A STUDY ON THE ADEQUACY AND APPROPRIATENESS OF COMPUTER SCIENCE CURRICULA IN NEPALI SECONDARY SCHOOLS

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Abstract

This study analyzes the Computer Science (CS) curricula for Grades 9 and 10 in Nepalese schools. The mixed-method research design was used in this study. Data and information were collected through questionnaire surveys and interviews with curriculum designers, CS textbook authors, school principals, CS teachers, and CS students. Random and purposive sampling techniques were used to select the study respondents / participants. The quantitative data was analyzed using Microsoft Excel. The qualitative information was analyzed through thematic and content analysis techniques.

The Pinar, and TPACK models, and 21st- Century Learning Skills were used as theoretical framework. The study reveals that the present CS curriculum introduces students to HTML, CSS, QBasic, C, and MS Access database, providing them with foundational exposure to programming concepts and database management. There are significant opportunities to further enhance the CS curriculum aligned with students' needs and social context. The study also concludes that (a) the CS curriculum has limited flexibility, allowing students to explore their individual interests in areas such as programming, graphics, or content creation, (b) textbooks are insufficiently-balanced regarding the distribution of easy and difficult units across the academic session, (c) there has been less emphasis on hands-on learning and skill development by allocating more teaching hours to theoretical classes, (d) it demands customizable CS curriculum based on school facilities and infrastructures to cover a broad range of schools in Nepal, and (e) a teacher's guidebook, along with teacher training program, is essential for the effective implementation of the CS curriculum.

The study proposes a revised framework and committee for developing a CS curriculum. The committee is to include present and alumni CS students for designing

the curriculum as student-centric. The study presents significant implications for curriculum developers and education policy-managers to develop a student-centric CS curriculum at the secondary school level aligned with social context.

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Declaration

I hereby declare that this thesis is my original work and it has not been submitted for candidature for any other degree.

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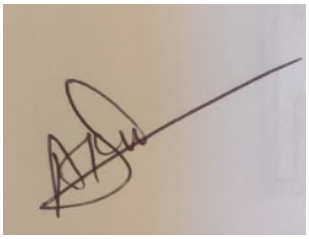


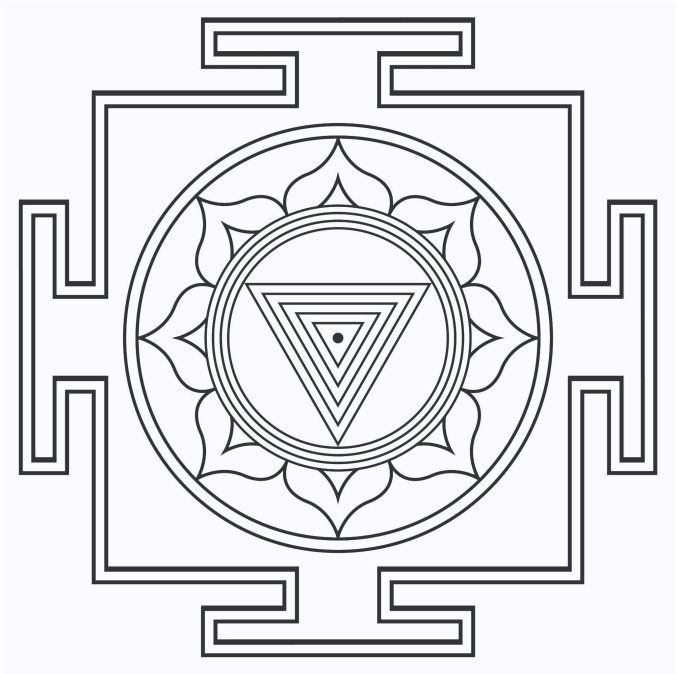
Ajay Kumar Yadav

16 Dec 2024

Dedication

To Ma Kali…

Om Kreem Kalikayai Namah

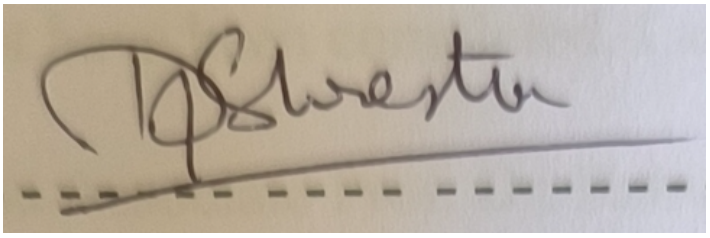


Thesis is a scientific long essay and requires a lot of dedication and patience to complete. Writing this thesis gave me an opportunity to explore in depth about several issues and philosophical views.

For all these dedications and effort, I would like to thank Goddess Ma Kali for giving me utmost energy and finally presenting this study. Additionally, I would like to thank the International Society for Krishna Consciousness (ISKCON), Kathmandu where I used to attend the arati, bhajan to refresh my mind. In the course of writing this thesis, I became a more philosophical spiritual person.

Recommendation Letter

The undersigned certify that I have read and recommend to the Faculty of Education Tribhuvan University for acceptance, a thesis entitled **A Study on the Adequacy and Appropriateness of Computer Science Curricula In Nepali Secondary Schools** submitted by Ajay Kumar Yadav in partial fulfillment of requirements for the degree of Master of Philosophy in Education.



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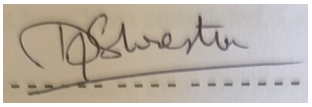
Approval Letter

The undersigned certify that we have read, approved and recommended to the Faculty of Education, Tribhuvan University for acceptance, a thesis entitled **A Study on the Adequacy and Appropriateness of Computer Science Curricula In Nepali Secondary Schools** by Ajay Kumar Yadav in partial fulfillment of the requirement for the degree of Master of Philosophy in Education.



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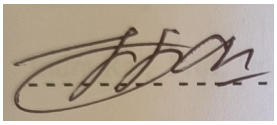

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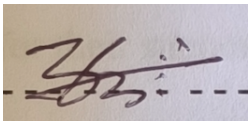

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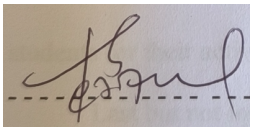

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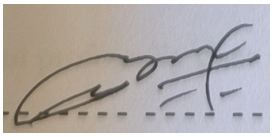

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I am indebted to my family members, parents, Bijay Yadav (dai) and Aman Yadav for their support and encouraging me to pursue higher study. I would also like to thank Mr. Sushant Gautam for having a detailed discussion about the Computer Science topic and teaching-learning paradigm. I would like to thank all teachers and students for their active participation in the survey.

Last but not least, in this technological era, I am thankful to the internet society and digital database repository from where I read several literatures, and documents related to Computer Science education. Thanks to the machine age that had profoundly contributed to society through advancement in digital technology.

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List of Acronyms and Abbreviations

CS	Computer Science
PL	Programming Language
AI	Artificial Intelligence
CDC	Curriculum Development Center
CSS	Cascading Style Sheets
FGD	Focussed Group Discussion
GUI	Graphical User Interface
HTML	HyperText Markup Language
MS	Microsoft
MM	Mixed Methods
NCF	National Curriculum Framework
NEB	National examination board
QBasic	Quick Beginner's All-Purpose Symbolic Instruction Code
SQL	Structured Query Language
URL	Uniform Resource Locator
TPACK	Technological Pedagogical Content Knowledge

CHAPTER I

Introduction

*"*The principal goal of education in the schools should be creating men and women who are capable of doing [explore and learn] new things, not simply repeating what other generations have done*"* Jean Piaget.

In today's context where digital technology and tools influence human lifestyle and society, a few questions arise. Are we teaching the right curriculum and value-oriented education from the Computer Science (CS) subject? Do students understand the fundamental concepts of CS during their school education? Are curriculum designers developing the right curriculum to equip students with knowledge and skills for the future workforce?

There has been rapid innovation in the CS discipline. Internet was introduced around 1991, which helped to connect several regions in the world through transfer of data and information. During 2005, people started to connect with each other through social media platforms. People started sharing their personal lifestyles and activities on social media platforms with a broader audience that slowly breaking the closed traditional environment in society. By 2010, smartphones were commonly used by individuals having capability to perform several tasks. Smartphones are often considered as micro-computer used to store critical data and information. People have to physically isolate themselves from each other during the COVID pandemic that results in shifting from physical to digital online classes. Our lifestyle, work culture, and learning environments are influenced by digital technologies. Now, Artificial Intelligence (AI) technologies have started to influence human lifestyle since several utility tasks could be performed through AI tools. AI tools have the ability to answer several questions, and even write essays or letters instantaneously. This rapid

innovation in digital technologies requires assessing the current Computer Science curriculum in Nepal. Thus, as an educational practitioner, we need to revisit and rethink the learning resources that would help students to equip themselves with the foundation of Computer Science knowledge in an interconnected digital society.

Technologies have been created to support our activities. However, some people are so dependent on technology tools (smartphones), that they become anxious, afraid, and nervous when they forget or even lose their phone, medically termed nomophobia (Bhattacharya, 2019). According to Steve (2018), Computer programming can be considered as a second language of instruction since digital technologies are omnipresent in several domains (TEDx Talks, 2018, 3:51). Education is a process that involves the acquisition of knowledge, skills, and social values. The proper use of technology in human life should be educated in school. Learning comes from formal and informal experiences that help to shape individuals intellectually, socially, and emotionally. School is the formal institution where students formally pursue their education journey. According to Pew Research Center - people born between 1997 to 2012 are categorized as Generation Z or iGenerations, while those born between 2010 and 2025 are classified as Generation Alpha (Dimock, 2019). These two generations have been part of internet technologies from childhood and are called *digital natives*. Generation Z not only learn from the curriculum but their learning process is highly influenced from the Internet resources and social media (Szymkowiak et al., 2021). Friedman (2005) mentions a paradigm shift in people's lifestyle in a book "*The World Is Flat*", due to innovations in digital technology, social media, and fast information access across the world.

Digital technology refers to a broad spectrum of electronic devices that utilize digital formats to store data and programs, serving as mediums for the communication

of the data. Digital technologies have profoundly impacted human lifestyles by enabling vast data storage, efficient data processing, and personalized information dissemination through the use of algorithms and AI tools (Schmiedt Streck & Schneider-Harpprecht, 2021). Digital Literacy is a fundamental skill in the internet era that helps to use, understand and critically evaluate information from digital devices (Lestari & Santoso, 2019). Digital literacy helps to use several software applications related to language translation, reading and creating educational content materials.

Background of the Study

Grade 10 is considered as one of the significant educational milestones for Nepalese students. Grade 10 results are significantly observed across Nepal. Student's future is often predicted from the marks and knowledge acquired in Grade 10. Thus, Nepalese people are interested in knowing details about the curriculum, studied subjects, and the knowledge gained by Grade 10 students. Guardians often prefer schools where the Computer Science subject is taught. However, during discussions with students and teachers, I noticed a dissatisfaction in relation to the Computer Science curriculum. These students from Kathmandu belong to the "Digital native Generation" who have been using the Internet and digital devices from their childhood (Dimock, 2019). This raises my curiosity to dive into the subject matter and look thoroughly into the curriculum and syllabus for Computer Science subject in Nepal. I have been working as a software project manager and teaching facilitator in the Computer Science domain. Thus, I thought of looking into a detailed Computer Science curriculum with my expertise and knowledge for the welfare benefits of future generations by taking the Computer Science curriculum as a research topic.

Computer Science Discipline

Computer Science is a subject of computation systems that digital technologies use to process data and present information to users. In 1985, the Association for Computing Machinery (ACM) Education Board approved Computer Science as a discipline having its own paradigm of theory, abstraction and design (Comer et al., 1989). Contemporary technologies such as AI, the Internet of things, and robotics are integral components of automation systems (Matthew et al., 2018). This discipline provides knowledge about programs, algorithms, applications, computational thinking, and digital technologies (Webb et al., 2017). Computational thinking is based on mathematics, algorithms and critical thinking to provide solutions for complex problems (Weintrop et al., 2016). Computational thinking can even be taught without a computer, termed as unplugged programming (Code.org, 2016). Algorithms are a set of rules having defined steps to solve the problem. Flowchart is a visual representation of algorithms having geometric diagrams such as rectangles, diamonds, squares, arrows that helps to visualize the problem in solution format. Pseudocode is the informal way of writing programming language that helps developers to write programs with defined steps to solve problems. A program is a set of instruction commands given to a machine in a programming language. Programming language follows the syntax rules that programmers need to follow in the coding process (Bers, 2019).

Digital devices operate instructions provided through programming languages to perform specific tasks by machines. Programming languages act as intermediaries between the human interface and the machine. Thus, developers write code in programming languages to instruct computers on taking inputs, processing data, executing commands, and producing desired outputs understandable by humans.

Computer Science Education in Nepal

The government of Nepal (GoV) has emphasized information technology knowledge through Science and Computer Science subjects in the National Education Policy (MoEST, 2019). Students can choose two elective subjects at Grade 9. Computer Science is a second elective subject at secondary education in Nepal (CDC, 2019a, p. 75). Students can choose Computer Science subject directly in Grade 9 although they have not studied at prior grades. This course is designed in a combined curriculum for Grades 9 and 10. Students are learning five programming languages (Qbasic, HTML, CSS, MS Access database and C) during the two-year academic programme at Grades 9 and 10 in Nepal (Gharti et al., 2020a, 2020b). The specification grid for the Computer Science subject is mentioned at Appendix I (CDC, 2023c)**.** Students should have opted Computer Science subject at Grade 9 if they want to study the subject at Grade 10 (CDC, 2019a, p. 64). The Computer Science subject has four credits and 128 teaching hours (CDC, 2019a, p. 58). The Computer Science curriculum includes 50% weightage to theoretical (64 hours) and practical (64 hours) instruction (CDC, 2019a, p. 58). The textbooks prescribed in the curriculum are designed with horizontal and vertical subject integration, adequacy and sufficient contents, relevant to student life and skill-based learning (CDC, 2019a, p. 5,9).

Secondary Education Examination (SEE) in Nepal

The Secondary Education Examination (SEE) is the final examination administered by the National Examination Board (NEB) for Grade 10 in Nepal (NEB, 2020). The total marks for the Computer Science curriculum is 100 marks, comprising 50 marks for theory and 50 marks for practical assessments (NEB, 2020). The 50 marks theory exam for the Computer Science subject is conducted by SEE and must

be completed within 90 minutes. The SEE exam is often locally termed as an “iron gate” a significant milestone for Nepalese students in the school career.

Curriculum Development Center (CDC)

Curriculum Development Center has prescribed the Computer Science textbook, printed by Janak Education Materials Centre Ltd., Sanothimi, Bhaktapur in 2076 BS (2020 AD) for Grades 9 and 10 (Gharti et al., 2020a, 2020b). A textbook is used as a primary instructional tool in a classroom by teachers and students (Czeglédy & Kovács, 2004; Lin & Wu, 2007). To assist students in learning and comprehending the subject contents, the textbook has a critical role with organized contents, examples, summaries, questions, activities, and sample solutions (Fisher & Frey, 2015). Textbooks are the key educational resources having a well-organized structured framework for learning. Good textbook could be easily understood by students and students could read the chapter ahead of teaching class so that they can come up with questions when the teacher teaches (Lin & Wu, 2007). Political, social and cultural influences occasionally have an impact on the textbooks (Hickman & Porfilio, 2012).

Statement of the Problem

Curriculum development entails significant costs and efforts in collaborating with various stakeholders to develop learning resources. It serves as a reflection of the nation's future by influencing students. In the Nepalese context, the Computer Science curriculum is developed by a “roster” committee member comprising teachers, subject experts, and curriculum designers. The committee members select topics for the curriculum. These topics are given to subject experts to develop learning resources. Despite the substantial effort put into curriculum development by CDC members, there is dissatisfaction among end-users, including teachers and students,

regarding the Computer Science curriculum. Moreover, the decision regarding the necessity to modify the Computer Science curriculum to align with the social context and to identify gaps between the implemented and enacted curriculum is not based on findings of any study. Students' opinions and needs are not identified and considered whether core concepts in the Computer Science subject such as problem-solving, computational thinking, and programming skills are to be adequately incorporated into the curriculum. In the Nepalese context, there are insufficient research studies focusing on the Computer Science curriculum at the school level that find gaps between intended curriculum and enacted curriculum, and schools are teaching core concepts of Computer Science. The current Computer Science curriculum is not frequently updated with contemporary technology and adequate learning resources that create friction to equip students with required skills and knowledge.

