Later it was fully conducted with smart board with internet connectivity along with the computer lab. Teachers also uses smart board connected with internet and teaching methodology with slide content as

multimedia tool and effect which makes us easy to understand. We get the pdf as we require while being absent due to any reason. As in covid-19, blended learning shown as boon for us without disturbing the class connected with zoom app.

We really feel awesome as learning in blended learning in this class, because we can study in all ways as we want to study from class or remotely due to having any of the reason to not present in the class. I would like to recommend continuing this study method continuously in now and future.

Chapter: 5. Summary, Findings, Conclusion & Recommendation

Both blended learning and traditional learning methods were used in this study. Comparing pupils' academic achievement in two distinct environments was the study's primary goal. Traditional instruction without online tools and technology was given to one group, and blended learning was given to the other. The study focuses on the difficulties associated with teaching and studying computer science, which have been made worse by the COVID-19 pandemic and the move away from in-person instruction toward online learning. The purpose of the study is to comprehend how instructors and students feel about the use of internet resources in computer science instruction including the traditional classroom.

5.1. Research Summary

Blended learning in computer education is a modern approach that combines essential skills and tech knowledge for staying current in the digital age. It mixes various tools with traditional lessons for better understanding. In schools, computer education is vital, teaching new skills and smart tech use for learning and daily life. In Nepal, computer education is introduced to enhance student talents and academic performance, utilizing ICT tools and blended learning techniques. Research is essential to evaluate its effectiveness.

In this blended learning study, the research objective was to assess the impact of the blended learning over traditional learning on the dependent variable, "student achievements." Additionally, the research aimed to investigate the challenges and perception associated with utilizing ICT tools at the secondary level twelve class students of computer science. The researcher intentionally isolated the as the sole independent variable for comparison, focusing on the students' achievements before and after its implementation. Consequently, this study concentrated on evaluating the effectiveness of online learning with multimedia contents into classroom teaching by analyzing pre-test and post-test achievements.

In this study, the researcher gathered information in two ways: by using tests to measure how well students were doing in their studies and by conducting interviews with some teachers and principals. The aim was to get a comprehensive

understanding of the research. The students were divided into two groups: one group was taught without the blended learning, and the other group was taught with traditional learning paradigm. The researcher administered tests at the beginning and end of the study to assess how much the students had learned. To analyze the test results, the researcher used a specialized computer program called Microsoft Excel 2007 alternative of SPSS, and they compared the results to see if there was a real difference between the two groups. When it came to the interviews, the researcher examined what the students said to identify common ideas and themes, which helped draw conclusions from the findings.

5.2. Findings from the Research

As per the researcher provision, the study's results under the following sections based on the analysis and interpretation of both quantitative and qualitative data collected through achievement tests and interviews.

5.2.1. Quantitative Data Analysis Findings

In the realm of blended learning, it became evident that the experimental group showed improved performance in the post-test compared to their pre-test scores. Simultaneously, the experimental group achieved higher scores than the control group after the educational intervention. These positive changes can be attributed to the use of blended learning through the integration of online learning the experimental group's teaching during the research. This led to the conclusion that blended learning are more effective compared to traditional methods, and they have the potential to transform the classroom's teaching environment.

5.2.2. Qualitative Data Analysis Findings

The study discovered the difficulties in integrating ICT tools at the secondary level, according to the researcher's conclusions. These issues were identified through qualitative research that was conducted when interviewing individuals from the schools. The main conclusions are listed below.

i. Average internet speed.
ii. Insufficient number of computer for students
iii. Lack of repairing and maintenance of computers.
iv. Average numbers of computers have internet connection.
v. Internet is only for administration
vi. No additional electricity backup sources.
vii. Lack of addition training from the govt or school administration.
viii. Average security for students over computer login.
ix. No any cyber security and awareness training for students and teachers.
x. Lack of control of website access in computer lab over pornography or irrelevant site.
xi. Progressive on computer lab status.
xii. Poor control of computer lab using CCTV camera.
xiii. No biometric or Card basis security check for lab access.
xiv. No fire-alarm or power failure (UPS, voltage guard etc) devices available.
xv. hardware and software that is outdated or incompatible
xvi. Insufficient technical assistance for resolving problems
xvii. restricted availability of online learning materials
xviii. Language difficulties for students who do not speak English
xix. ignorance of the advantages of ICT tools
xx. Difficulty in determining whether ICT integration is effective
xxi. Difficulties in protecting private student information
xxii. Ineffective uses of the ICT Tools resources are there available.
xxiii. LMS was found as excellence view for blended learning.

5.3. Verification

The process of verifying data, conclusions, or results by methodical and independent checks, which could include multiple experiments, analyzing the data, or having other researchers validate it's known as verification in research. It guarantees the dependability and credibility of study findings (Smith, J, 2020). It is possible to assure the validity of research and foster confidence in the study findings by employing several techniques to collect data on the same subject.

We discovered from examining the data that the student's scores were comparable without using any kind of teaching. However, it became clear from comparing their performance before and after utilizing blended learning with multimedia materials that the group utilizing this technique performed significantly better on their post-tests. This shows that blended learning, which allows students who are physically present in a learning space with internet connectivity to the class, may be a tremendously successful teaching tool in the classroom.

The examination of the qualitative data showed that there were multiple challenges secondary level teachers faced when utilizing ICT tools and resources. These difficulties included a limit number of computers, internet connection, and lack of funding, expertise, skills, and time limits while using ICT tools. According to the study's theories, learning can be enhanced with the internet and graphical resources. According to the cognitive theory, the use of multimedia tools improves the efficacy of instruction. The systematic arrangement of tools and programs with a variety of text, audio, video, graphics and animation materials aids students in solving challenging issues. Using blended learning and multimedia contents to actively participate students' knowledge building achievement. The research findings are consistent with each other, as shown by the investigation's premise.

5.4. Conclusion

Blended learning helps teachers use class time better and reach more students. It gives students flexible, personalized, and engaging learning. The research had made the experimental research for the outcome on A comparative study of blended learning over traditional study in secondary level student and student perception on ICT learning which was effective measure and found effective. Two schools of Kirtipur municipality of Kathmandu district were selected for this experimental research for finding result of the test as well as principal and teachers were sampled for the qualitative data as interview.

The pre-test achievement scores of the control and experimental groups did not differ significantly, according to the research findings, suggesting that students' knowledge levels were comparable before treatment. As a result. Nonetheless, a

notable distinction in the accomplishments of the control and experimental groups was noted when comparing pre- and post-test scores for twelve class computer science students. As a result, only alternative hypothesis was accepted. The fact that the post-test score was considerably higher than the pre-test indicates that using a blended learning in the classroom can be a useful teaching strategy. In the post-test, the experimental group performed better than the control group, confirming the preferable choice of learning strategy.

Teachers at the secondary level students faced problems with steady performance. There were also some of the issues related with computers, the internet, their skills, time, and security issues.

5.5. Recommendation to apply

The researcher recommended applying some of the changes in computer science in secondary level while teach:

i. There must be fast internet services handling the video sharing capability strongly with multimedia computer topic as per requirement.
ii. Teachers must have the training with certification about online class and related app to use excellence.
iii. School, Local, State or central govt. must have to provide the training and assistance regarding online teaching learning tools.
iv. There must be the addition of the topic as online teaching and learning tool as chapter of computer science in secondary level.
v. The book must be included Google Classroom, YouTube, LMS software and more topics related to it theoretical and practical.
vi. The government must upload the update training .pdf file and related video of ICT tools and training to the MoE website quarterly.
vii. Teacher should get the get the latest information from web, blog, journals offline or online as mass media.
viii. Government must consider and apply blended learning classroom in Govt School and notice to apply in private or other type school.
ix. Government must apply the competent, progressive with qualitative teacher pattern for selection procedure with degree of certification.

x. There must be the digital library in each school with valid access card to the student.

xi. The local govt must consider as the municipality library with digital access with digital content for study for library along with physical library for learn.

5.6. Further Research

The purpose of this study was to evaluate the effectiveness of blended learning in the classroom and to identify the difficulties that secondary school teachers have when utilizing ICT tool and techniques. Even though the study had some drawbacks, the researcher offered ideas to further research.

i. Researcher covered only secondary level grade twelve students.

ii. This research consist quantitative data for research. so, you may select other method for research

iii. It contains the grade twelve students analysis only regarding blended learning, so you may select other grade.

iv. It is focusing on computer science subject, so, other subject can also be helpful for research.

v. It is focusing for teacher challenges only, so other participants like admin or other might be selected.

vi. It could be reference for other research for theoretical and empirical literature review.

vii. It is containing the Kirtipur municipality district data, so other district my you select for sampling.

viii. It is the 2023 A.D. data of analysis of research, so later year will be source of data for this research or further research

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Appendixes

Test Questions

Time: 1:00 hours Post-Test 2080 F.M: 40

Subject : XII/Computer Science P.M: 14

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1. What is the primary purpose of a Database Management System (DBMS)?

a) To store and manage data in a structured b) To design user interfaces for db

c) To analyze data for business intelligence d) To create web applications

2. Which term refers to a collection of related data that is organized and stored in a structured format?

a) Data b) Field c) Database d) Record

3. What is a Primary Key in a database?

a) A key used for encryption purposes b) An index for speeding up query

c) A unique identifier for each record in a table d) A foreign key ref another table

4. What does the term "Composite Key" mean in the context of databases?

a) A key made of composite materials for durability b) A key that can open multiple doors c) A key made up of multiple columns to uniquely identify records d) A key used in encryption algorithm

5. What is the role of a Foreign Key in a relational database?

a) It enforces data integrity by ensuring unique values in a column.

b) It links a record in one table to a record in another table.

c) It is a primary key used for indexing purposes. d) It's a data type storing text info

6. What is the definition of communication?

A) The process of conveying info & exchanging ideas through verbal or non-verbal means.

B) The act of speaking loudly to get one's point across.

C) The use of technology to transmit messages. D) None of the above.

7. Which of the following is an example of non-verbal communication?

A) text messaging B) Thumbs-up sign C) Talking on the phone D) Writing an email

8. What are the elements of communication?

A) Sender, receiver, and message B) Phone, computer, and television

C) Language, tone, and location D) Emojis, hashtags, and likes

9. Which of the following is not an application of communication?

A) Sending emails for personal communication B) Conducting job interviews

C) Publishing a book D) Playing video games

10. Define the Communication System.

A) A rules for polite conversation B) Sending and receiving messages between

C) A type of computer software D) A system for organizing meetings

11: What does HTML stand for in the context of Internet Technology?

a) Hyper Transfer Mark-up Language b) Hypertext Mark-up Language

c) High-Text Machine Language d) Hyperlink and Text Mark-up Language

12: Which of the following is an example of server-side scripting language?

a) JavaScript b) Python c) Java d) HTML

13: When is client-side scripting executed in a web application?

a) On the web server b) On the user's computer/browser

c) On the database server d) On the DNS server

14: Which keyword is used to declare a variable in JavaScript?

a) var b) variable c) vartype d) let

15: To add JavaScript code to HTML document, where should you place the `<script>` tag?

a) Only in the `<head>` section b) Only at the end of the `<body>` section

c) Either in the `<head>` or at the end `<body>` section

d) Inside the `<title>` section

16. What is the primary purpose of using functions in C programming?

a) To declare variables b) To organize code into reusable blocks

c) To create arrays d) To define data structures

17. Which keyword is used to declare a function prototype in C?

a) func b) prototype c) declare d) void

18. What does a "return" statement do in a C function?

a) Terminates the program b) Exits the current loop

c) Returns a value to the calling function d) Declares a new fn

19. What is a C library in the context of programming?

a) A place to store personal notes

b) A collection of pre-written functions and headers

c) A type of data structure d) A folder for organizing code files

20. What is one advantage of using user-defined functions in C programming?

a) They are faster than built-in functions b) They require less memory

c) They allow you to create custom functionality and improve code organization

d) They can only be used in specific situations

21. What is the primary programming paradigm associated with (OOP)?

a) Procedural b) Functional c) Declarative d) Object-Oriented

22. Which of the following is NOT a fundamental feature of OOP?

a) Inheritance b) Encapsulation c) Abstraction d) Concurrency

23. What is the main advantage of encapsulation in Object-Oriented Programming (OOP)?

a) It promotes code reusability b) It enhances code readability

c) It restricts access to certain data and methods d) It simplifies program execution