Significance of the Study

It is predicted that one-third of jobs that exists today could be performed by smart technology, artificial intelligence, robotics, and algorithms (STARA) (Brougham & Haar, 2018). Therefore, education needs to prioritize equipping students with new skills, technologies, and knowledge required for the shifting workforce. This study will be useful for the curriculum planners and designers to design an effective Computer Science curriculum within the social context. The subject experts can include the contemporary topics in the Computer Science curriculum. This study will be useful for inquiry-based learning focused on creativity, collaboration, and problem-solving that can be used for application development with Computer Science knowledge. Teachers can gain insights into the effectiveness of their teaching methods and student engagement within the revised curriculum. The research findings could open up new opportunities for professional development

programs, addressing existing gaps in teaching strategies and learning resources. This study will also be useful for education policy-makers to provide an inclusive and diversified Computer Science curriculum. Moreover, this study is useful for EdTech to design online Computer Science courses to meet the current needs of society and the business world.

Objectives of the Study

The objective of this study is to thoroughly examine the Computer Science curricula for Grades 9 and 10 in Nepal. Furthermore, the study seeks to propose a revised framework for the Computer Science curricula for Grades 9 and 10 at the Secondary School level. The specific objectives of the study include:

1. To examine the Computer Science curricula designed for Grades 9 and 10.
2. To analyze the adequacy, usefulness, and effectiveness of the existing Computer Science curricula for Grades 9 and 10 from different stakeholders' perspectives (students, teachers, curriculum designer, textbook authors, and school principals).
3. To revise the existing Computer Science curricula framework and propose a Model for developing a Computer Science curricula for Grades 9 and 10.

Research Questions

Based on the study objectives, the following research questions were formulated.

1. How do the Computer Science courses contribute to students' application of knowledge gained from fundamental concepts, skills, and technologies in Computer Science?
2. What are the perspectives of key stakeholders (Computer Science students, teachers, curriculum designers, textbook authors, and school principals)

regarding the adequacy, usefulness, and effectiveness of the Computer Science curricula for Grades 9 and 10?

3. What aspects are required to enhance the Computer Science curriculum based on stakeholders' insights to improve educational outcomes?
4. What elements are necessary for developing a Computer Science curriculum?

Delimitations of the Study

The study is delimited to the Computer Science curriculum and textbooks for Grades 9 and 10 at the Secondary School level in Nepal. This study does not cover the assessment, pedagogy and classroom delivery of Computer Science.

Although the study was conducted in overall Nepal, the majority of CS students and teachers participating in the survey questionnaire were from Grades 9 to 12 of Secondary Schools from Kathmandu valley. The qualitative data were collected from CS students, CS teachers, curriculum designers, textbook authors, and school principals from Kathmandu valley. Therefore, findings from this study can only be generalized in the context of Secondary Schools within the Kathmandu valley.

Operational Definitions of the Key Terms

The variables used during research activities imply a specific meaning from the researcher's perspective (Trochim, 2002, p. 45). These variables have been used for data collection and measurement within a specific context during the study. The operational definition provides an insight for the data collection and measurement used in the variables. The operation definition of variables used in this research study are:

Teacher: The term "Teacher" refers to teaching staff of the Computer Science subject at Secondary Schools in Nepal.

Expert: The term “Expert” refers to the knowledgeable person in the Computer Science domain.

Student: The term “Student” refers to the Computer Science students in Grades 9 to 12 at Secondary Schools in Nepal.

Curriculum Designer: The term “Curriculum designer” refers to the government officers involved in the curriculum designing process for Computer Science subject at Grades 9 and 10.

Curriculum: The term “Curriculum” refers to the Computer Science curriculum framework, learning outcomes, syllabus, and textbook units for Grades 9 and 10.

Textbook Authors: The term “textbook authors” refers to individuals officially responsible for writing the Computer Science textbooks for Grades 9 and 10 in Nepal.

School Principal: The term “school principal” refers to individuals who have been involved in leadership positions such as founder, chairperson, principal in Grade 10 school.

Textbook: The term “Textbook" refers to the prescribed Computer Science textbook by the Curriculum Development Center (CDC), Nepal.

Analysis: The term “Analysis” refers to investigating the units and learning resource materials in Computer Science curricula for Grades 9 and 10.

Secondary School: The term “Secondary School” represents schools from Grades 9 to 12 in Nepal.

Application: The term “Application” refers to knowledge and skills gained from CS subjects that can be applied to real-world problems.

Adequacy: The term “Adequacy” refers to the sufficient content materials provided in the textbook to cover the diverse range of students.

Usefulness: The term “Usefulness” refers to whether students learn knowledge and skills related to applications and future career readiness after studying the CS.

Effectiveness: The term “Effectiveness” refers to the holistic CS curriculum plan with arrangement of units and contents in the textbook, and aligned with national educational objectives that cover a diverse range of students.

Organization of the Thesis

This thesis is divided into seven chapters. The first chapter presents the study's context, research problems, study objectives, research questions, delimitations of the study, and definitions of some key terminologies used in the study. The second chapter reviews the academic literature within the areas of Computer Science and educational domains by identifying gaps and conceptual framework for the study. The third chapter presents the research design, methods, and tools used in the study. The fourth chapter presents an analysis of adequacy and effectiveness of the Computer Science curricula of Grades 9 and 10 from perspectives of different stakeholders (students, teachers, curriculum designers, textbook authors, and school principals). The fifth chapter contained the revised framework and CS curriculum structure to develop the Computer Science curriculum. The sixth chapter presents results and discussion, and researcher’ reflection on the findings in relation to the theoretical frameworks- The Pinar, TPACK models, and 21st- Century Learning Skills. The final seventh chapter deals with the conclusions of the study and implications for stakeholders.

CHAPTER II

Review of Literatures

A literature review would help study the relevant researched problem and understand the problem in a more detailed way that helps conduct the study. This study aims to analyze the present Computer Science curricula of Grades 9 and 10 in Nepal, and recommend key elements to develop Computer Science (CS) curriculum aligned with a social context.

This chapter mainly deals with four headings. The first heading presents the theoretical foundation knowledge with reference to learning theories, curriculum theories, and curriculum models. The second heading is dedicated to information about empirical and conceptual studies related to CS as a discipline. The third heading builds a conceptual framework and variables used in this study. The fourth heading furnishes information about the knowledge gap from the previous studies that justifies conducting this study.

Theories of Learning and Curriculum Models

A theoretical foundation provides a philosophical lens to understand research problems with existing educational and curriculum theories, and curriculum models. Theoretical concept is the deductive approach where research makes use of the existing theories in the study (Imenda, 2014).

Philosophical Worldviews

As a researcher, I would start research by understanding the foundational concepts of CS knowledge in relation to ontology, epistemology and axiology that helps understand CS subject, its implementation in school and value-oriented towards human life.

Ontology. Ontology is the truth about the nature of reality. Ontology is related to fundamental concepts of computation thinking in Computer Science. Computation thinking is the fundamental skill that includes breaking down problems into sub-problems, identifying the patterns, and designing suitable algorithms for problem-solving (Code.org, 2016, 4:50; Wing, 2016). Computational thinking can be comprehended through decomposition, pattern recognition, generalization, abstraction, logical reasoning and evaluation of complex problems (Computer Science Lessons, 2020, 1:34). The concepts of loops, sequences, conditional statements, and data abstraction are building blocks for computational thinking.

In this study, my ontological stance is that computational thinking represents a fundamental concept for problem-solving and critical thinking skills. I believe that the concepts of breaking down problems and recognizing patterns are required to solve complex problems. These perspectives shape my study to explore how these core concepts of computational thinking are effectively integrated into the present CS curriculum.

Epistemology. Epistemology is related to practice of Computer Science knowledge in relation with students-teachers. This deals with teaching-learning methods such as learning by doing, problem-solving, and project based learning that would help students to apply Computer Science concepts in the real world.

In relation to epistemological stance, I believe that knowledge in CS is acquired through practical learning and exploring to solve more problems through self-initiative. The curriculum is supposed to provide adequate learning resources to students so that they have the opportunity to explore more topics in depth. I emphasize project-based learning with problem-solving activities where students experiment more while learning. I aim to further study how these practices can bridge

the gap between theoretical knowledge and real-world application making Computer Science education more relevant and impactful to students.

Axiology. Axiology emphasizes Computer Science knowledge for human value and society. Axiology connects ethical usage and value-oriented digital tools and technologies for human, and society. This helps to create a collaborative and inclusive learning environment with advanced digital technology, artificial intelligence tools, and robots in school environments.

My axiological stance is that Computer Science education should emphasize both technical skills and the cultivation of social, ethical, and moral values. I believe that the integration of digital tools, artificial intelligence, and robotics in education should be guided by moral and ethical principles that prioritize human well-being. Therefore, my study emphasizes curriculum to be aligned with social ethical values and culture oriented. In this way, I aim to equip students with knowledge in technological advancement with understanding of social and cultural values.

The philosophical worldview influences methods, and tools used by researchers in the study. Pragmatism's philosophical approach is used in this study to address research problems. The philosophical worldviews are positivism, interpretivism and pragmatism (Jansen, 2023). Positivism is based on the objective reality whereas interpretivism is based on the subjective opinions. Pragmatism is based on the problem-solving approach that combines both the qualitative and quantitative research methodology (Pluye et al., 2021).

Reviews of Learning Theories

All students are unique and they have different abilities to learn and know the subject. The learning theories would provide a comprehensive understanding for the

teaching-learning process and have a crucial role in educational practice at the school level.

Behaviorism. Learning is based on the result of conditioning, reinforcement, reward and punishment. Behaviorism theory is focused on observable behaviors, stimuli activities, and responses. Behaviorist approaches involve structured learning environments, clear objectives, and systematic reinforcement to encourage desired behaviors through learning outcomes at school level (Davies, 2015). This study uses the behaviorism theory to analyze the structured learning resources and textbook contents inlined with educational policy and objectives.

Cognitivism. Cognitivism theory emphasizes the activity of mental processes, including perception, memory, and problem-solving as per student age and ability. Fostering critical thinking and designing activities that involve learning through engagement is focused on the cognitivism approach of teaching-learning process (Kim et al., 2014). Cognitivism theory is more oriented towards teachers where they should understand student individual ability to learn and comprehend subject. The programming concepts are learned based on the cognitive ability of students. This study uses cognitivism theory to understand how students comprehend and develop problem-solving skills in Computer Science education. I analyzed the learning resources whether scaffolding tools are provided to students that help to to understand CS concepts as per their ability.

Constructivism. Learners actively construct knowledge by understanding and experiencing the subject (Bonk & King, 2012). Knowledge building is the process of activity. It takes time for individuals to construct their understanding through experiencing subjectively and reflecting on those experiences (Mugambi, 2018). Experience is the only source of knowledge. Knowledge is derived from the meaning

that is constructed as a result of life experiences. Constructivist learning approach involves hands-on project activities, team and collaborative learning (Niederhauser, Salem, & Fields 1999; Petraglia, 1998, as cited in Cey, 2001). Constructivism theory is oriented towards students where they explore and construct understanding, knowledge on the subject. This study uses constructivism to understand how students actively build their knowledge through hands-on learning, explore concepts, develop applications, test their ideas and refine their understanding in a reflective way.

Connectivism. Connectivism learning theory is related to the learning process in a digital era. This theory emphasizes learning is distributed across networks of people, online information, and resources (Siemens, 2005). The student learns and builds character and knowledge through engagement in digital platforms and social media. This study uses connectivism to understand how students learn in a digital era where knowledge is distributed across networks, resources, and communities. The study aims to identify the effective techniques for integrating digital learning resources into the formal curriculum thereby enhancing students' engagement in learning.

Learning theories provide a foundation to design the subject contents, and teaching-learning activities for the Computer Science curriculum aligned with social context and student engagement.

Curriculum

Curriculum is the formal official education plan prescribed by the Curriculum Development Center (CDC) that education administration and teachers need to follow during an academic year (Ornstein & Hunkins, 2018, p. 20). Curriculum is the first base level document for all stakeholders in education since other subsequent teaching materials and activities are planned based on curriculum. Curriculum includes

textbook, theory and practical class, class duration and any other additional activities required to be performed during the academic year. A good curriculum provides a learning opportunity not only for students but also for teachers. As CS is an exploratory subject, thus even teachers learn new knowledge and skills while exploring in-depth through the practice of programming. The formal curriculum is the official document that contains standards, content, and desired learning goals for the subject. The curriculum not mentioned in the curriculum plan and textbook is termed as hidden curriculum. This generally refers to the school environment and interactions of students in the school context. The null curriculum refers to the educational material that is intentionally left out of the curriculum due to social and political reasons (Stinson, 2017). I have used curriculum definition to analyze how the formal Computer Science curriculum is implemented in school. I examined hidden and null curricula in addition to the information specified in the official curriculum, taking into account how social interactions and the school environment affect learning.

Theories and Models Related to Curriculum

Curriculum theory is focused on the design, development, implementation, and evaluation of curriculum within an educational context (Coşkun Yaşar & Aslan, 2021). This deals with organization of contents, pedagogical aspects, assessment process for effective learning experiences. The traditional curriculum theory emphasizes a fixed set of education models. The essentialist theory advocates a core curriculum that focuses on essential knowledge and skills. The postmodern theory emphasizes individual student perspectives, diversity and the deconstruction of power dynamics in education. The critical pedagogy theory emphasizes questioning societal norms and fostering critical consciousness by empowering students to analyze and challenge oppressive structures.

William Pinar curriculum theory emphasizes a broader and more holistic understanding of curriculum that considers multiple perspectives, contexts and stakeholder opinions (Pinar, 2004). Curriculum should be viewed as a lived experience rather than a set of prescribed materials or activities. There should be focus on the experiential aspects of education where students actively engage with educational content and make personal connections. Curriculum designers should design curriculum within specific cultural, social, and historical contexts. Reflective process of curriculum inquiry helps to review previous educational experiences, then analysis of the current curriculum, and looking ahead to incorporate advanced learning materials. This approach is intended to design a more relevant and value-oriented curriculum for students. Pinar mentioned in an interview "As a curriculum theorist, I'm less interested in how teachers teach and what they teach, what students learn, and what they don't. I am interested on- What knowledge is of most worth? That's the key curriculum question*" (Pinar, 2019, 0:14)*.

A model is a prescribed solution for a particular problem. A model helps to design, develop and implement a curriculum by following a framework. It provides a structured approach for curriculum development often outlining specific components such as objectives, content, teaching methods, assessment strategies and sequence of learning experiences. Tyler (1949) had developed a rational linear model for curriculum having four components related to objectives, activities, organization of activities and evaluation (Bhuttah et al., 2019). Taba (1962) developed a seven-step model for curriculum development- that is a modified version from Tyler's model (Soto, 2015). Wheeler (1967) proposes a cyclical model for curriculum development that considers curriculum development as an ongoing process with evaluation feedback as an input to the next revision for curriculum goal and objective (Kelly,

2004). Kerr (1972) model provides flexibility to start developing curriculum from any of these four components- objective, knowledge, school learning experience and evaluation (Kelly, 2004). This study uses William Pinar's theoretical concept by analyzing curriculum with required knowledge for students' daily life and academic career. This theory ensures that the curriculum is relevant, meaningful, and reflective with lived experience that covers a wide range of students in Nepal.

Technological Pedagogical Content Knowledge (TPACK) Model. In an Internet era, technology has impacted the pedagogical teaching activities for delivering contents, and learning experiences to students. TPACK model emphasizes on effectively integrating technology and tools for teaching practices and content materials (Mishra & Koehler, 2006). Teachers should be designing lesson plans, content materials by using appropriate technology and tools for the subject content and pedagogical process to deliver interactive content materials (Green, 2014, 2:13). They need to cross check whether the lesson plan is rightly designed with appropriate technology tools. TPACK model can be applied to any educational discipline and act as a neutral tool for the subject (Green, 2014, 1:50). TSPACK is an extension of the TPACK model that emphasizes social knowledge with pedagogical, technological, and content integrations in a learning environment. The usage of technology integration in pedagogy and content changes with the local context environment.

The TPACK theoretical concept is used in this study to analyze the teaching-learning process of the Computer Science subject in Nepal. By integrating technology into the Computer Science curriculum, TPACK ensures that learning resources are delivered to students in a more interactive and engaging manner, enhancing their comprehensive understanding in the subject.

Conceptual and Empirical Studies in Computer Science

Concept is an abstract representation of the research problem studied with the variables identified in the study (Kivunja, 2018). Empirical studies are based on the data collection and finding's from those data. This heading lists practical studies related to Computer Science textbook and content selection. The studies from literature are organized from secondary education level curriculum to Computer Science textbook contents.

Computer Science Curriculum at the Secondary Education Level

Secondary Education Level is preceded by Primary Education Level that provides knowledge in various discipline areas of Mathematics, Science, Arts, Literature to prepare students for critical thinking and make their own decision for career aspiration as per interest level (Van Laar et al., 2020). Secondary education is considered as a critical stage in student life since they are transitioning towards adulthood and the academic system is supposed to prepare students with sufficient knowledge required for their life activities (Eccles, 1999; Thompson et al., 2021). Nepalese secondary education establishes a connection between classroom learning and real-world, implements theoretical to practical knowledge, and self-reflection ability in student life with acquired skills and knowledge (CDC, 2019a, p. 48).

Principals are the leaders in school responsible for managing the entire school activities (Stringer & Hourani, 2016). School principals are responsible for fulfilling the educational goals, prescribed subject curriculum plans in school (Ifeoma, 2013). Enacted or planned curriculum comprises the subject contents, learning goals, pedagogical techniques, and evaluation systems used in the classroom. The enacted curriculum depicts what should be taught and lessons learned by students in an educational context. The study focuses on the Computer Science curriculum at the

secondary education level in Nepal by examining the existing learning resources integrated with technology and the alignment of curriculum with real-world applications. Moreover, this study explores the perspectives of students and teachers on the curriculum's relevance and effectiveness in Nepalese context.

Content Selection

The textbook includes content materials organized systematically into units, chapters, data and information with practical solutions that facilitate the learning environment. Curriculum development center has a Computer Science committee member responsible for selection and organization of content materials in the textbook. In Spain, the content was selected through an expert judgment method by conducting a test on computational thinking for Computer Science Grade 8 students. The test duration was 40 minutes consisting of 40 items. The result of the test gives the validity of contents through an expert judgmental for curriculum planning (González, 2015).

Grades 9 and 10 Computer Science Textbooks. Curriculum Development Center, Nepal has prescribed the Computer Science textbook for Grades 9 and 10, printed by Janak Education Materials Centre Ltd., Sanothimi, Bhaktapur in 2076 BS (2020 AD). For this research study, I have taken reference of Computer Science units from the textbooks as mentioned in Table 1 and Table 2.

Table 1:

Grade 9 Computer Science Textbook Units

Units	Contents	Page no
Unit 1.1	Computer Fundamental	1
Unit 1.2	Types of Computer	12
Unit 1.3	Basic Architecture of Computer	22
Unit 1.4	Computer Hardware	29
Unit 1.5	Computer Software	57
Unit 2.1	Computer Graphics	77
Unit 3.1	Internet Technology	99
Unit 3.2	HTML	113
Unit 3.3	CSS	157
Unit 4.1	Computer Programming	174
Unit 4.2	Programming in Qbasic	186
	End of Unit 4.2	266

Source: From Gharti, Upreti, & Thapa (2020a).

Table 2:

Grade 10 Computer Science Textbook Units

Units	Contents	Page no
Unit 1.1	Network and Telecommunication	1
Unit 1.2	Ethical and Social Issues in ICT	34
Unit 1.3	Computer Security	47
Unit 1.4	E Commerce	64

Unit 1.5	Contemporary Technology	73
Unit 1.6	Number System	83
Unit 2.1	Database Management system	103
Unit 3.1	Programming in Qbasic	150
Unit 3.2	Modular Programming	157
Unit 3.3	File Handling in Qbasic	187
Unit 4.1	Structured Program in C	209
	End of Unit 4.1	250

Source: From Gharti, Upreti, & Thapa (2020b).

Textbooks

Fisher and Frey (2015) mentioned that the textbook is an organized and prepackaged set of learning resources. The textbook is developed and organized so that it suits the level, interest, and needs of learners. The good quality of the textbook does not only teach but also tests readers (Apple & Christian-Smith, 1991). Textbooks have prescriptive content materials to prepare students for their career and serve as a backbone for the teaching-learning process (Lawrence, 2011). A textbook is written as per Grade level and students can use the textbook even before the academic year. This helps students to explore content materials before the formal class. Textbook analysis refers to three major parts that are physical aspect, academic aspect and supplementary materials provided to students (Kattel, 2021). Physical aspect refers to the printing quality and text readability to students. Physical aspect is important for programming purposes since it helps students to read, type and execute programs. Academic aspect is organized with the objective of intended learning outcomes for students. Supplementary materials refer to the references and additional information provided in the book. However, teachers and guardians misinterpret the textbook as a holy-book, ordering students to strictly follow the textbook due to limited experience.

Inexperienced teachers rely heavily on textbook following to cover all assignments without students preference, knowledge and understanding on the subject (Czeglédy & Kovács, 2004).

Lin and Wu (2007) conducted an empirical study ($N = 32$) for the Computer Science textbook at Taiwan high school and found several issues with the textbook. Textbooks often confuse students for the Computer Science concepts in relation to commercial applications like Windows, Intel. Textbooks describe features and commands of commercial applications in such a detailed way that they resemble miniature versions of manufacturer product manuals. Textbooks should focus on the computing concepts and algorithms so that students know applications are byproducts of Computer Science concepts. Lin and Wu (2007) recommend that textbooks should be written in simple understandable sentences as per student age. Use of technical jargon burdens readers to understand the meaning of words rather than Computer Science concept understanding. Use of analogies words such as body vs brain to contrast with Computer hardware, software should be avoided in textbook. Fisher and Frey (2015) mentioned analyzing text complexity in the textbook. The qualitative text complexity dimension includes word meaning, sentence structure and paragraph complexity specific to reader knowledge and grade level. The quantitative text complexity dimensions include word and sentence length. According to Czeglédy and Kovács (2004), textbooks help to increase efficiency and decrease differences across schools teaching-learning methods. Moreover, the research highlights functions of textbooks as (1) basic source of information presenting and explaining, (2) transformational role with application methods that improve student abilities and skills, (3) pedagogical role for teaching, (4) motivation for independent learners with sufficient examples and exercises.

Textbook and Politics. A school is often viewed as a powerful democratic institution that ensures mobility, opens up new opportunities, and enhances the thinking ability of learners (Apple & Christian-Smith, 1991). However, some view education institutes in different dimensions as a social control mechanism to manifest cultural hazards (Hickman & Porfilio, 2012). According to Hickman and Porfilio (2012), textbooks are biased by mentioning only the specific culture and value system of elite groups. Even textbook committee members are subjected to the political, social, and cultural influences that impact the content materials written in textbooks for subjects such as Science, Mathematics, English, and Social Science. State law related to curriculum also has a role in controlling textbook influence and adoption in the market. The textbook committee members are important because textbooks play a major impact in influencing students' belief system and how they see each-other in the community. Political influence on textbooks can be seen with educational policies and community involvement in curriculum development for academic courses (Paglayan et al., 2023).

Textbooks and Pedagogy. Selecting the appropriate textbook might be challenging job for school administration due to the several numbers of books available in the market (Lawrence, 2011). A research study conducted by Mccune (2023) for Grade 8 Computer Science teachers ($N = 41$) found that several teachers lacked conceptual understanding of Computer concepts as well as pedagogical expertise to teach the subject. This leads to improvement in teacher preparation programs for Computer Science instruction and detailed description of contents in textbook. The Curriculum Development Center (CDC) has the potential to further enhance the effectiveness of CS textbooks and learning resources by conducting more comprehensive studies to support engaging teaching-learning activities.

Textbooks and Readability. The words, language and sentence used in the textbook impacts the comprehensive understanding of the content by the student. Readability is the tool to judge the contents used in the textbook. Readability provides insight into whether a language used in a book is effectively tailored to the audience's background with minimum level of education. The readability level of a textbook should become a criterion to select textbook with regard to content, organization of content, supplementary materials, and services offered by publishers (Spinks & Wells, 1993). It is a complex decision to assign a particular textbook to a specific curriculum in a school. In personalized learning, selecting a textbook is easy since the teacher can assess the learning needs of students (Dufty et al., 2006). Flesch Reading Ease score is an objective measurement of readability since it is based on numerical data of sentence length and word syllable count. The score ranges from 1 to 100, where higher scores indicate easier reading levels (Flesch, 1948; Readable, n.d.). The Flesch-Kincaid Grade Level is a readability formula that estimates the appropriate reading level of a text based on U.S. grade levels (Zhou et al., 2007). The range of value in Flesch-Kincaid Grade Level is from 0 to 18. If the score value is 8, then it signifies text is suitable for grade 8 students. Gunning Fog Index assesses the readability of a text by estimating the minimum education required by a person to read text. The range of value in the Gunning Fog Index is from 0 to 20. If the score value is 8, then it signifies that text is readable by grade 8 students. The readability of context can be calculated by character calculator (charactercalculator, n.d.). The Computer Science textbooks in Nepal have not been evaluated using readability tools. There is no scientific evidence to confirm whether these textbooks are appropriately readable by Nepalese students in their social context. Implementing a readability test could help ensure that students better understand the content in the CS textbooks.

Integration of Technology in Teaching

Learning platforms that promote critical thinking, problem-solving, and logical reasoning are required in school. Holistic education experience cannot be provided only through a traditional direct instruction approach (Hannafin & Land, 1997). Traditional education system had difficulty accessing content and information materials apart from textbooks (Himmetoglu et al., 2020; Huk, 2021). Students had a fixed career in the traditional system. However, today's career depends upon industry and market demands. Government is not the primary source of employment. In today's digital era, learning materials are available from several sources apart from textbook such as online courses, forums, ebooks, and social media. Education 4.0 emplaces an integral role of technology for the education system by incorporating social, cultural, and educational events into digital platforms (Huk, 2021). Real-time monitoring, competency assessments are performed through artificial intelligence tools. Himmetoglu et al. (2020) states that the flipped classroom uses innovative teaching-learning strategies where students learn more by exploring contents through digital resources like videos, presentation materials before coming to the classroom. The present Computer Science curriculum and textbooks in Nepal does not sufficiently incorporate digital tools for learning processes. The digital tools provide more personalized learning with students' ability to solve problems by giving choices from easy to difficult questions.

Essential Aspects of the Computer Science Curriculum

The Computer Science discipline provides knowledge about computing concepts with its theory, abstraction and design (Comer et al., 1989). Textbook should be designed to provide students with adequate and sufficient information related to computing technologies. The content within textbooks serves as a valuable resource

for acquiring fundamental knowledge about digital innovation and technology and should allow students to explore the subject.

Text and Visual Based Programming. Program is a set of instruction commands given to a machine. Learning programming is difficult since it requires mastering a number of distinct and prerequisite skills that present challenges for both teachers and students (Ericson et al., 2022). Ericson (2022), in a literature review of programming ($N = 677$), emphasizes using visual block-based programs for novice learners that helps them to be familiar with programming logics and concepts. In block based, students learn by dragging and connecting blocks to create code like structures before progressing to writing actual code in a text-based format (Ericson et al., 2022). Parsons' problem is like a puzzle where students need to arrange blocks of coding lines. Parsons problems remove the requirement of program syntax knowledge. Parsons problems are specific with a focused objective and are close-ended that helps learners to get quick feedback on their learning progress. Parsons problem feedback are of two types: line-based and execution-based. Line-based feedback is provided by highlighting visual blocks to show that they are incorrect or at the wrong position, whereas execution-based feedback is known by running the full program code. Visual block based programs such as parsons program help learners to slowly transition to text-based coding programs (Weintrop & Wilensky, 2019). In text-based programming, one has to write code character-by-character with correct syntax and semantic knowledge of the programming language. Using text-based programs in introductory programming courses may take longer duration depending on the complexity of the problem statement (João et al., 2019). Students should be taught about debugging skills in the program. Debugging is the process of identifying, isolating, and fixing errors in a

computer program. Debugging skill requires narrowing down the scope of the problem to identify the specific part of the code where the error originates. This may lead to trace the flow of execution and analyzing relevant variables and data. The goal of debugging is to ensure that the program runs and behaves correctly as intended by the programmer. Debugging involves systematically finding and fixing issues in the code that may cause unintended behavior, incorrect output, or even result in a system crash.

Game-Based Learning. Coding for game based applications help students to be proactively involved in the learning process (Videnovik et al., 2023). William (2019) mentioned that game based learning is more interactive and fun compared to traditional learning methods in the classroom. Teachers need to develop a strategy that incorporates technological tools and application in the classroom to create active learning environments. Developing stimulating learning environments can help students to become more creative, cooperative, critical thinkers, and problem solvers. Games can be used as a tool for teaching strategy to boost student learning and engagement (Li et al., 2021 as cited in Videnovik et al., 2023).

In game-based learning, teachers establish the rules for the development of games. Students play games with their peers, earning reward points. These accumulated points serve as a measure for student proficiency in the learning outcome. Gamification can be defined as the practice of creating dynamic and engaging learning environments by enabling competitive environments within players such as points, awards, badges, stage in the learning process (Turan et al., 2016, as cited in 2023). Carbonaro et al. (2010) in a research study for Grade 10 students ($N = 50$; 26 females, 24 males) on game-based learning found that computer games create interactive learning environments, fostering enthusiasm for participants

of both genders. Game based learning helps to create a multi-stimulating educational environment with emotions reflecting compared to textbook materials (Kuzu & Durna, 2020). A child's freedom can be observed while playing, and with lego games they could build any imaginable stuff such as home, bird (Nouri et al., 2020).

Project-Based Learning. Jonassen (1995) coined the phrase “Groups don’t learn, individuals learn". Individuals learn from their experiences in projects. Project has an objective that requires the use of several disciplines. When students participate in workshops, they are engaged more in learning, discussing, and cooperating with team members in verbal and non-verbal mode to meet project goals (Hanna, 2008). Students should engage in real-world projects available at school such as gardens, libraries. Project should be published in school newsletter and shared to forums and discuss within students that help to create interactive learning environment (The MindFuel Foundation | Youth STEM Innovation, 2018, 2:13). The Computer Science textbook currently includes project-based tasks. However, these tasks would be beneficial from integrating interdisciplinary examples that incorporate concepts from Mathematics, Science, and the Arts. By including such interdisciplinary examples, students can apply their knowledge from various subjects to their Computer Science projects and demonstrate the practical relevance of their skills across different domains.

Contemporary Technology. The technologies used and prevalent at present time is contemporary technology. Some examples of contemporary technologies are artificial intelligence, internet of things, robotics, automation, cloud based applications. Python programming language is widely used in contemporary technologies. Python is a high level general purpose programming language used in the field of artificial intelligence (Shoaib et al., 2021). Python programming can be

used to solve mathematical problems, data analysis and visualization, and machine learning applications (Fatima, 2022). Javascript is a high level general-purpose programming language used for web development and front end artificial intelligence.

AI is making computers intelligent enough to learn, think and make decisions similar to the human brain. AI includes machine learning , deep learning and neural networks. Machine learning encompasses interdisciplinary knowledge of Computer Science, Mathematics, and Statistics for creating intelligent computer systems (Salas-Pilco et al., 2022). AI programming differs from traditional programming. Programmers are focused on computation thinking to write programs for desired results in traditional programming. However, the Machine Learning programmer spent more time on defining data sets and gathering data to input ML programs, so as to analyze the probability statistic result so that particular ML program can be chosen for specific solution (Insightsoftware, 2023). AI has limitations and could be smart only as long as the data sets are served to the system. Innovative products can be created through use of AI technologies such as speech recognition systems, auto-response in emails, and image detection. AI technologies are helpful for students with special needs that help them to understand and express in an interactive way to create an inclusive education environment (Edyburn, 2000). Assistive technologies include screen reader, voice recognition tool, speech to text, text to speech, that are helpful for special needs students. There will be work for people who design the rules for AI technologies, and others who follow the AI technologies (Bruun & Duka, 2018).