24. Which of the following is a potential disadvantage of using Object-Oriented Programming (OOP)?

a) Improved code organization b) Increased modularity

c) Difficulty in modelling real-world objects d) Enhanced code maintainability

25. In Object-Oriented Programming (OOP), what is a class?

a) An instance of an object b) A blueprint for creating objects

c) A method for data abstraction d) A container for variables and functions

26. What is the primary goal of a software project?

a) To design system architecture b) To create software documentation

c) To deliver a working software product d) To train end-users

27. Which of the following is NOT a phase in the Software Development Life Cycle (SDLC)?

a) Planning b) Design c) Debugging d) Testing

28. What is the main role of a system analyst in the software develop process?

a) Writing code b) Designing user interfaces c) Gathering and analyzing requirements d) Managing project schedules

29. How does the role of a software engineer differ from that of a system analyst?

a) Software engineers focus gathering requires, while system analysts focus on coding

b) Software engineers design system arch, while system analysts design user interfaces.

c) Software engg. Primarily write code, while system analysts gather and analyze require

d) Software engineers and system analysts have identical roles in software devops.

30. What is the purpose of the system design phase in the SDLC?

a) To gather and document user requirements

b) To create a detailed blueprint of the software systems architecture

c) To conduct extensive testing of the software d) To write the final user manual

31. What is the primary goal of Artificial Intelligence (AI)?

A) To replicate human intelligence in machine B) To create robots with human look

C) To automates all tasks without human intervention

D) To increase the data processing speed

32. Which of the following is NOT a common application of robotics?

A) Manufacturing and assembly lines B) Autonomous cars and drones

C) Social media marketing D) Healthcare and surgery assistance

33. What is a key advantage of using cloud computing services?

A) Lower upfront hardware & software cost B)Complete control on physical servers

C) Limited scalability D) Slower data access compared to on-premises servers

34. Which of the following is a disadvantage of cloud computing?

A) Enhanced data security B) Limited accessibility from remote locations

C) Increased hardware maintenance costs D) Reduced flexibility in resource allocation

35. What is the primary challenge associated with handling big data?

A) Lack of data variety B) Slow data generation

C) Managing and analyzing large volumes of data D) Limited data storage options

36. In a relational database, what is a field?

A) A unique identifier for each record B) A collection of related records

C) A column representing a specific data attribute D) A group of tables

37. What does the term "Primary Key" refer to in the context of a database?

A) An alternate way to identify records B) A candidate key that is not unique

C) A unique identifier for each record in a table D) A secondary key used for indexing

38. Which of the following scripting types is executed on the web server before delivering a web page to the client?

A) Server-side scripting B) Client-side scripting

C) Both server-side and client-side scripting D) None

39. What technology is used to store and manage large vol. of data that exceed the capabilities of traditional database sys?

A) Cloud Computing B) Artificial Intelligence C) Big Data D) OOPs

40. What does the term "SDLC" stand for in software development?

A) System Design and Library Compilation

B) Software Development and Lifecycle Control

C) System Development Life Cycle D) Software Deployment and Licensing Control

***

Appendix - B: Answer Key of Test Questions

1. a). 2.(c). 3.(c). 4. (c). 5. (b). 6. (A), 7. (B). 8. (A). 9. (D). 10. (B). 11. (b) , 12. (b) , 13. (b) , 14. (a), 15. (c) 16. (b) 17. (d) 18. (c) 19. (b) 20. (c), 21. (d). 22. (d) 23. (c), 24.(c), 25. (b) 26. (c) 27. (c) 28. (c) 29. (c) 30. (b) 31. (A) 32. (C) 33. (A), 34. (C) 35. (C), 36. (C), 37. (C), 38. (B), 39.(C), 40.(C).

Appendix – C: Teaching Items

Unit 1: Database Management System (DBMS)

- Introduction to Data, Database, Database System, DBMS
- Define Field, Record, Objects, Primary Key, Alternate Key, Candidate Key

Unit 2: Data Communication and Networking

- Basic elements of Communication System
- Concept of Communication System

Unit 3: Web Technology II

- Introduction to Web Technology
- Server Side and Client Side Scripting
- Introduction to internet technology.
- Adding JavaScript to HTML page

Unit 4: Programming in C

- Review of C programming concept
- Functions
- Concept of library and user defined function.

Unit 5: Object Oriented Programming (OOP)

- Programming Paradigms: Procedural, Structural and Object Oriented.
- Advantages and Application of OOP.

Unit 6: Software Process Model (SPM)

- Software Project Concept.
- Concept of software development process.
- Concept of SDLC life cycle.
- System Analyst vs. Software Engineer.
- Concept of System Design

Unit 7: Recent Trends in Technology:

- Concept of Artificial Intelligence(AI) and Robotics
- Concept of Cloud Computing.
- Concept of Big Data

Appendix – D: Lesson Plans

Lessons Plan

Activity-1

(Teaching With Traditional Learning Approach)

Unit-1: Database Management System (DBMS) **Time:** 45 Minutes

Grade : XII **Period:** 2nd

Topic: Introduction & Key Attributes

---

1. Behavioural Objectives

At the end of the lesson student should be able:

(a) To Define Data, Database, Database System, DBMS

(b) Define Field, Record, Objects, Primary Key, Foreign Key, Composite Key

2. Teaching learning materials

(a) Whiteboard, Marker and Duster. (b). Book

3. Teaching learning strategies

First of all, Researcher begins the class by asking the students a few general questions related to computers and databases to check their prior knowledge. For example:

(a) What is the role of computers in our daily lives?

(b) Have you ever heard about databases? If yes, what they purpose is used for?

(c) Then, Researcher define the each term of the topic one by one and written the short definition of each term on the board and teach with deliberately.

(d) Meanwhile, researcher explains the topic through method to the students, students were divided into 4 groups for discussing the topic.

(e) Each group was given one-one task relating to the topic.

Group A: Define Data, Database and Database System with two examples.