Internet of Things (IoT) is the network of interconnected devices that can communicate and share data with other devices. Physical devices can communicate with each other in digital space but in physical space there is no communication

between devices. IoT helps to communicate physical devices with each other in a digital space and exchange information across platforms. The benefits of IoT devices are to optimize the maximum efficiency, reduce operational cost and perform the automation for routine tasks (Duffy, 2016, 2:12). Machine learning (ML) can be used to analyze the IoT data and suggest the predictive analysis of tasks (Ong, 2018). IoT can be used in the educational industry for real-time communication and collaboration between teacher-students, personalized learning, optimal resources usage such as textbooks, classrooms.

Robot is a programmatic mechanical device to perform tasks. Robotic comprises interdisciplinary subjects concepts of Mathematics, Science, Arts that would require students to think critically for problem solving (Pooja, 2023). Students learn motor skills by building and assembling parts of robots.

Cloud computing allows users to use hardware and software computing resources such as servers, storage, databases, applications over the internet rather than relying on their personal computer (Yadav et al., 2023). Cloud storage is a service that allows users to store and manage their data on remote servers. Cloud-based application are programs that operate on remote servers accessible over the internet. The companies that provide the cloud based service are called cloud service providers. The present CS curriculum could benefit from incorporating more knowledge and practical applications related to cloud computing, robotics, IoT, and AI.

Data and Knowledge Management

Clive Humby (2006) coined the phrase "*data is the new oil*". As the raw oil is processed in an industry for various product outputs, similarly the digital raw data can be processed to extract various levels of information (Batty, 2022). Understanding

data helps to find out the hidden information that helps to maximize operational efficiency, understand your own mindset and predicting others behaviors. Students should learn about various data types and the process of extracting information from data. Even data is the primary source to make AI machines intelligent. The pyramid model of data, information, knowledge, wisdom (DIKW) explains about different levels of data (Khera, 2023; Weje, 2018).

Data. Data is an unorganized form of numbers or characters in a raw format. Raw data does not provide any meaning. For example, the (20230112) number does not have any meaning without context.

Information. Information is structured data having a contextual meaning. (20230112) number has the contextual date meaning of 12th January 2023. AI tools can be used to understand the meaning of data at some context level.

Knowledge. Knowledge gives an answer related to the "*how*" or "*why*" questions from the context information. Only the human mind would be able to analyze and extract knowledge. AI tools and machines function as a support system to analyze the big data for the knowledge building process.

Knowledge can be built through experience and it would take time to construct knowledge. One of the biggest hurdles for the knowledge building process- people do not want to share knowledge, since they may need to share about failure and choices that signifies why a particular decision was taken? According to KnowledgeMT, there is no strict way to extract knowledge from an experienced person's notebook so that anyone by reading those documents can become an expert, due to which universities had never produced experienced managers (KnowledgeMT, 2017, 1:23). Knowledge is built upon experimenting things and failure is seen as part of the learning culture for the knowledge building process. Failure helps to refine the knowledge. Reddy

(2018) in a ted talk mentioned that around (90%) of global corporations innovation happened through informal knowledge sharing rather than formal meeting discussion. It is very critical to have a knowledge building system in organization since several technological products have become obsolete in recent decades due to innovation in new products. Reddy mentioned that sharing the knowledge helps to build innovative products over time (TEDx Talks, 2018, 8:38). Students in the digital era should be focused on data and information sharing to have collaborative discussions that help to gain experience and build the knowledge over time in the academic year.

Wisdom. Wisdom is the applied action from choices of several knowledge, information, and data at the right time, and right place. Wisdom comes with deep understanding on the subject. It gives decision making choices about why something was chosen as the best choice. Only the human mind can judge at the wisdom level. Although AI tools and machines perform several tasks in today's era, wisdom will always be great assets for humans. Wisdom is known at the context level. The choice of a particular decision in a given context is influenced by individual wisdom. The same problem would have different decisions outcomes as per individual wisdom in an environment context.

Data and information describe details about past activity. However, knowledge and wisdom are helpful for present and future activities that help to know- what action or decision should be taken now or in future (Ontotext,n.d.). Computer Science education should focus from data to wisdom level at Secondary School. Computer Science task activity should focus on utilizing AI machines and tools for data analysis that help to extract information for better decisions. The present Computer Science curriculum at the secondary level needs to be enhanced to address the transition from

data to wisdom. The textbook needs to mention several ways to solve the problem and why a particular approach was chosen in a certain context for decision-making.

Review of Policies Related to Information and Communication Technology

The Constitution document of Nepal underscores the importance of education and the development of science and technology as fundamental aspects of the nation's progress (OoAG, 2015). The National Planning Commission fifteenth plan emphasizes the importance of integrating Information and Communication Technology (ICT) into education to enhance learning outcomes, accessibility, and improve the quality of education by incorporating modern technological tools and artificial intelligence (NPC, 2020). The 15th Plan document ensures students acquire relevant skills that match job market demands and competitive global environment. Additionally, the 16th plan document emphasizes the smart city in Nepal (NPC, 2024). The School Sector Development Plan (SSDP) document highlights the use of ICT as risk management for resilience of educational infrastructure (MoE, 2016). The School Education Sector Plan (SESP) document aims to extend digital infrastructure to all schools, teacher development programmes in ICT technology, and integrate basic ICT skills into several subjects (MoE, 2022). The secondary education (grades 9-12) should focus on Technical Education to better prepare students for the workforce.

21st Century Learning

The 21st century learning emphasize on three key skills: Learning and Innovation skills that include creativity and innovation, critical thinking and problem-solving, communication, and collaboration; Information, Media, and Technology skills that includes information literacy, media literacy, and technology

literacy; and Life and Career skills that includes initiative, productivity, self-awareness, flexibility, and leadership (Nouri et al., 2020; Van et al., 2020).

The present Computer Science curriculum in Nepal needs to be restructured with the skills highlighted in the 21st-century learning. The curriculum should emphasize creativity tasks and critical thinking as we have already entered in the AI era. The curriculum requires student engagement activity that encourages collaboration and communication to develop leadership skills.

International Computer Science Curriculum

Code.org. The Code.org has designed curriculum as per student age or grade level (Code.org., 2023a, 2023b, 2023c). The curriculum offers a diverse range of subjects, including graphics, programming, and AI, along with practical labs for app development, game design, and web module creation. The curriculum for Grades 9 to 12 includes Programming, AI, Games design. The Grade 9 curriculum emphasizes on Computer Science principles concepts and Grade 10 in software engineering concepts with object-oriented programming and data structure.

Central Board of Secondary Education (CSBE) India, Curriculum. The CBSE Computer Science curriculum at Grade 9 focuses on the basics of information technologies, cyber safety, and office tools such as word, spreadsheet (CBSE, 2023). There is more focus on the practical applications related to documents, spreadsheet, presentations, privacy in social media usages, and computer operations. The curriculum emphasizes only the software applications and hardware components of Computer architecture. There are more practical course periods (70) as compared to theory (50) although the weight of marks is 50% each for theory and practical.

The CBSE Computer Science curriculum at Grade 10 includes networking, HTML, CSS, Cyber ethics, and network concepts (CBSE, 2023). It includes only two

languages. There are more practical periods (65) as compared to theory (55) even though the mark distribution is 50% each for theory and practical. The contents emphasized on the conceptual understanding of CS and common applications knowledge required for students.

The present Computer Science curriculum in Nepal is more content-oriented having five programming languages (HTML, CSS, C, MS Access database, QBasic) in the syllabus. The international curricula are focused towards developing skills and knowledge related to practical applications. Thus, the existing CS curriculum could provide learning opportunities that are crucial for developing the practical skills necessary for real-world applications.

Ancient Computation

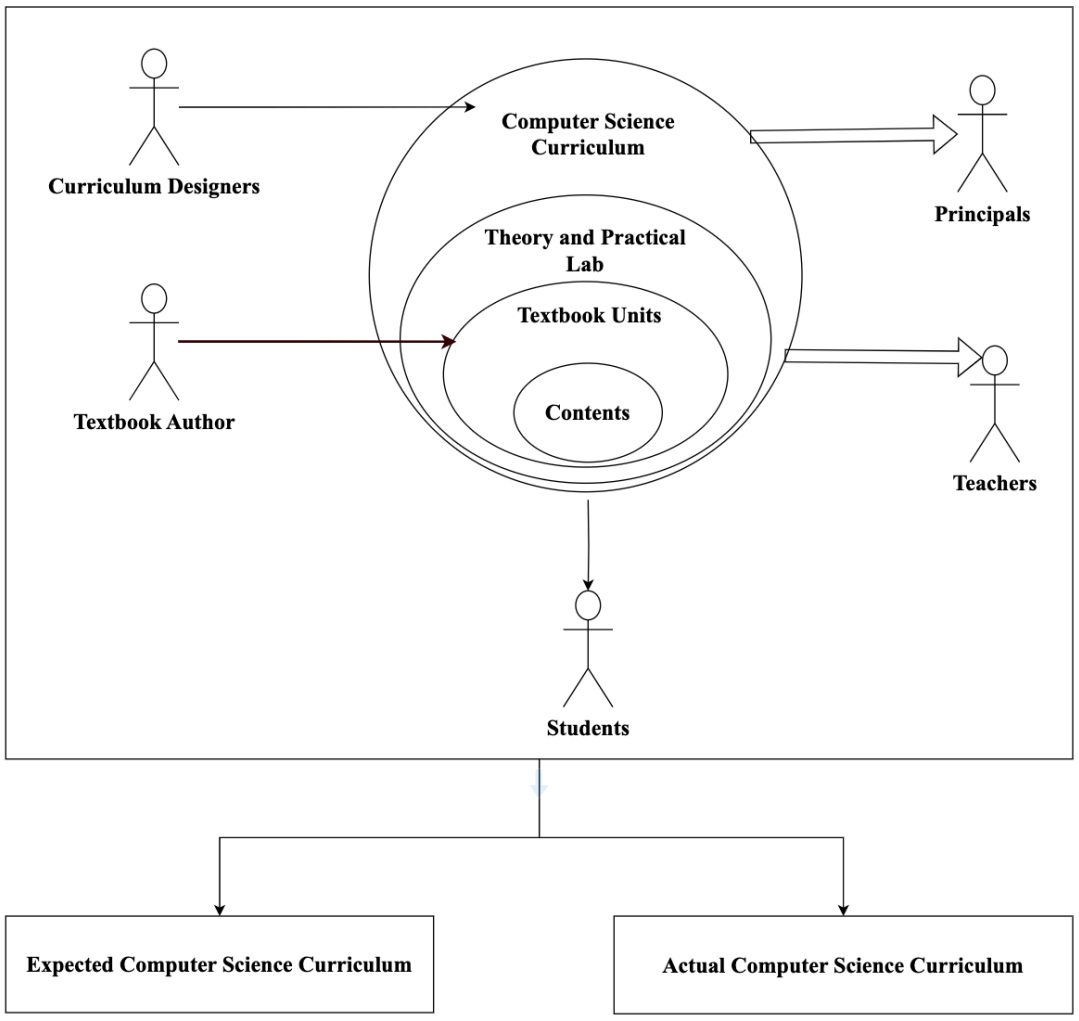
Although Computer Science is the modern technology, the idea of computational thinking related to problem breakdown, pattern recognition had been used in ancient Vedic literatures (Kumar, 2024). The Kayastha community was responsible for record-keeping, accounting practice and arithmetic calculations for economic governance of society (Bellenoit, 2012). The astrologers used significant mathematical calculations to project the festival dates based on the solar system planets (Alexander, 2014). The number zero "0" which plays a vital role for designing computation systems was invented by Indian Mathematician Brahmagupta in the 7th century (Divakaran, 2015). The incorporation of the ancient knowledge related to mathematics and geometric will to enrich knowledge to students, by connecting with the ancient wisdom and modern technology.

Conceptual Framework and Operational Variables Used in the Study

A conceptual framework is used to study problems for guiding the investigation process and define the significance of the data collected in research activities (Imenda, 2014). The conceptual framework highlights operational variables and their relationships within the context of study to address the research problem. Conceptual framework is represented by using actors involved in the Computer Science curriculum in Figure 1. The purpose of conducting this study is to analyze the Computer Science curriculum at Secondary Schools in Nepal.

Figure 1

Conceptual Framework of the Study



Note: Computer Science curriculum key stakeholders.

The Computer Science curriculum is represented in a circular shape. The curriculum includes both theoretical and practical aspects of the Computer Science subject. Practical aspects involve hands-on experience and laboratory exercises for students. Both theoretical concepts and practical exercises are covered in the Computer Science textbooks for Grades 9 and 10 in Nepal. Textbook contains detailed content about units and topics. School level curriculum includes all the formal level documents prescribed by the CDC, Nepal.

The independent variables in this study are the role and responsibility of curriculum designer, textbook authors, school principals, Computer Science teachers and students. The dependent variable is the effectiveness of the Computer Science curriculum. The Computer Science curriculum is an overall educational plan that includes syllabus for theoretical content and practical exercise. The textbook serves as an educational tool within the curriculum that includes all theoretical content and practical exercise aligned with the curriculum's topics.

Curriculum designers are responsible for developing an outline curriculum plan aligned with society and nation welfare. Textbook authors are responsible for writing contents in textbooks. Principals are responsible for implementing the Computer Science subject as governed by CDC, and National Educational Policy. Principals implement the curriculum in a school that incorporates teaching-learning experience and activities required as per subject. Teachers are responsible for delivering the instructional educational materials. Textbook is referred for all the teaching learning activities. Students can assess the impact of the Computer Science curriculum in their life and academic career purpose.

Implications of the Literature Review for the Study

The literature reviewed in this chapter provides insights into various aspects of learning theories, curriculum models, key elements for Computer Science curriculum and the effectiveness of educational tools. While previous research mainly focused on specific computer tools, textbook analysis, and pedagogical methods within school, there remains a study gap for addressing the development of Computer Science curricula for Grades 9 and 10. The rapid advancements in digital technologies highlight the need to assess the Computer Science curriculum at the secondary education level in Nepal.

The previous research was mainly focused on the technical content selection in Spain and textbook effectiveness in Taiwan, predominantly focused on individual elements of the Computer Science curriculum from a specific stakeholder's perspective. However, these studies have not performed a comprehensive evaluation of the Computer Science curriculum that includes feedback from a diverse range of educational stakeholders including students, teachers, principals, curriculum designers, and textbook authors.

This study aims to address the gap by incorporating feedback from multiple educational stakeholders to assess the effectiveness and relevance of the Computer Science curriculum for Grades 9 and 10 in Nepal. This study focuses on the feedback of both students and teachers regarding the CS curriculum, as they are key participants in the teaching-learning process. This study will help to develop an effective Computer Science curriculum aligning with students' needs and future demands of the workforce. This study seeks to contribute to the development of a more effective and contextually relevant Computer Science curriculum.

The findings from this study will provide valuable insights to curriculum developers, textbook authors and educational stakeholders. The suggested framework in this study will facilitate the development of a comprehensive Computer Science curriculum aligned with social context, contemporary technology, and future career opportunities.

CHAPTER III

Research Methodology

Research methodology is a framework for carrying out detailed methods and processes followed during research investigations. This chapter mainly deals with six headings. The first heading presents research design. The second heading presents population and sampling strategy. The third heading gives detailed information about research tools. The fourth heading describes the data collection procedures used in a study. The fifth heading is related to data and information analysis. The sixth heading lists ethical considerations that have been followed for research activity.

Research Design

Research design is a systematic overall plan to study research problems. The research design outlines the methods and procedures used to study the research questions. Paradigm provides a philosophical lens to study the research problem. As a researcher, I have followed the pragmatism paradigm for this study. Pragmatism focuses on problem-solving and application knowledge related to Computer Science (CS) at Grades 9 and 10 (Jansen, 2023). The unit of analysis in this study is the individual CS students and CS teachers at Secondary Schools in Nepal.