Group B: Define Field and DBMS with two examples.

Group C: Define Record and Object with examples.

Group D: Define Primary Key, Foreign Key and Composite Key.

(f) After 5 minutes, All group's answer were discussed with proper answer.

(g) Then, all the students were given some task after finishing the topics.

Assessment

(a) Define the following term:

Data, Field, Record, Database System, DBMS with examples

(b) List out the Database Keys and explain it.

***

Lessons Plan

Activity-1

(Teaching With Blended Learning Approach)

Unit-1: Database Management System (DBMS) **Time:** 45 Minutes

Grade: XII **Period:** 2nd

Topic: Introduction & Key Attributes

---

1. **Behavioural Objectives**

   At the end of the lesson student should be able:

   (a) To Define Data, Database, Database System, DBMS

   (b) Define Field, Record, Objects, Primary Key, Foreign Key, Composite Key

2. **Teaching learning materials**

   (a) PowerPoint Slides

   (b) Projector, Laptop, High Speed Internet

   (c) Google Meet

3. **Teaching learning strategies**

   First of all, Researcher begins the class connected physically as well as virtually with remote student by Google Meet App and asking the students a few general questions related to Communication and its element to check their prior knowledge. For example:

   (a) Do you know the role of computers in our daily lives?

   (b) Have you ever heard about databases? If yes, what they purpose is used for?

   (c) Then, Researcher displayed the pictures along with text of each term on the projector and teach with deliberately.

   (d) Meanwhile, researcher explains the topic through method to the students; students were divided into 4 groups for discussing the topic.

   (e) Each group was given one-one task relating to the topic.

   Group A: Define Data, Database and Database System with two examples.

   Group B: Define Field and DBMS with two examples.

   Group C: Define Record and Object with examples.

   Group D: Define Primary Key, Foreign Key and Composite Key.

(f) After 5 minutes, All group's answer were discussed with proper answer.

(g) Then, All the students were given some task after finishing the topics.

Assessment

(a) Define the following term:

Data, Field, Record, Database System, DBMS with examples

(b) List out the Database Keys and explain it.

***

Lessons Plan

Activity-2

(Teaching With Traditional Learning Approach)

Unit-2: Data Communication and Networking **Time:** 45 Minutes

Grade : XII **Period:** 2nd

Topic: Concept of Communication System.

---

1. **Behavioural Objectives**

   At the end of the lesson student should be able:

   - To Basic elements of Communication System
   - To Know the Concept of Communication System

2. **Teaching learning materials**

   (a) Whiteboard, Marker and Duster.

   (b) Book

3. **Teaching learning strategies**

   First of all, Researcher begins the class by asking the students a few general questions related to Communication and its element to check their prior knowledge. For example:

   (a) Do you know about communication?

   (b) Have you ever make communication? If yes, tell me the example.

   (c) Then, Researcher define the each term of the topic one by one and written the short definition of each term on the board and teach with deliberately.

   (d) Meanwhile, researcher explains the topic through method to the students, students were divided into 4 groups for discussing the topic.

   (e) Each group was given one-one task relating to the topic.

   Group A: Define Communication with two examples.

   Group B: List out the element of communication.

   Group C: what are the applications of communication?

   Group D: Define the Communication System.

   (f) After 5 minutes, All group's answer were discussed with proper answer.

   (g) Then, all the students were given some task after finishing the topics.

Assessment

(a) Define the Communication? List out its basic elements.

(b) Define Communication System. With its diagram.

***

Lessons Plan

Activity-2

(Teaching With Blended Learning Approach)

Unit-2: Data Communication and Networking **Time:** 45 Minutes

Grade : XII **Period:** 2nd

Topic: Concept of Communication System.

Behavioural Objectives

At the end of the lesson student should be able:

- To Basic elements of Communication System
- Know the Concept of Communication System

1. Teaching learning materials

(a) PowerPoint Slides

(b) Projector, Laptop, High Speed Internet

(c) Google Meet

2. Teaching learning strategies

First of all, Researcher begins the class connected physically as well as virtually with remote student by Google Meet App and asking the students a few general questions related to Communication and its element to check their prior knowledge. For example:

(a) Do you know about communication?

(b) Have you ever make communication? If yes, tell me the example.

(c) Then, Researcher shown the slides on the projector and define the concept and application of each slides one by one including remote student connected with Google Meet App.

(d) Meanwhile, researcher explains the topic through method to the students, students were divided into 4 groups for discussing the topic.

(e) Each group was given one-one task relating to the topic.

Group A: Define Communication with two examples.

Group B: List out the element of communication.

Group C: what are the applications of communication?

Group D: Define the Communication System.

(f) After 5 minutes, All group's answer were discussed with proper answer.

(g) Then, all the students were given some task after finishing the topics.

Assessment

(a) Define the Communication? List out its basic elements.

(b) Define Communication System. With its diagram.

***

Lessons Plan

Activity-3

(Teaching With Traditional Learning Approach)

Unit-3: Web Technology II **Time:** 45 Minutes

Grade : XII **Period:** 2nd

Topic: Introduction & Server Side and Client-Side Scripting

---

1. **Behavioural Objectives**

   At the end of the lesson student should be able:

   - To introduce Internet Technology.
   - Introduce server-side and client-side scripting.
   - Introduce the use of JavaScript fundamental and JavaScript data types and add JavaScript to the HTML

2. **Teaching learning materials**

   (a) Whiteboard, Marker and Duster.

   (b) Drawing Picture

   (c) Book

3. **Teaching learning strategies**

   First of all, Researcher begins the class by asking the students a few general questions related to Internet Technology and Scripting Technology to check their prior knowledge. For example:

   (a) Do you know that how internet is developed?

   (b) Have you ever make a website like Facebook, Google.

   (c) Do you have known how your form is checked while submitting?

   (d) Then, Researcher define the each term of the topic one by one and written the short definition of each term on the board and teach with deliberately.

   (e) Meanwhile, researcher explains the topic through method to the students; students were divided into 4 groups for discussing the topic.

   (f) Each group was given one-one task relating to the topic.

   Group A: Define Web Technology II.

   Group B: List out the type of Web Technology II with example.

Group C: What is Client-Side Technology with supported Scripting Language?

Group D: Define Server-Side Technology with Scripting Examples.

(g) After 5 minutes, All group's answer were discussed with proper answer.

(h) Then, all the students were given some task after finishing the topics.

Assessment

(c) Define Web Technology II? List out its basic elements.

(d) Define Client-Side and Server-Side Scripting Language.

(e) Differentiate between Client-Side and Server-Side Scripting Language.

***

Lessons Plan

Activity-3

(Teaching With Blended Learning Approach)

Unit-3: Web Technology II **Time:** 45 Minutes

Grade : XII **Period:** 2nd

Topic: Introduction & Server Side and Client-Side Scripting

---

1. **Behavioural Objectives**
   - At the end of the lesson student should be able:
   - To introduce Internet Technology.
   - Introduce server-side and client-side scripting.
   - Introduce the use of JavaScript fundamental and JavaScript data types and add JavaScript to the HTML

3. **Teaching learning materials**
   (a) PowerPoint Slides, Notepad, Chrome Browser
   (b) Projector, Laptop, High Speed Internet
   (c) Google Meet

4. **Teaching learning strategies**

   First of all, Researcher begins the class connected physically as well as virtually with remote student by Google Meet App and asking the students a few general questions related to Communication and its element to check their prior knowledge. For example:

   (a) Do you know that how internet is developed?
   (b) Have you ever make a website like Facebook, Google.
   (c) Do you have known how your form is checked while submitting?
   (d) Then, Researcher shown the slides on the projector and define the concept and application of each slides one by one including remote student connected with Google Meet App. Research open Notepad program and type the Client-Side Scripting code adding JavaScript to HTML. Save it and display it on Chrome by opening it.
   (e) Meanwhile, researcher explains the topic through method to the students; students were divided into 4 groups for discussing the topic.

(f) Each group was given one-one task relating to the topic.

Group A: Define Web Technology II.

Group B: List out the type of Web Technology II with example.

Group C: What is Client-Side Technology with supported Scripting Language?

Group D: Define Server-Side Technology with Scripting Examples.

(g) After 5 minutes, All group's answer were discussed with proper answer.

(h) Then, all the students were given some task after finishing the topics.

Assessment

(f) Define Web Technology II? List out its basic elements.

(g) Define Client-Side and Server-Side Scripting Language.

(h) Differentiate between Client-Side and Server-Side Scripting Language.

***

Lessons Plan

Activity-4

(Teaching With Traditional Learning Approach)

Unit-4: Programming in C **Time:** 45 Minutes

Grade: XII **Period:** 2nd

Topic: Review of C Programming

---

1. **Behavioural Objectives**
   - At the end of the lesson student should be able:
   - To Review the concept of C Programming.
   - Introduce functions with the prototype, call and return statements.
   - State the concept of a library and user-defined functions and their advantages.
2. **Teaching learning materials**
   (a) Whiteboard, Marker and Duster.
   (b) Drawing Picture
   (c) Book
3. **Teaching learning strategies**

   First of all, Researcher begins the class by asking the students a few general questions related to Basic of C Programming and Structure to check their prior knowledge. For example:

   (a) Do you know how Operating system Linux has been developed?
   (b) Have you ever make a small program to calculate sum of two numbers like calculator?
   (c) Then, Researcher define the each term of the topic one by one and written the short definition of each term on the board and teach with deliberately with its concept and uses.
   (d) Meanwhile, researcher explains the topic through method to the students; students were divided into 4 groups for discussing the topic.
   (e) Each group was given one-one task relating to the topic.

   Group A: Define C.

   Group B: List out the features of C Programming Language.

   Group C: Write the main Header file of C

Group D: Define any two differences between user-defined function and library function.

(f) After 5 minutes, All group's answer were discussed with proper answer.

(g) Then, all the students were given some task after finishing the topics.

Assessment

(a) Define C with its any 2 features.

(b) Write the basic structure of C Program.

(c) Write any 3 differences between user-defined function and library function.

***

Lessons Plan

Activity-4

(Teaching With Blended Learning Approach)

Unit-4: Programming in C **Time:** 45 Minutes

Grade: XII **Period:** 2nd

Topic: Review of C Programming

---

1. **Behavioural Objectives**

   At the end of the lesson student should be able:

   - To define the concept of C Programming.
   - To define functions with the prototype, call and return statements.
   - To State the concept of a library and user-defined functions and their advantages.

2. **Teaching learning materials**

   (a) PowerPoint Slides, Turbo C++ IDE Compiler

   (b) Projector, Laptop, High Speed Internet

   (c) Google Meet

3. **Teaching learning strategies**

   First of all, Researcher begins the class connected physically as well as virtually with remote student by Google Meet App and asking the students a few general questions related to Communication and its element to check their prior knowledge. For example:

   (a) Do you know how Operating system Linux has been developed?

   (b) Have you ever make a small program to calculate sum of two numbers like calculator?

   (c) Then, Researcher displayed some of the slides containing the picture of C language with some written code inside of it. Along with the Turbo C++ editor for visualizing the actual compiler.

   (d) Meanwhile, researcher explains the topic through method to the students; students were divided into 4 groups for discussing the topic.

   (e) Each group was given one-one task relating to the topic.

Group A: Define C.

Group B: List out the features of C Programming Language.

Group C: Write the main Header file of C

Group D: Define any two differences between user-defined function and library function.

(f) After 5 minutes, All group's answer were discussed with proper answer.

(g) Then, all the students were given some task after finishing the topics.

Assessment

(a) Define C with its any 2 features.

(b) Write the basic structure of C Program.

(c) Write any 3 differences between user-defined function and library function.

***

Lessons Plan

Activity-5

(Teaching With Traditional Learning Approach)

Unit-5: Object Oriented Programming (OOP) **Time:** 45 Minutes

Grade: XII **Period:** 2nd

Topic: Programming Paradigms and Features of OOPS

---

1. Behavioural Objectives

At the end of the lesson student should be able:

- To Introduce Object-Oriented Programming (OOP) with programming paradigms and features.
- State Advantages and Application.

2. Teaching learning materials

(a) Whiteboard, Marker and Duster.