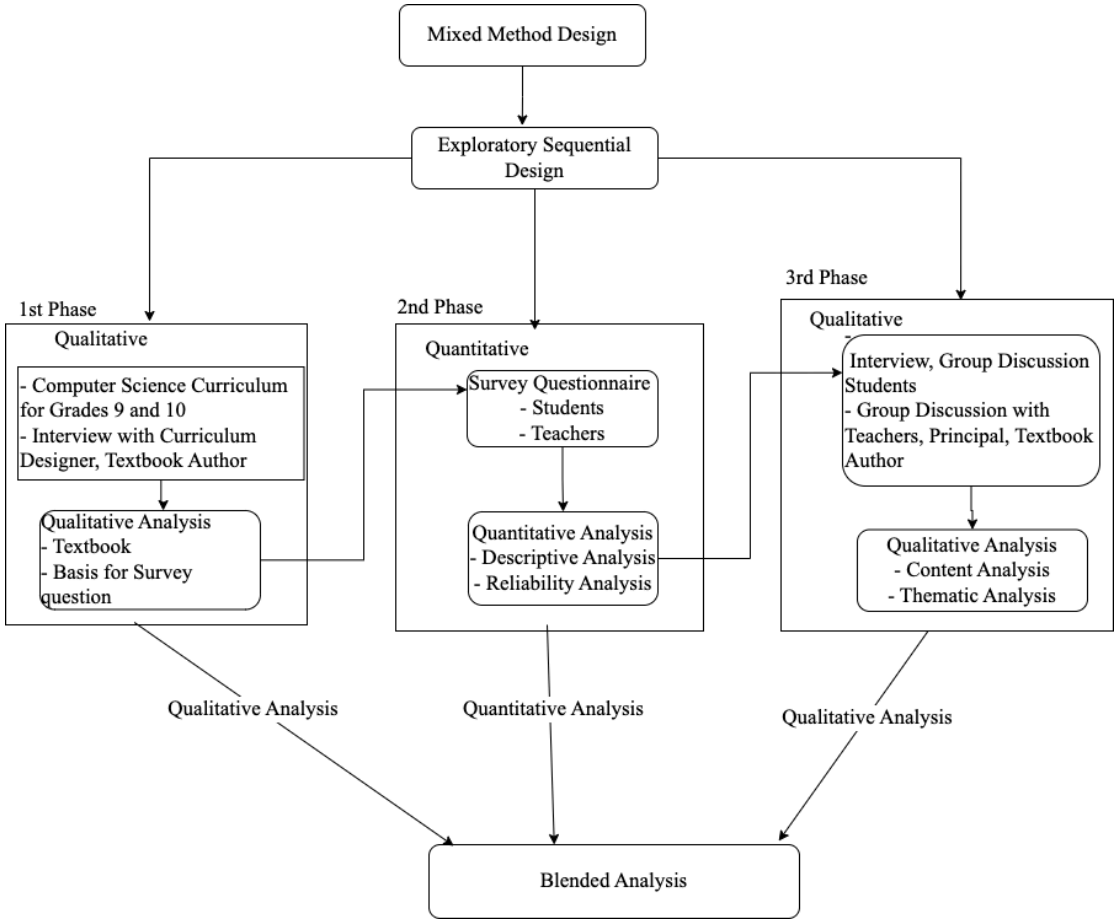
Pragmatic research involves both qualitative and quantitative methods often termed as mixed-methods research design. The exploratory sequential mixed-method research design was used since this design incorporates both quantitative and qualitative research to study in depth and provide comprehensive understanding for this research (Creswell & Creswell, 2018). This research design was followed in three steps for the study. The first qualitative phase was used to understand details about CS curriculum and opinions on the textbook contents coverage from textbook authors and curriculum designers. This first phase has helped to draft survey questionnaires for CS

teachers and CS students. The pilot testing for these survey questions were done with teachers and students. The second quantitative phase was used to collect data from CS teachers and students. A descriptive survey method is used to collect a wide range of data from survey participants. Statistical tools were used for the generalization of study findings from survey data. The third qualitative phase was used to discuss the research findings from teachers and students surveys. The findings from quantitative and qualitative data were verified using a triangulation method. This study has broad coverage in quantitative research for the Computer Science curriculum.

The participants in this study were teachers, students, curriculum designers, school principals, and textbook authors who are the main actors in the educational institutions. Teachers instruct learning materials and guide students in their academic and personal development. They often know the students' interest and their persuasion in the subject. Teachers' feedback would help to analyze the present CS curriculum. Curriculum designers are the main actors from a governance perspective responsible for designing the Computer Science curriculum. The interviews were conducted with textbook authors to know the purpose of specific topics included in the CS curriculum, and compare the Nepal CS curriculum with the international CS curriculum. The interviews were conducted with school principals to know the effectiveness of the Computer Science curriculum. Figure 2 depicts the exploratory sequential mixed-method (Creswell & Creswell, 2018, p. 306) research design used in this study.

Figure 2:

Mixed Methods Design



Source: Adapted from Creswell & Creswell, (2018).

Study Population and Sampling Strategy for CS Students

Population helps the researcher to generalize conclusions from study findings that would be applied to the total population (Trochim, 2002, p. 81).

Total Study Population

Total study population for students represents the entire CS students of Grades 9 and 10 in Nepal. The student survey was on an online platform accessible across Nepal. There are seven provinces in Nepal. Bagmati province has 13 districts (see Appendix A - Set I and Set II).

Target Population

The target population is the group from where the researcher selects individuals for study. In this study, initially the target populations were the Computer Science students at Grades 9 and 10 in Nepal. However, due to limitations, the majority of students participated in an online survey from Kathmandu Valley. Kathmandu valley has robust internet connectivity infrastructure and there were several schools having CS subjects in Grades 9 and 10. Additionally, there were experienced and trained CS teachers in Kathmandu valley. Therefore, the target population was considered only from Kathmandu Valley. Kathmandu valley comprises Lalitpur, Bhaktapur, and Kathmandu districts in Bagmati province of Nepal. Table 3 mentions the target populations of CS students for the study.

Table 3:

Target Population of Computer Science Students in 2078 B.S. (2022 A.D)

Population of CS students				
Kathmandu valley	Grade 9	Grade 10	Total students	Population percentage
Kathmandu	10918	10822	21740	68%
Bhaktapur	1608	1498	3106	10%
Lalitpur	3430	3556	6986	22%
Total CS students	15956	15876	31832	100%

Source: From National Examination Board, Sanothimi, Bhaktapur.

Target Population for CS students in Kathmandu valley is 31,832.

Sample Populations of Computer Science Students

A sample is the subset from the target population selected in the research study. Sample represents a mirror characteristic for the whole population. The inference and generalization drawn from the sample studied are applied to a larger population.

Sample Size Calculation. A sample size is calculated from the target population. As the Computer Science students population is known from the National Examinations Board, Nepal government source, thus the sample size is calculated through the Slovin formula.

$$n = \frac{N}{(1 + Ne^2)}$$

Where:

- n = Number of sample,
- N = Total population and
- e = Error tolerance level

For quantitative study, I have assumed a confidence level of 95 percent, error tolerance (e) as 5%. The CS student population in Kathmandu Valley (N) = 31,832 and error tolerance level (e) = 5%, this results sample size for student (n_S) = 395.04 students (rounded off 395).

For the total sample size, adding 5% to sample size = 395 + 5% of 395 = 414.75 = rounded off 415 total students.

The total required sample size for CS students is 415.

Proportionate Sample size selections for CS Students. Table 4 mentions the required number of CS students participating from Kathmandu, Bhaktapur and Lalitpur districts, proportionately from the target population.

Table 4:

Distribution of Sample Size for Computer Science Students

District	Percentage of total population	Total sample size	Proportionate sample size
Kathmandu	68%	415	282
Bhaktapur	10%	415	42
Lalitpur	22%	415	91
Total CS students sample size			415

Thus 282 students from Kathmandu district, 42 students from Bhaktapur district, and 91 students from Lalitpur district were required to participate in the CS survey.

Sampling Techniques

Sampling technique helps to select participants from the target population in study. This technique identifies the criteria and process for selecting participants in the study.

Sampling Technique Used to Select Schools and Students

Random sampling was used to select schools from the Kathmandu Valley. The list of schools within Kathmandu valley is from the Center for Education and Human Resource Department, Nepal (see Appendix A, Set III). The CS students from grades 9 to 12 participated in an online survey questionnaire based on their availability in the schools (see Appendix B, Set I).

Random sampling is a method of selecting individuals from a larger population in such a way that every individual has an equal chance of being a participant in the survey (Trochim, 2002, p. 88). Random sampling is considered a

preferred technique for descriptive studies in quantitative survey research. Random sampling reduces bias and increases the likelihood that the sample accurately represents the larger population (Muijs, 2004). This ensures that the sample is representative of the larger population, which is used for generalization in quantitative research.

Sampling Technique Used to Select Sample Teachers

Purposive sampling technique was used to collect data from CS teachers. Purposive sampling technique is used when researchers intentionally select individuals based on certain characteristics in research study (Trochim, 2002, p. 94). The teachers who are currently teaching CS subject at Grades 9 to 12 were purposely selected to participate in this survey (see Appendix B, Set II). The study focuses on the comprehensive aspect of the Computer Science curriculum encompassing both theoretical and practical knowledge and how these concepts are applied in student's academic and daily life. To study in depth, qualitative data collection from teachers is essential, as they are the key people who understand students' needs and how students comprehend the current CS curriculum.

Participants for Qualitative Study

Individuals having in-depth knowledge and information related to study questions and CS subject were selected on the judgmental basis (Kumar, 2011). The textbook authors and curriculum designers were selected with their names mentioned in the preface page of the Computer Science textbook for Grades 9 and 10 (Gharti et al., 2020a, 2020b). The principals having a CS subject in their school for Grades 9 and 10 were selected to understand their CS education plan. The teachers having at least five years of teaching experience in CS were purposefully selected. Five years of teaching experience reflects consistent teaching practice and deep understanding of

the CS subject contents, pedagogical approaches, and the curriculum. The present CS students were selected to understand perspectives of the CS curriculum. The alumni CS students were selected to understand the application of knowledge learnt from CS subject at Grades 9 and 10. Table 5 lists the participants involved in the qualitative research.

Table 5:

Participants for Qualitative Data Collection

Divisions	Number	Criteria
Subject Experts	3	CS textbook authors
Curriculum Designers	2	CS Curriculum Designers (names mentioned in a textbook)
School Principals	2	School having CS subject
CS Teachers - Female	2	More than five years of experience
CS Teachers - Male	4	More than five years of experience
CS Students - Male	4	Grades 9
CS Students - Female	3	Grades 9
CS Students - Male	4	Grades 10
CS Students - Female	3	Grades 10
CS Students - Male	2	Grade 11
CS Students - Female	2	Grade 11
CS Students - Male	2	Grade 12
CS Students - Female	2	Grade 12

Study Tools

A study tool is used for data collection during the research process. The selection of tools depends on the nature of the research questions and the type of data to be collected for this study. The following tools were developed and used in the research study.

Quantitative Data Collection Tools

The quantitative data collection tools help to capture a wide range of data. The tools used in this study are mentioned:

I. Teacher survey questionnaire

II. Student survey questionnaire

III. CS Textbook Module-Based Analysis Guideline

The survey questionnaire was developed and used as a tool to collect data from CS teachers and students. The pilot-testing of these tools was performed before going to the field survey.

Pilot-Testing of Survey Questionnaire. The intent of pilot testing of the questionnaire was to know the feasibility of survey questions that students and teachers could complete within a minimum time frame and effectively capture the data needed for this study. The pre-testing of the survey questionnaire was conducted for a two-week duration with CS teachers and students. During the pre-test phase, it was found that questionnaires were too lengthy and participants required more time to fill the survey. Thus the survey questionnaires were modified with multiple choice response options so that participants could participate in a survey at a feasible time-frame. The items were validated while reviewing surveys from subject experts and teachers. Data collected during pilot testing was verified to ensure that the study tool had captured the required data for the study.

Descriptive Survey. The purpose of the descriptive survey was to obtain detailed information from teachers and students about the Computer Science curriculum, including the adequacy of content units and identifying which units are perceived as easy or difficult. The descriptive survey method was used to capture a large amount of data from CS students and teachers. Survey method helps to get objective information from respondents. Descriptive research is a method used for documenting students' and teachers' opinions about current and expected CS curriculum (Muijs, 2004).

Questionnaire. Questionnaires are a set of structured questions designed to gather information from respondents (Trochim, 2002, p. 151). Survey questionnaires were created in the google form. The question used in the survey comprises both close-ended and open-ended questions. Closed-ended questions were used to standardize responses and analyze data quantitatively, whereas open-ended questions provide more detailed and qualitative responses in participants' words.

Likert scales of three to five points were used to collect data. Likert scale is used to measure respondents' attitudes, opinions levels on a set of statements (Trochim, 2002). The multiple points in the Likert scale help respondents to respond with finer distinctions on the subject opinion. In terms of multiple response options, an additional "other" free-text field was used to collect user opinions. The other option in question is a balance between structured response and open-ended feedback that helps to capture both quantitative and qualitative data. The choice ranking question in grid format is used to know the preference for programming courses. The reliability and validity of the survey question was based on the principles mentioned.

Neutrality. Neutrality in survey questions refers to the principle of designing questions in a way that avoids bias, prejudice, and leading responses. The neutrality

was included by avoiding leading language with a balanced and unbiased tone in question. The double-barreled question was not used in the survey. The response choice was clear with unambiguous language. The questions were not poised to affect any social belief systems and culture.

Reliability. Reliability is consistent in the data measurement (Trochim, 2002, p. 125). The reliable tool helps a researcher to take consistent data in a research survey. Cronbach's alpha is a statistical test used to measure internal consistency for the survey response on a scale of 0 to 1 value. Higher values indicate greater consistency among response items. The Cronbach alpha value is calculated using a formula.

$$Cronbach's\ alpha\ (\alpha) = \frac{k}{k-1}\left(1 - \frac{\sum_{i=1}^{k} \sigma^2 yi}{\sigma^2 y}\right)$$

Where:

k = number of items in measure

$\sigma^2 yi$ = variance associated with each item "i"

$\sigma^2 y$ = variance associated with the total scores $\left(y = \sum_{i=1}^{k} yi\right)$

The interpretation of Cronbach's alpha values as: >.9 is excellent, >.8 is good, >.7 is acceptable, >.6 is questionable, >.5 is poor and <.5 is unacceptable (George & Mallery, 2016, p. 240).

Validity. Validity refers to the measurement of variables by the tool that it is supposed to measure for the study. Content validity determines whether the survey items encompass the construct used in the conceptual framework for the CS subject (Trochim, 2002, p. 101). The survey questionnaires were reviewed by Computer Science subject experts to verify that the items are relevant, representative and

comprehensive to capture intended data for CS curriculum study. Hence, validation of tools from subject experts emphasizes the trustworthiness of the tools.

***Generalization*.** The survey items were designed to capture a large number of data from several participants. The findings from this study would be generalized to the study populations for Kathmandu valley.

Teacher Survey Questionnaire. The purpose of the teacher survey questionnaire was to understand the present status and expectation from the CS curriculum that would help to develop an effective CS curriculum. The questions in the teacher survey were about CS textbook contents coverage, digital skills required by students and new technologies in CS. There were two sections in the teachers survey. The first section has a list of seven questions intended to capture demographic data. The second section has a list of 11 questions that were related to current status, expectations about CS curriculum and expected digital skill required by students. The questions responses were the type of single choice or multiple responses close-ended, multiple response with "other" free-text option, Likert five-point scale question (strongly agree, agree, neutral, disagree, strongly disagree), choices ranking response in a grid format and two open-ended questions to know opinions for the new CS curriculum. The teacher survey questionnaire is provided in Appendix C- Set I.