(b) Drawing Picture.

(c) Book.

3. Teaching learning strategies

First of all, Researcher begins the class by asking the students a few general questions related to Basic of OOP, and its features to check their prior knowledge. For example:

(a) Do you know that how can we retrieve necessary data only from other class.

(b) Have you hear about inheritance in real life?

(c) Then, Researcher define the each term of the topic one by one and written the short definition of each term on the board and teach with deliberately with its concept and uses.

(d) Meanwhile, researcher explains the topic through method to the students; students were divided into 4 groups for discussing the topic.

(e) Each group was given one-one task relating to the topic.

Group A: Define OOP

Group B: list out the features of OOP.

Group C: Explain any two features of OOP.

Group D: List any two advantages and Application of OOP.

(f) After 5 minutes, All group's answer were discussed with proper answer.

(g) Then, all the students were given some task after finishing the topics.

Assessment

(a) Define the features of OOPs.

(b) What do you mean by polymorphism and inheritance?

(c) Define class and object.

***

Lessons Plan

Activity-5

(Teaching With Blended Learning Approach)

Unit-5: Object Oriented Programming (OOP) **Time:** 45 Minutes

Grade: XII **Period:** 2nd

Topic: Programming Paradigms and Features of OOPS

---

1. Behavioural Objectives

At the end of the lesson student should be able:

- To Introduce Object-Oriented Programming (OOP) with programming paradigms and features.
- State advantages and disadvantages.

2. Teaching learning materials

(a) PowerPoint Slides, Google Drive

(b) Projector, Laptop, High Speed Internet

(c) Google Meet

3. Teaching learning strategies

First of all, Researcher begins the class connected physically as well as virtually with remote student by Google Meet App and asking the students a few general questions related to Basic of OOP, and its features to check their prior knowledge. For example:

(a) Do you know that how can we retrieve necessary data only from other class.

(b) Have you hear about inheritance in real life?

(c) Then, Researcher displayed slides containing the graphics of class with defined data and method as well as the object, inheritance and polymorphism slides one by and explains it about coding and real life use in software and teaches with deliberately with its concept and uses.

(d) Meanwhile, researcher explains the topic through method to the students; students were divided into 4 groups for discussing the topic.

(e) Each group was given one-one task relating to the topic.

Group A: Define OOP

Group B: list out the features of OOP.

Group C: Explain any two features of OOP.

Group D: List any two advantages and Disadvantage of OOP.

(f) After 5 minutes, All group's answer were discussed with proper answer.

(g) Then, all the students were given some task after finishing the topics.

Assessment

(a) Define the features of OOPs.

(b) What do you mean by polymorphism and inheritance?

(c) Define class and object.

***

Lessons Plan

Activity-6

(Teaching With Traditional Learning Approach)

Unit-6: Software Process Model (SPM) **Time:** 45 Minutes

Grade: XII **Period:** 2nd

Topic: Software Project Concept and SDLC Life Cycle

---

1. Behavioural Objectives

At the end of the lesson student should be able to:

- State the concept of a software project, software development process, and SDLC.
- Compute between system analyst and software engineer.
- State the concept of system design.

2. Teaching learning materials

(a) Whiteboard, Marker and Duster.

(b) Drawing Picture.

(c) Book.

3. Teaching learning strategies

First of all, Researcher begins the class by asking the students a few general questions related to Basic of Software project development and SDLC, and its features to check their prior knowledge. For example:

(a) Do you have any idea that how software is developed?

(b) Have you ever seen that how software is developed in a company?

(c) Then, Researcher define the each term of the topic one by one and written the short definition of each term on the board and teach with deliberately with its concept and uses.

(d) Meanwhile, researcher explains the topic through method to the students; students were divided into 4 groups for discussing the topic.

(e) Each group was given one-one task relating to the topic.

Group A: Define software development.

Group B: list out the steps of SDLC

Group C: Define software Analysist.

Group D: Define software analyst and software engineer.

(f) After 5 minutes, All group's answer were discussed with proper answer.

(g) Then, all the students were given some task after finishing the topics.

Assessment

(a) Define System analyst and system design?

(b) Define Software Project Development.

(c) List the Software development of SDLC.

***

Lessons Plan

Activity-6

(Teaching With Blended Learning Approach)

Unit-6: Software Process Model (SPM) **Time:** 45 Minutes

Grade: XII **Period:** 2nd

Topic: Software Project Concept and SDLC Life Cycle

---

1. Behavioural Objectives

At the end of the lesson student should be able to:

- State the concept of a software project, software development process, and SDLC.
- Compute between system analyst and software engineer.
- State the concept of system design.

2. Teaching learning materials

(a) PowerPoint Slides

(b) Projector, Laptop, High Speed Internet

(c) Google Meet

3. Teaching learning strategies

First of all, Researcher begins the class connected physically as well as virtually with remote student by Google Meet App and asking the students a few general questions related to Basic of Software project development and SDLC, and its features to check their prior knowledge. For example:

(a) Do you have any idea that how software is developed?

(b) Have you ever seen that how software is developed in a company?

(c) Then, Researcher displayed the slides of software development phase like SDLC with water fall model, spiral model and defined the each term of the topic one by one and written the short definition of each term on the board and teach with deliberately with its concept and uses.

(d) Meanwhile, researcher explains the topic through method to the students; students were divided into 4 groups for discussing the topic.

(e) Each group was given one-one task relating to the topic.

Group A: Define software development.

Group B: list out the steps of SDLC

Group C: Define software Analysist.

Group D: Define software analyst and software engineer.

(f) After 5 minutes, All group's answer were discussed with proper answer.

(g) Then, all the students were given some task after finishing the topics.

Assessment:

(a) Define System analyst and system design?

(b) Define Software Project Development

(c) List the Software development of SDLC.

***

Lessons Plan

Activity-7

(Teaching With Traditional Learning Approach)

Unit-7: Recent Trends in Technology **Time:** 45 Minutes

Grade: XII **Period:** 2nd

Topic: Concept of AI and Robotics, Cloud Computing, Big Data

---

1. Behavioural Objectives

At the end of the lesson student should be able:

- To Define Artificial Intelligence(AI) and Robotics and its Application
- To Know the Concept of Cloud Computing with its advantages and disadvantages.
- To Know the Concept of Big Data

2. Teaching learning materials

(a) Whiteboard, Marker and Duster.