Reliability of Teacher Survey Questionnaire. Cronbach's alpha statistical test was used to find the reliability for "adequacy and sufficient contents" in a survey question. Numeric value was assigned to Likert five point scale (1 = *strongly agree*, 2 = *agree*, 3 = *neutral*, 4 = *disagree*, 5 = *strongly disagree*. The Cronbach alpha (α) value for 22 number of items (k) is 0.971. Thus 0.971 value signifies very high reliability for inter consistency responses in the teacher survey.

Student Survey Questionnaire. The purpose of the CS students survey questionnaire was to understand present status and expectations from the CS curriculum that would help to design a new CS curriculum. The questions in the students' survey were related to CS textbook contents, programming and graphics application and any suggestion to include or exclude specific topics from the present CS curriculum. The student survey has only one section so that all data can be captured in a single page view. The student survey has a list of 18 questions that comprises single choice and multiple response close-ended questions, multiple responses with "other" free-text opinion, likert five points scale question (very difficult, difficult, neutral, easy, very easy) and one open ended question. There were five questions in the survey that were intended to collect demographic data of students. The detailed student survey questionnaire is provided in Appendix C - Set II.

Reliability of Student Survey Questionnaire. Cronbach's alpha statistical test was used to calculate reliability value for "easy to difficult units" questions in a Computer Science subject. Numeric value was assigned to likert five-point scale (1 = *very easy,* 2 = *easy,* 3 = *neutral,* 4 = *difficult,* 5 = *very difficult*). The Cronbach alpha (α) value for 22 number of items (k) is 0.936. Thus 0.936 signifies very high reliability between items from the student survey.

CS Textbook Module-Based Analysis Guidelines. The contents from Computer Science textbooks for Grades 9 and 10 have been categorized into three modules: theory, graphics, and program. These modules are used for numerical analysis of content coverage in textbooks. The parameter for modular analysis is based on the number of pages that cover the modular contents in a CS textbook. The guidelines for modules are mentioned in (Appendix C- Set III). The "theory" contents

are supposed to understand foundational concepts in Computer Science, "graphics" for visual computing, and "program" for software development.

Qualitative Data Collection Tools

The tools developed in this study were to gather information from the existing documents related to the Computer Science curriculum and participants selected for interviews and group discussion.

I. Desk Review guidelines
II. Semi-Structured Interview with Teachers, Curriculum Designers, and Principals Checklist
III. Focused Group Discussion Guidelines with Teachers
IV. Group Discussion guidelines with Teachers, Textbook Author, Principals
V. Interview and Group Discussion guidelines with CS Students Guidelines

Desk Review. The desk review process was incorporated to understand background and information about study problems from existing documents, which helped to frame questions for survey (Bowen, 2009). The following documents have been studied to gather information about the research- CS textbooks for Grades 9 and 10, National Curriculum Framework, Nepal ICT policy 2072, Nepal Secondary Education, and National Examination Board documents have been analyzed.

Tools for Semi-structured Interview with Teachers, Curriculum Designers, and School Principals. Interviews with teachers, textbook authors, school principals and curriculum designers were conducted to understand the current CS curriculum and expectations from the curriculum. The interview is a conversation between the researcher and participant to collect in-depth information about the subject (Trochim, 2002, p. 212). Interviews were conducted through telephone, in-person to know details about the CS curriculum. The list of interview questions for

teachers is provided in (Appendix D - Set I), for Curriculum Designers (Appendix D - Set II), for Principals (Appendix D - Set III), for textbook authors (Appendix D - Set IV).

Guidelines for Focused Group Discussion (FGD) with Teachers. FGD helps to gather in-depth insights, opinions on a specific topic and is guided by a moderator to engage participants on topic discussion (Creswell & Creswell, 2018). FGD helps to reach a common conclusion from several stakeholder participation. CS teachers, textbook authors, and school principals were invited for FGD. Meeting agenda was pre-informed to the invited members in a focused group discussion. Meeting was conducted online through Google Meet. The list of focused group discussion questions is provided in (Appendix D - Set V).

Guidelines for Group Discussion with Teachers, Textbook Author, and School Principals. The group discussion was conducted with the school principal, textbook authors, and teachers regarding the Computer Science curriculum. The survey findings were presented in this meeting and opinions from several stakeholders were taken in an account. The meeting agenda is mentioned in (Appendix D - Set V).

Guidelines for Interview and Group Discussion with CS Students. Interviews were conducted with Grade 11 and 12 students to know the benefit of the CS curriculum. The intent of the interview was to know the gist of valuable knowledge gained from the CS subject in the local context. The list of interview questions with students is provided in (Appendix D - Set VII). The interviews with four students from Grades 11 and 12 were conducted that included two male and two female students.

Group discussions were conducted with Grades 9 and 10 students to know the border aspect of the CS curriculum and impact in their life activities (Trochim, 2002,

p. 219). Group discussion helps to share their opinions in a more detailed way. The agenda was related to easy and difficult topics, programming and graphics contents, interdisciplinary subject integration in CS curriculum. The list of group discussion questions with students is provided in (Appendix D - Set VI). The group discussion comprises seven students from grades 9 and 10 that includes four male and three female students.

Data Collection Procedures

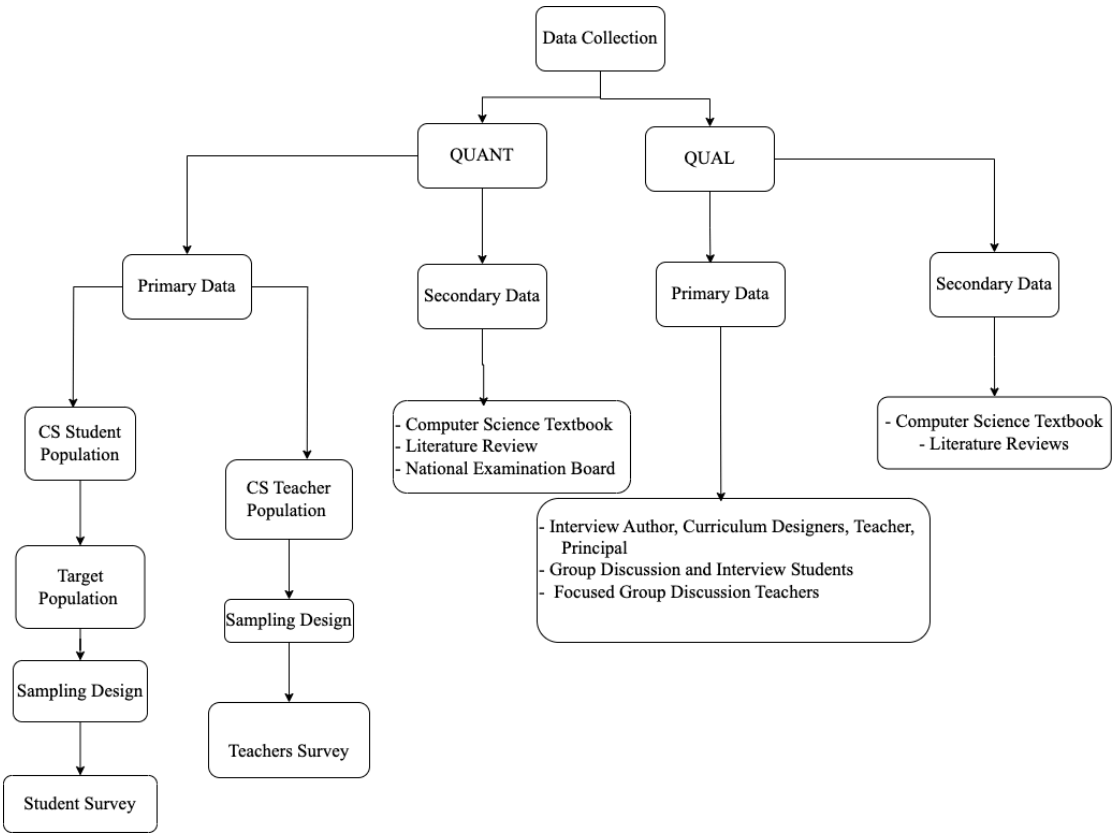
Both the qualitative and quantitative data were collected during the study. The data collection process from various sources is mentioned in Figure 3.

Sources of Data

Both primary and secondary sources of data were used in this study.

Figure 3:

Data Collection Procedures



Primary Sources of Data. The quantitative data was collected through questionnaire surveys from CS teachers and CS students. The qualitative data was collected from interviews of textbook authors, curriculum designers, teachers, FGD with teachers and experts, and students group discussion.

Secondary Sources of Data. The data was collected from the Computer Science textbook of Grades 9 and 10, prescribed by the Curriculum Development Center. The literature reviews of articles, thesis and books were used for secondary data related to CS. The secondary source data were used to analyze the CS curriculum and textbook content coverage. The secondary sources of data helped to frame interviews questions for the textbook authors, teachers, curriculum designers and students.

Quantitative Data Collection

The approval letter regarding the research study of the CS curriculum survey for Grades 9 and 10 was taken from Curriculum Development Center (CDC), Nepal (see Appendix E). I had done a presentation about the "*Need of Computer Science Survey*" to CS teachers and school principals. This presentation emphasizes the objective of the survey to be conducted and encourages participants from several schools to have diversified data.

Survey Platform. The survey data was collected through Google Forms. The online survey was publicly accessible across Nepal. The student survey was open for 5 weeks (15 September 2023 to 20 October 2023) and teachers survey was open for 8 weeks (15 September 2023 to 15 November 2023).

Qualitative Data Collections

The qualitative data was collected from both primary and secondary sources. The primary data was collected from CS teachers, CS students, curriculum designers,

principals and CS textbook authors. The data was collected from CS students Grades 9 to 12 to understand textbook adequate content coverage and learning resources. The secondary data was collected from the CS textbook for Grades 9 and 10, literature review of articles related to CS curriculum and programming. The qualitative data collection was for a longer period of duration from March 2023 to Feb 2024. The focussed group discussion with seven CS teachers was conducted from 8 am to 11 am on 23rd September 2023. The group discussion with six CS teachers and two school principals was conducted at 8 to 9.30 am on 7th October 2023. The interviews were conducted with three textbook authors and two curriculum designers. The qualitative data collection was involved at both the first and third phase for this study. The quantitative data were analyzed with qualitative data for validation of the study findings.

Steps for Data Collections

The data in this study has been collected in three phases. In the first phase, qualitative tools were used to understand in depth about the Computer Science curriculum from curriculum designers and textbook authors. These qualitative tools have been used in the first phase of data collection.

1. Semi-Structured Interview with Curriculum Designers, and Textbook Author Checklist
2. Desk Review

In the second phase, quantitative tools were used to collect survey data from teachers and students.

I. Teacher survey questionnaire

II. Student survey questionnaire

In the third phase, both qualitative and quantitative tools were used to collect data from CS teachers, principals, textbook authors, and CS students. The data collected from the survey were analyzed, discussed, and validated with qualitative data. These tools have been used in the third phase of data collection.

1. Semi-Structured Interview with CS Teachers and School Principals Checklist
2. Focused Group Discussion Guidelines with Teachers
3. Discussion with CS Teachers, Textbook Author, Principals
4. Interview and Group Discussion CS Students Guidelines
5. CS Textbook Module-Based Analysis Guideline

Data and Information Analysis Procedures

The data collected from primary and secondary sources of quantitative and qualitative data were analyzed, verified through a triangulation process for research findings.

Quantitative Data Analysis

Descriptive research helps to know answers related to what, where questions on the subject. Generalization can be derived from inference of data analysis in the research process (Kumar, 2011). The data from the survey was collected in the Google Form. The data collected from surveys of Computer Science teachers and students were manually reviewed, filtered and compiled to analyze data with Microsoft Excel. The data was analyzed and visualized using pie charts, grouped bar charts, stacked column charts, and funnel chart. The Likert scale data was coded in the numeric form to find Cronbach alpha value for reliability of data. The textbook content was categorized in three modules (program, graphics, theory) and analyzed in terms of page number, percentage coverage in textbook.

Qualitative Data Analysis

The data collected through interviews, group interviews, and FGD of teachers and students were noted, manually reviewed, and rearranged into similar topics set for the analysis of the quantitative data (Trochim, 2002, p. 215). The interviews and group discussion data were transcribed and arranged into themes related to program, graphics, localization and globalized contents, and pedagogy practice for Computer Science subject.

Content Analysis. The data from the interview is transcribed into textual format and systematic examination of textual contents was processed for content analysis (Bryman, 2011). Researchers identify and analyze the patterns of data within content to draw insights from data. The content analysis was done inlined with the study objectives. With respect to the first and second study objective, the interview with students and teachers were analyzed to assess the effectiveness of the present CS curriculum to prepare students with knowledge applicable to their lives and future academic careers. The identified gap in the existing and expected Computer Science curriculum has guided the revision of the CS framework and competency, aligning with the third objective of the study.

Thematic Analysis. Researchers examined the textual data to group into topics which were arranged into common themes, and thus a group of sub themes were used to form the desired theme. The thematic analysis presents a structured and rigorous approach to the development of themes from insights into textual data (Braun & Clarke, 2006). The thematic analysis in this study was done with interview data to group into topics such as program, graphics, content, artificial intelligence, teacher development, and policy.

Relation Table. A relational table was created to effectively monitor the research activities and processes that help to understand the connections between study objectives, research questions, study tools, and respondents. Table 6 presents these relationships to facilitate the study.

Table 6:

Relation Table of the Study

Research objective	Research questions	Study tools / Question no	Respondents
1. To examine the Computer Science curricula designed for Grades 9 and 10.	1. How do the Computer Science courses contribute to students' application of knowledge gained from fundamental concepts, skills, and technologies in Computer Science?	Appendix C- Set I: questions (9 to 14), Appendix C- Set II: questions (9 to 14), Appendix C- Set III, Appendix D- Set I, Set II, Set III, IV, V, VI, VII	CS Students, CS Teachers, School Principals, Textbook Authors, Curriculum Designer
2. To analyze the adequacy, usefulness, and effectiveness of the existing Computer Science curricula for Grades 9 and 10	2.1. What are the perspectives of key stakeholders (Computer Science students, teachers, curriculum	Appendix C- Set I: questions (15 to 18),	CS Students, CS Teachers, School Principals, Textbook Authors,

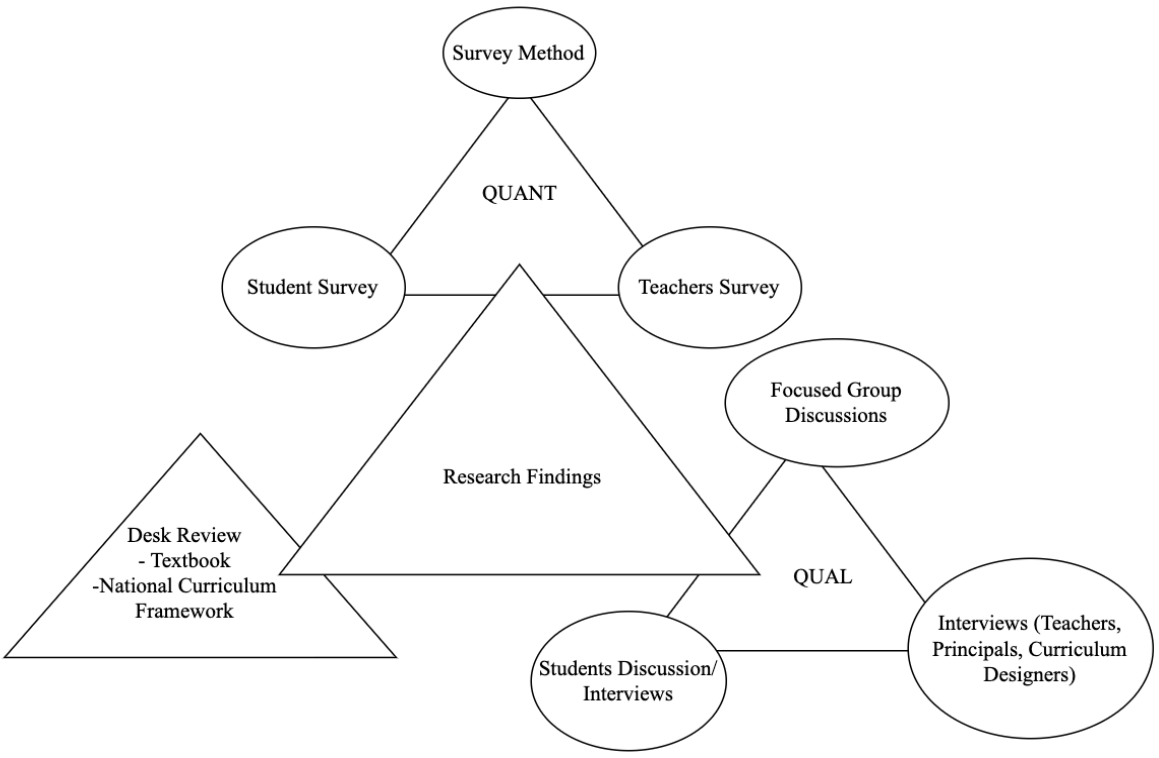
from different stakeholders' perspectives (students, teachers, curriculum designers, textbook authors, and school principals).	designers, textbook authors, and school principals) regarding the adequacy, usefulness, and effectiveness of the Computer Science curricula for Grades 9 and 10?	Appendix C- Set II: questions (6 to 8, 16, 17), Appendix C- Set III, Appendix D- Set I, Set II, Set III, IV, V, VI, VII	Curriculum Designer
	2.2. What aspects are required to enhance Computer Science curriculum based on stakeholders' insights to improve educational outcomes?	Appendix C- Set I: questions (9 to 11, 16), Appendix C- Set II: questions (10, 13, 18), Appendix D- Set I, Set II, Set III, IV, V, VI, VII	CS Students, CS Teachers, School Principals, Textbook Authors, Curriculum Designer
3. To revise an existing framework and propose a model for developing the Computer Science curricula for Grades 9 and 10.	3. What elements are necessary for designing a Computer Science curriculum?	All questions	Researcher

Data Triangulation

The data collected from multiple sources was validated to conclude findings for this study. The quantitative data collected from CS teacher and student (Appendix C- Set I and Set II) is validated with qualitative data from students and teacher participants (Appendix D - Set I, Set IV, Set V, Set VI, Set VII), and curriculum designers (Appendix D - Set II), and school principals (Appendix D - Set III). Figure 4 presents the triangulation of data.

Figure 4:

Triangulation of Data Collected during Research Process



Source: Revised and Adapted from Carugi, (2014, p. 71).

Ethical Considerations

This study has followed all ethical guidelines adhered by Tribhuvan university and education laws in Nepal. First, the survey letter about the Computer Science curriculum was approved from the Curriculum Development Center, Nepal. This

letter was appended in the appendix section in the teachers' survey questionnaire. The introduction section in a survey questionnaire mentions the purpose of the survey as “to suggest the suitable curriculum for Computer Science IX and Xth Grade as per Nepalese societal needs”. As a researcher, I have mentioned my details in the survey questionnaire (Appendix C - Set I, Set II).

Teachers and students have voluntarily participated in the survey questionnaire. They have the option of withdrawing at any time during the research process. Informed consent was obtained from participants for interviews and group discussions, and data collected from the interview were analyzed for this study. The data collected during this survey was used for academic study with the aim of analyzing the existing Computer Science curriculum in Nepal.

CHAPTER IV

Analysis of Computer Science Curricula

The main purpose of this study is to analyze the Computer Science (CS) curricula for Grades 9 and 10 at Secondary School in Nepal. This chapter provides detailed analysis and findings for the CS curriculum from the perspective of CS teachers, CS students, curriculum designers, school principals, and textbook authors.

A total of 419 CS students from Grades 9 to 12 participated in an online survey questionnaire, representing 17 schools from Kathmandu Valley (see Appendix B- Set I). The sample comprised (61.81%) boys, (37.95%) girls, and (0.24%) as others. The student participation in an online survey from Grade 9 was (10.26%), Grade 10 was (56.32%), Grade 11 was (28.88%), and Grade 12 was (4.53%).

Table 7:

Student Participation in Online Survey within Kathmandu Valley (N = 419)

Grade	Female	Male	Other	Total
Class 9	3.82%	6.44%	–	10.26%
Class 10	26.49%	29.59%	0.24%	56.32%
Class 11	6.44%	22.43%	–	28.88%
Class 12	1.19%	3.34%	–	4.53%
Total	37.95%	61.81%	0.24%	100.00%

The CS teacher participation (N = 40) in an online survey questionnaire were from 19 schools within Kathmandu Valley (see Appendix B- Set II). Table 8 provides

a cross-tabulation of CS teachers' participation in an online survey questionnaire, categorized by their teaching experience and educational qualifications.

Table 8:

Teachers Participation in Online Survey Within Kathmandu Valley (N=40)

Teaching experience	Bachelor	Master	M. Phil	PHD	Total
Below 2 Years	8%	5%	–	–	13%
2 to 4 years	8%	10%	–	–	18%
5 to 10 years	0%	5%	–	–	5%
Above 10 years	10%	45%	8%	3%	65%
Total	25%	65%	8%	3%	100%

The education qualification for CS teachers from Kathmandu Valley includes - (25%) Bachelor degree, (65%) Master degree, (8%) Mphil, and (3%) PHD. The participants teaching subject specialization includes Computer Science (87.5%), Science and Technology (7.5%), Master of Business Studies (2.5%), and Multimedia technologies (2.5%).

Assessment of Computer Science Curricula

This heading presents the analysis of Computer Science curricula from students and teachers' perspective. Teachers and students are the key stakeholders in the Computer Science curriculum, actively engaged in the teaching and learning activity. This heading addresses the research question - How do the Computer Science courses contribute to students' application of knowledge gained from fundamental concepts, skills, and technologies in Computer Science?

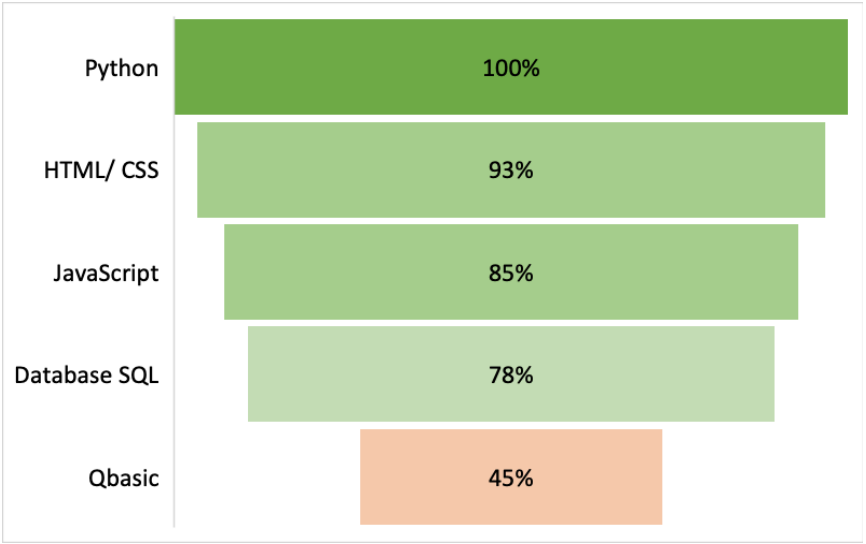
Teachers Perspective on Computer Science Curriculum

In an interview with CS teachers, they mentioned that the Computer Science curriculum has five programming languages (HTML, CSS, QBasic, C, MS Access database) in Grades 9 and 10. All of these programming languages have different syntax and programming methods. Computer Science content materials require more focus on programming concepts rather than teaching several programming languages (PL). They suggested that focusing on fewer programming languages could be more effective teaching as students get confused with various programming syntaxes.

The priority of the programming language was known from a teacher's survey. Figure 5 presents the priority of programming languages from the teachers' survey (see Appendix C - Set I, question 11). The detailed response for programming language priority is mentioned at (Appendix G - Set III).

Figure 5:

Programming Languages Priority from Teachers Perspective



As per survey, Python has received first priority among five programming languages, securing a (100%) response. The HTML CSS language has received a second priority for PL's securing (93%) response. Javascript has received as a third

priority for PL's securing (85%) response. Database SQL received a (78%) response as the fourth-priority language. Qbasic has received the least priority among the five PL's securing only (45%) response.

In a survey, (87.5%) teachers mentioned that programming knowledge requires to be taught in functional ways that are used for application development. This was also discussed during the group discussion where Computer Science teachers mentioned:

> The CS curriculum needs to be updated with the Python programming language. However, teaching Python instead of Qbasic seems to be changing in terms of human resources. The existing teacher needs to learn a new Python programming language and several teachers may hesitate to learn a new programming language. So it is better to provide two options related to programming language (Python or Qbasic) in the CS curriculum for a certain duration so that existing teachers would get adequate time to upgrade skill and this will be easier for school management to upgrade skill of teachers in training programmes.

In a Survey, (77.5%) teachers mentioned that the Computer Science curriculum needs to focus on skill based education so that students learn practical skills in an academic year. (45%) teachers only agreed that the CS textbooks include examples from interdisciplinary subjects such as Mathematics, Statistics, Science, Literature. CS teacher mentioned in a focus group discussion-

> Students find reading textbooks tedious and time-consuming. Nowadays, students tend to rely more on online learning resources like YouTube video tutorials and e-learning platforms. In the past, when internet study materials were not sufficient, students primarily studied from textbooks. Therefore,

there is a need to redesign textbooks to better suit the learning preferences of today's generation. The textbook needs to include- additional learning materials in website URL or Quick response (QR) code to explore in-depth learning materials. The textbook requires re-designing with interdisciplinary subject contents materials so that students can implement data and information from other interdisciplinary subjects in learning Computer Science concepts.

About (65%) teachers mentioned that a teacher guide book for CS curriculum is required. A majority of the teachers (82.5%) emphasized on the teachers training programming for competency development. Teacher development program will help to share teaching experience and upgrade knowledge and skill in CS subject. In the teachers' survey, (42%) teachers emphasized on the teacher's competency test to assess and upgrade knowledge in CS subject as tests would encourage them to learn and explore learning materials. In a group discussion:

Teachers emphasized allocating extra time for teacher competency learning programs. Even if the CDC changes the programming language from QBasic to Python; there will be a significant challenge to train existing teachers for the Python programming language. This challenge may create job insecurity among CS teachers. Thus, as of now students are supposed to learn programming concepts through QBasic programming language rather than contemporary languages like Python and Javascript. Once students understand the CS programming fundamental concepts, they can easily adapt to learn any new programming language.

As per teachers survey, CS Grade 10 students are expected to possess important skills and knowledge (see Appendix C - Set I, questions 9 and 16). About (85%) of teachers emphasized on programming skills, (82.5%) teachers emphasized

that students are required to develop a basic portfolio website, (82%) emphasized on operating system knowledge such as file management, (80%) teachers emphasized on students are required to be familiar with cloud-based tools such as Google Drive, Google Sheets, and Google Docs, and possess basic knowledge of computer operations and troubleshooting, including software installation, uninstallation, and monitoring computer health, (72.5%) emphasized on proficiency in office applications like Word, Excel, and PowerPoint, (70 %) emphasized on digital data security, (67.5%) emphasized on knowing basic internet usage such as web browsing and email communication, (57.5%) teachers mentioned that students are required to be proficient in typing Nepalese local languages scripts and ability to search relevant learning resources on digital platforms. The data analysis from qualitative and quantitative suggest that students are required to learn problem solving and application usage skills through which they can apply CS concepts in their life activities.

In the teachers survey, around (72%) teachers mentioned artificial intelligence, (70%) as audio and video editing, (42%) as data analysis, (45%) as data visualization content materials required to be included in the revised CS curriculum. Data analysis and data visualization is related with interdisciplinary subjects such as Mathematics and Statistics. In a teachers survey, about (52%) teachers mentioned that students need an opportunity to pursue short-term learning projects in the companies. CS teachers mentioned in an interview:

> Students are familiar with the rules and regulations of several games played in a school. Developing small game based applications include knowledge of interdisciplinary subjects such as Math, Arts, Literature. Government needs to collaborate with companies so that students have an opportunity to learn from

real projects and that help to get practical exposure in Computer Science applications.

Students' Perspective on Computer Science Curriculum

During an interview, students mentioned that they choose a Computer Science subject so that they learn about digital tools and technologies. They are using various digital applications and tools in their daily life such as smartphones, TVs, smartwatches, fitness trackers.

In a survey, approximately (61%) students acknowledged that CS textbooks include examples from interdisciplinary subjects like Mathematics, Science, English, Nepali. CS students mentioned in an interview-

> Textbook requires a wide range of examples in programming, graphics, and sample solutions related to examination. Teacher help is required to understand and execute programs from the textbook. YouTube tutorial videos are more interesting and practical oriented on programming.

From a student survey, about (18%) students are comfortable with programming, (41%) students somehow know coding and the rest (41%) students don't even understand the concept of programming. Students require additional support and learning resources in programming. In a survey, (54 %) students mentioned that they were taught CS course contents with practical exercise. CS students mentioned in an interview-

> We are learning programming languages such as HTML, CSS, QBasic, C, and MS Access database. The CS curriculum covers several contents. It would be better if CS class could be conducted only in the laboratory so that we can simultaneously practice theoretical concepts in programming.

In a student survey, around (71%) students emphasized including game development, (66%) for Artificial Intelligence, (64%) for graphics audio and video editing, (55%) for Robotics, and (41%) for application programming in a new CS curriculum. In a student survey, (88.5%) students do not know to type in Nepali language. The Grade 10 students mentioned in a group discussion:

> We would like to explore programming languages that can be used to develop applications and also like to know about AI. I would like to know more about digital content creations, digital art and animations since my hobby is painting.

About (73%) students mentioned that there was no field visit in the CS subject. However, some CS students have been to field visits as part of their extra curricular activities in the school.

Adequacy and Appropriateness of the Computer Science Curriculum

Adequacy, Usefulness, and Effectiveness are integral components for evaluating a curriculum. Adequacy evaluates whether the curriculum has sufficient learning materials to cover the diverse range of students. Usefulness analyzes whether students learn knowledge and skills related to application and future career readiness after studying Computer Science. Effectiveness is used to analyze whether the curriculum meets the national educational objectives and prepares students with required skills and knowledge in social perspective. Furthermore, effectiveness helps to understand whether the curriculum is suitable across nations having different school infrastructure and student ability.

This heading addresses the two research questions- What are the perspectives of key stakeholders (Computer Science students, teachers, curriculum designers, textbook authors, and school principals) regarding the adequacy, usefulness, and effectiveness of the Computer Science curricula for Grades 9 and 10?. What aspects

are required to enhance Computer Science curriculum based on stakeholders' insights to improve educational outcomes?.