(b) Drawing Picture.

(c) Book.

3. Teaching learning strategies

First of all, Researcher begins the class by asking the students a few general questions related to Basic of Artificial Intelligence, Cloud Computing and Storing large amount of data to check their prior knowledge. For example:

(a) Do you know about Robot? Say something about it.

(b) Have you ever stored data on Google drive?

(c) Then, Researcher define the each term of the topic one by one and written the short definition of each term on the board and teach with deliberately with its concept and uses.

(d) Meanwhile, researcher explains the topic through method to the students; students were divided into 4 groups for discussing the topic.

(e) Each group was given one-one task relating to the topic.

Group A: Define AI with its application

Group B: Define Cloud Computing. List any two services.

Group C: What do you mean by Big Data?

Group D: List any two advantages and Disadvantage of Cloud Computing.

(f) After 5 minutes, All group's answer were discussed with proper answer.

(g) Then, all the students were given some task after finishing the topics.

Assessment

(a) What is cloud computing and Robotics?

(b) What is AI? List its application.

(c) What is Big Data? List its type.

***

Lessons Plan

Activity-7

(Teaching With Blended Learning Approach)

Unit-7: Recent Trends in Technology **Time:** 45 Minutes

Grade: XII **Period:** 2nd

Topic: Concept of AI and Robotics, Cloud Computing, Big Data

---

1. Behavioural Objectives

At the end of the lesson student should be able:

- To Define Artificial Intelligence(AI) and Robotics and its Application
- To Know the Concept of Cloud Computing with its advantages and disadvantages.
- To Know the Concept of Big Data

2. Teaching learning materials

(a) PowerPoint Slides, Google Drive

(b) Projector, Laptop, High Speed Internet

(c) Google Meet

3. Teaching learning strategies

First of all, Researcher begins the class connected physically as well as virtually with remote student by Google Meet App and asking the students a few general questions related to Cloud Computing and its Big Data use in our daily life. For example:

(a) Do you know about Robot? Say something about it.

(b) Have you ever stored data on Google drive?

(c) Then, Researcher displayed slides containing the graphics of class with defined data and method as well as the object, inheritance and polymorphism slides one by and explains it about coding and real life use in software and teaches with deliberately with its concept and uses.

(d) Meanwhile, researcher explains the topic through method to the students; students were divided into 4 groups for discussing the topic.

(e) Each group was given one-one task relating to the topic.

Group A: Define AI with its application

Group B: Define Cloud Computing. List any two services.

Group C: What do you mean by Big Data?

Group D: List any two advantages and Disadvantage of Cloud Computing.

(f) After 5 minutes, All group's answer were discussed with proper answer.

(g) Then, all the students were given some task after finishing the topics.

Assessment

(a) What is cloud computing and Robotics?

(b) What is AI? List its application.

(c) What is Big Data? List its type.

***

Appendix – E: Name of Sampled Schools

These Schools were selected from Kirtipur Municipality, Kathmandu

1. Mangal Secondary School
2. Janahit Secondary School

Appendix - F: Principal Interview Guideline

The research has asked some of the questions related to the investment of contribution of the ICT tools and technology as well as related resources to avail in the school from the SMC, local, central government or from the foreign aids. Some of the topics were asked with the principal from the school. The details of format and questions were as:

Principal Details

Name: - Mr. /Mrs.....

School's Name: -.....

Qualification: -.....

Experiences: -...../...../.....

a. Financial support of ICT tools and technology funds

Appendix- G: Responses from Principal Interview

"I'm implementing a digital framework in teaching, using smart boards, desktops, laptops, and PowerPoint. Our school promotes digital-friendly education, with many teachers favouring blended learning and projectors. We have a reliable 24/7 power supply with solar backup and use three-phase wiring. Funding comes from local government, the Parent-Teacher Association (PTA), the central government, and foreign aids. Technicians address technical issues, although only the central government provides support, with no contributions from local or state governments during my tenure. Foreign aids offer training and physical tools like laptops and desktops. Examinations are paper-based, except during COVID-19, when online testing was introduced. We use Learning Management System (LMS) software, and our school's vision aligns with government objectives for quality education"

Appendix - H: Teacher Interview Guideline

The purpose of the interview was to learn more about the attitudes, experiences, and insights of a sample of teachers about the difficulties they have when utilizing ICT technologies in the context of teaching in grades twelve computer science. The following main topics were covered in the interview:

Teacher Details

Name: - Mr. /Mrs.....

School's Name: -.....

Qualification: -.....

Designation: -.....

Teaching experiences: -...../...../.....

The research selected the open ended interview for the teachers for collecting the data for the challenges facing regarding the following topics below:

a. Computer and internet availability.
b. Knowledge and experience.
c. Time and ICT tool usage.
d. Financial support for ICT tools.

Appendix- I: Responses from Teacher Interview

A. Computer and Internet Availability:

"The teacher used both traditional tools and the internet for teaching but discontinued the latter due to limited ICT resources. They favoured blended learning during COVID-19, with the use of a projector and a dedicated app, which was exclusive to that period. Students preferred blended learning, and the teacher plans to continue it in the future, emphasizing the benefits of data storage and presentations."

The author prefers teaching with blended learning, utilizing a smart board connected to a laptop with an internet connection. They have access to Learning Management System (LMS) software in their school, which was employed during the COVID-19 pandemic, and they primarily use Google Drive for data storage. The paragraph also notes that slow internet connectivity poses a challenge for administering tests via Google Forms.

B. Knowledge and Experiences:

"The teacher has been teaching for more than five years and got training for blended learning during COVID-19."

"The author holds educational credentials from TU, CSIT, and currently serves as a teacher at Janasewa Secondary School, accumulating more than 2 years of teaching experience. Additionally, they have pursued personal training in CCNA and web development for a duration exceeding one year."

C. Time and ICT Tool Usage:

"The teacher primarily employed blended learning during the COVID-19 pandemic, while in non-pandemic times, traditional teaching methods, such as analyzing marks on physical paper, were more prevalent. They express a preference for incorporating blended learning in the future, citing the benefits of using digital tools like Google Docs and presentations for data storage and educational delivery".

"The preference for blended learning is evident due to its efficiency in lesson coverage compared to traditional teaching methods. Regular assessments are conducted every Sunday, with results meticulously recorded using Excel. Additionally, multimedia content, including pictures, plays a pivotal role in classroom instruction, enhancing the learning experience."

D. Financial Support for ICT Tools

"It was the Limited resources and discontinuation of some digital tools, indicating potential limitations in this aspect. I have not received any laptop or any tools teaching preparation to the class room".

"I have not received any of the financial devices from the school yet, but some of the other govt school had provided, which i had found the information from the news".

Overall, the teacher's experiences and preferences reflect a shift towards blended learning during COVID-19 due to limited resources, with a preference for using blended learning now and in the future.

Appendix- J: Student's Interview Guideline

The purpose of the interview was to conceive more about the perceptions of the students as their feeling, experiences, study outcome and recommendation to apply the recent technology specially ICT tools and technologies in school for the effectiveness of the study in the class room of grades twelve computer science. The following main topics were covered in the interview:

Student Details

Name: - Mr. /Mrs.....

School's Name: -.....

Grade level: -.....

Faculty: -.....Roll No.....

The research selected the open ended interview for the students for collecting the data regarding the effectiveness of the blended learning based on the following topics below:

Student Interview Questions Pattern

A. General Perceptions

1. What is your prior experience with blended learning, if any?
2. How would you define blended learning?
3. On a scale of 1 to 5, please rate your overall satisfaction with blended learning.
4. How does blended learning compare to traditional in-person learning in your opinion?

B. Advantages and Disadvantages

5. What are the key advantages you see in blended learning?
6. What are the key disadvantages you see in blended learning?
7. How has your performance or academic achievement changed since engaging in blended learning?
8. Would you choose blended learning again if given the option?

C. Technology and Tools

9. What types of online tools or technologies do you find most effective in supporting your learning in a blended environment?
10. How do you manage your time and schedule in a blended learning program?
11. In your opinion, does blended learning provide sufficient opportunities for hands-on or practical learning experiences?
12. Has the COVID-19 pandemic influenced your perceptions of blended learning in any way?

D. Interaction and Recommendations

13. How do you feel about the balance between online and in-person components in your blended courses?
14. Do you believe blended learning has improved your ability to interact with peers and instructors?
15. What recommendations would you make to improve the blended learning experience at this institution?
16. Are there any specific courses or subjects in whom you feel blended learning is particularly effective or ineffective?

Appendix- K: Responses from Student's Interview

Student 1 and Student 2 student's perceptions toward blended learning and its tools, feeling, recommendations have been added in each of the category of the topics are as follows:

A. General Perceptions

"Student 1 feels that blended learning is beneficial. They say that this is how they had never studied before and that they now find it to be a more effective approach to learn. They give it a good satisfaction rating of 4.5 out of 5. With teachers who are skilled educators and knowledgeable about the subject matter, blended learning is said to be easier to understand and more socially acceptable. The author also notes how simple it is to download and read anything from Google Drive and how this kind of learning is good for their eyesight and learning process in general. They stress how integrated learning is preferable than traditional approaches."

"In general student 2 stated that blended learning is seen favourably in the text as stated. Student 2 states that they had not previously studied in this manner and that they felt it was a more effective and intelligible method. They give it a high score of 4.5 out of 5 and say it's better than reading books by hand. The instructional quality and accessibility of the resources, particularly with modern tools like Google Drive, are highly valued by them. Although the author notes certain drawbacks, such as eye strain, power outages, and the requirement for expensive equipment, blended learning is generally viewed favourably".

B. Advantages and Disadvantages

"Student shows better comprehension, simpler access to resources; enhanced teacher-student interaction, flexibility in learning place and time, and the capacity to review recorded content or notes are all benefits of blended learning. Listed drawbacks include the necessity for expensive laptops or mobile devices with internet connection, possible health risks, distractions

from electricity, and the required for technological infrastructure. The author's overall opinion is favourable, nevertheless, and they believe the benefits outweigh the drawbacks".

"Student 2 highlights several benefits of blended learning, such as enhanced comprehension, effortless access to resources, the capacity to download and read at home, adaptability in learning settings and schedules, and enhanced communication for queries and recommendations from educators and peers. However, numerous drawbacks are also cited, including the demand for expensive mobile or laptop devices with internet connectivity, potential health risks (such as eye problems), the need for electricity, and diversions from other applications."

C. Technology and Tools

"The student 1 emphasizes how technology and equipment, like projectors, digital whiteboards, laptops, desktop computers, and internet access, are used in blended learning. These resources, which the author has access to both individually and at her school, are thought to be helpful for the educational process. They also touch on downloading and accessing educational resources using Google Drive. The use of tools and technology is a major factor in their preference for blended learning over conventional techniques.

"Student 2 stated that a number of technological and instructional aides utilized in blended learning are mentioned in the text, such as digital boards, whiteboards, laptops, desktop computers, markers, and internet access points. The author also mentions the availability of recorded videos and notes for lessons missed, as well as the usage of Google Drive to access study resources. These resources add to the favourable impression of blended learning as a whole and are seen as necessary elements of the process."

D. Interaction and Recommendations

"Student 1 highlights the value of communication in blended learning, particularly the capacity to seek advice and ask questions of peers and teachers. They advocate for blended learning to be implemented at all colleges, especially for courses like computer programming and arithmetic. In the event that students must miss a class, the author believes that recorded videos and notes can be quite helpful. They advocate using blended learning in a variety of topic areas and see it as a means to improve interaction."

"Student 2 strongly suggests that blended learning be implemented in all universities. They emphasize the ease of studying at any time and from any location, as well as the advantages of having recorded videos and notes ready for review. The essay also highlights the importance of question-and-answer sessions with friends and teachers. Because these courses require complex programs and reference materials, the author argues that blended learning is especially helpful for math, computer, and programming courses. The author's experience with blended learning has been mostly good, and they think that more educational institutions ought to use it."