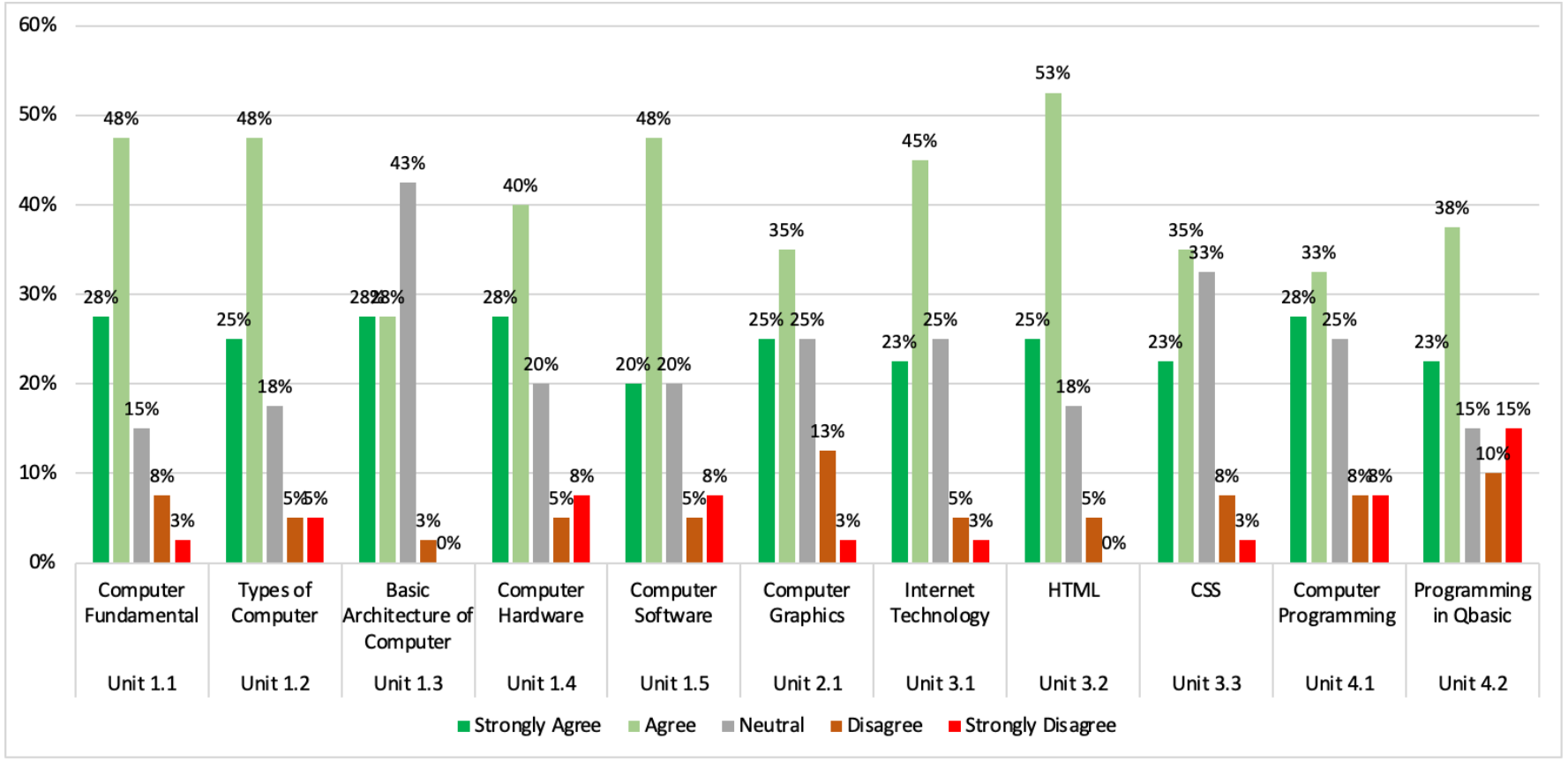
Computer Science Teachers' Opinions on the Adequacy of the Curriculum

Teacher opinions were known for the adequacy and sufficiency of Computer Science textbook contents materials for Grades 9 and 10. The purpose of the survey question was to understand whether the textbooks provide sufficient information and examples on Computer Science topics to cover a wide range of learners. This question helps to check content in terms of breadth and depth. The questions for "*adequacy and sufficient contents*" were designed in Likert five points scale (see questions 17 and 18 in Appendix C - Set I). There are a total of 22 units that includes 11 units from Grade 9 and 11 units from Grade 10 (see Table 10 and Table 11 for details).

The visual representation for "adequacy and sufficient contents" from teachers' survey for Grade 9 is depicted in Figure 6. G*rouped bar charts* help to understand trends patterns related to adequacy and sufficient contents for CS textbook units. The *red* color in a graph signifies the insufficient contents, *green* signifies the sufficient contents, and *gray* color signifies the neutral. (Appendix G - Set I) mention responses from teachers survey for Grade 9 questions related to adequacy and sufficient contents.

Figure 6

Teachers' Perspective on Adequacy and Sufficiency of Grade 9 CS Textbook Contents



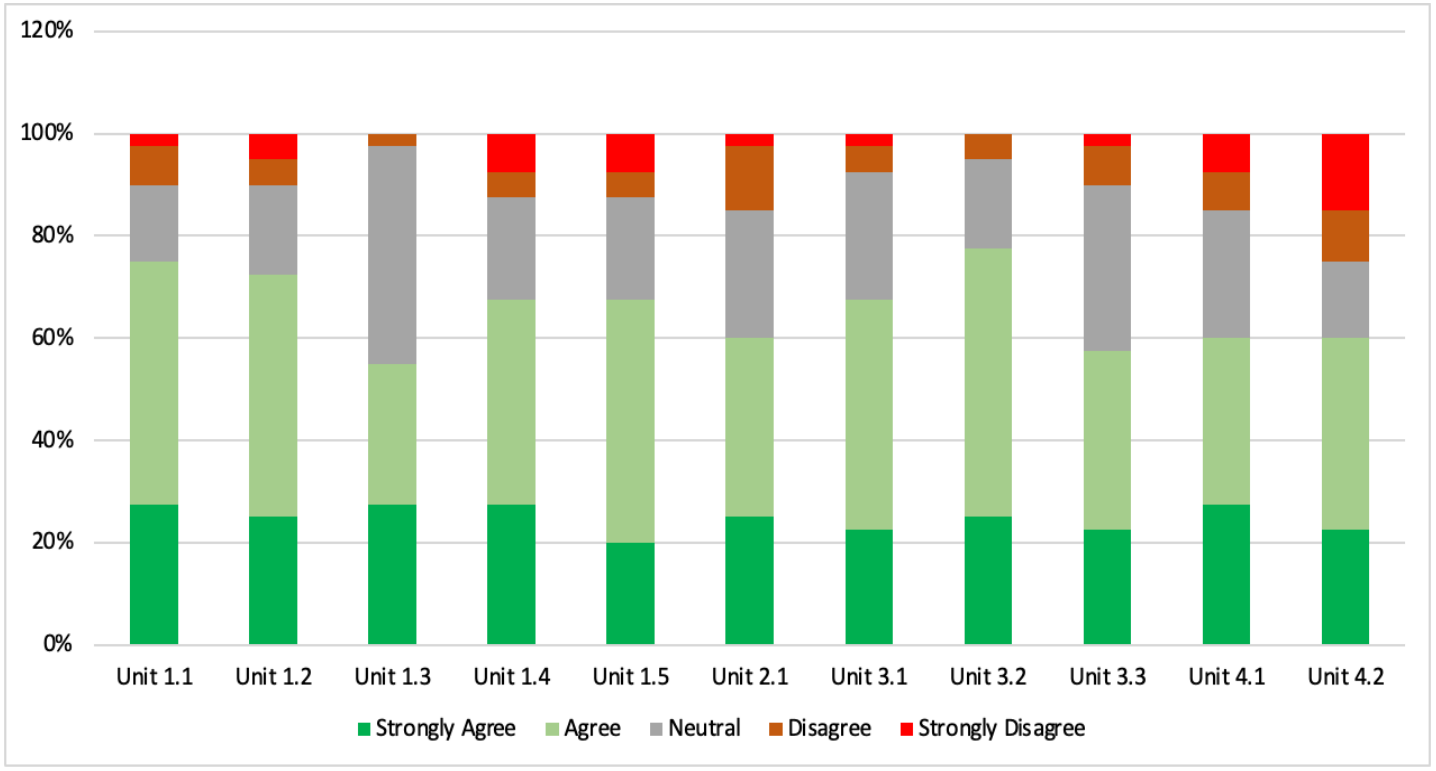
Note: Grouped bar chart shows the variation for CS textbook units..

The inference from the above grouped bar graph shows that there are sufficient content materials in the CS textbook from teachers' perspective. The graph is inclined towards the agreed portion for all units in Grade 9 Computer Science textbook.

Figure 7 uses a Stacked *column chart* to represent the teachers percentage share of opinions for adequate and sufficient contents in a CS textbook. The graph helps to visualize the percentage share for agree, neutral, and disagree for Grade 9 individual CS textbook units. For example - In Unit 1.1, the percentage of (green color) constitutes the major portion in the stacked column graph.

Figure 7:

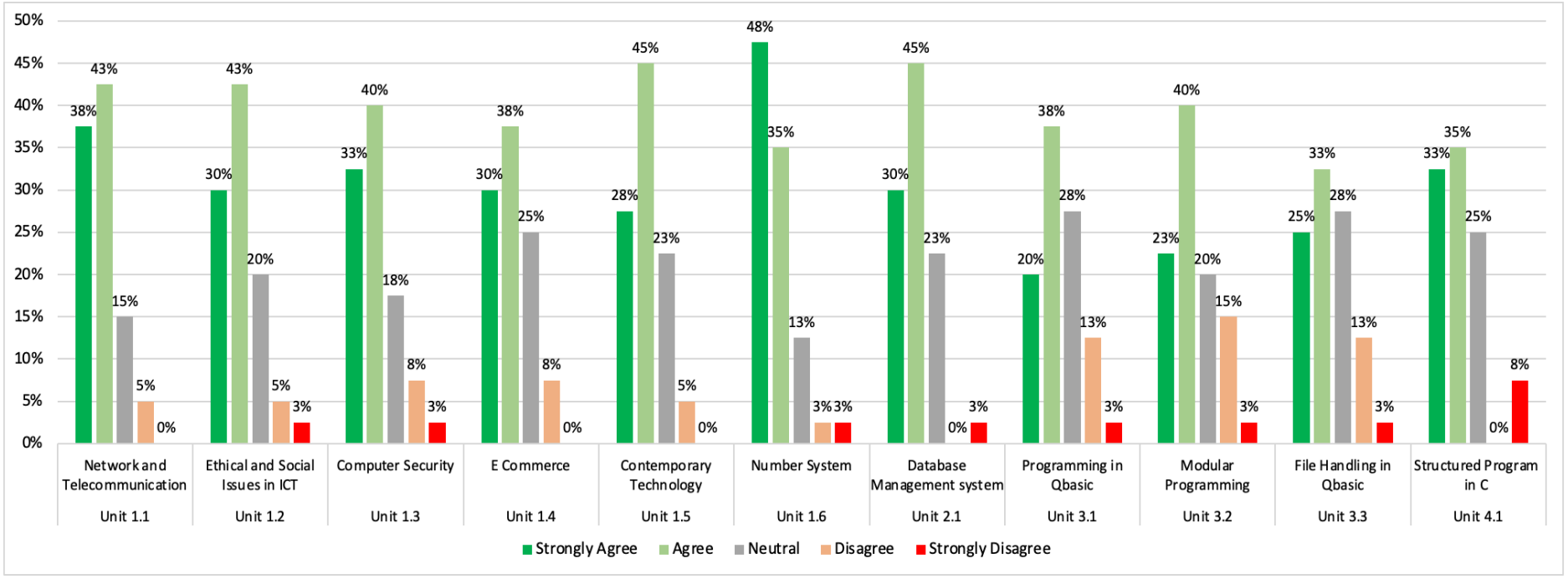
Teachers Perspective for Grade 9 CS Textbook for Adequacy and Sufficiency of Contents in Percentage Distribution



Similarly, Figure 8 presents the visual representation for "adequacy and sufficient contents" in Grade 10. (Appendix G - Set II) question mentions responses from teachers survey for Grade 10 related to adequacy and sufficient contents in units.

Figure 8

Teachers' Perspective on Adequacy and Sufficiency of Grade 10 CS Textbook Contents



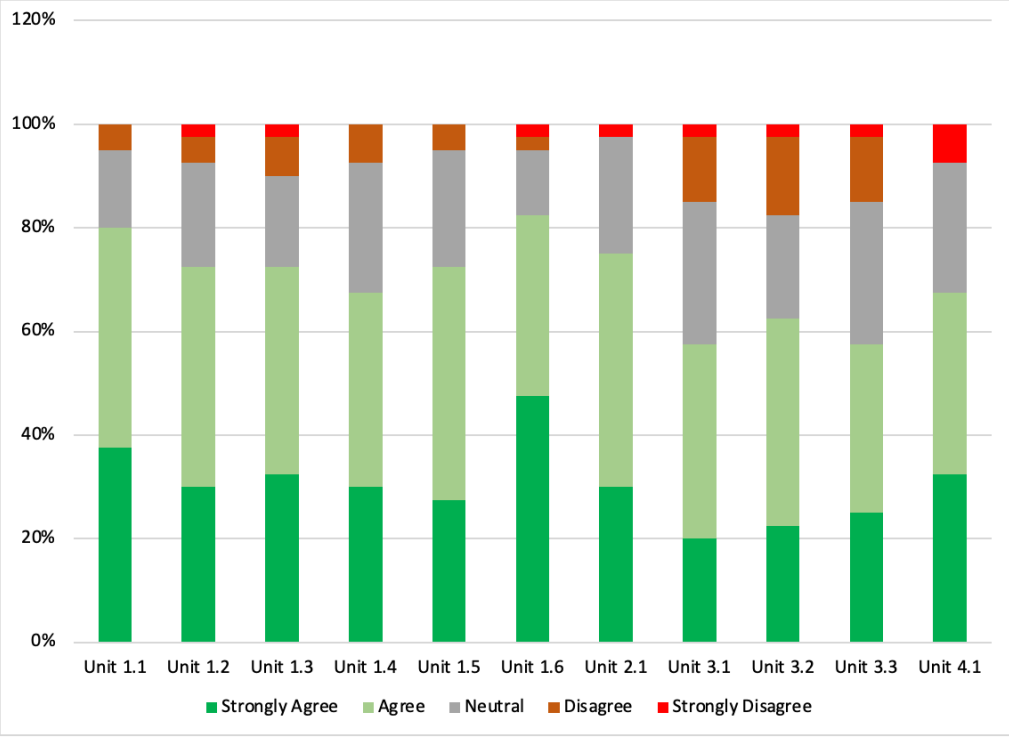
Note: Grouped bar chart shows the variation for CS textbook units.

The pattern direction shift in the graph is inclined towards the agreed portion for sufficient contents of all units in Grade 10 CS textbook. Thus, teachers have agreed that there are sufficient content materials provided in the Grade 10 CS textbook.

Stacked column chart graph helps to visualize the percentage shared for each unit in the CS textbook for Grade 10. Figure 9 represents the teachers percentage share of opinions for adequate and sufficient contents in a CS textbook.

Figure 9:

Teachers Perspective for Grade 10 CS Textbook for Adequacy and Sufficiency of Contents in Percentage Distribution



The major portion contributes to the green color in the graph. Thus based on the teacher survey- it can be inferred that there is sufficient and adequate content in the textbook for both Grades 9 and 10.

Curriculum Designers' Opinions on the Appropriateness of the CS Curriculum

Curriculum designers were involved from initial planning for developing the Computer Science curriculum from Curriculum Development Center (CDC) in Nepal. National Curriculum Framework (NCF) states that curriculum should be aligned with the educational objectives of the Computer Science subject at secondary school in Nepal. The competencies of the CS curriculum state that "Students are required to have knowledge of application and system software. They should learn skills required for higher education in CS technology" (Appendix K- Set II, Point 4 and 14). CDC has formed committee members for CS curriculum who are responsible to select units and create contents in the subject. The interviews were conducted with CDC officers to understand about the development process of the CS curriculum (see Appendix D, Set II). The CDC officer mentioned in an interview:

> A subject experts committee (often known as roster) is responsible for developing the Computer Science curriculum. However, only the selected members from the roster committee were invited to attend the curriculum design meeting. These members select and include topics in the curriculum as per their approach.

According to Curriculum designers, the Computer Science subject was designed with interdisciplinary subject integration and includes localized learning resources as per social context. Nonetheless, from study findings it was found that students do not know how to type in Nepali language since local language typing is not taught in the CS curriculum. The CDC officer mentioned in an interview:

> The CS curricula for Grades 9 and 10 do not incorporate Nepalese local language typing skills and also Office applications such as PowerPoint, Excel, Word. Office applications are included in the Science subject at Grade 8.

> However, Science teachers have been dissatisfied with including CS applications in the Science subject. They have emphasized that ICT skills should be a part of the CS curriculum not Science subject. Thus, curriculum development teams need to define clear boundaries, roles and responsibility between Science and Computer Science subject. Science is a mandatory subject whereas Computer Science is an elective subject. The Computer Science curriculum needs to be redesigned by including learning resources within a Nepalese social context.

Textbook Authors' Opinions on the Adequacy and Appropriateness of the Contents of CS Curricula

Textbook authors are considered to be experts in their domain knowledge and skills. The interviews were conducted with textbook authors to understand the process of writing a Computer Science textbook in Nepal (see Appendix D, Set IV). The textbook writer mentioned in an interview:

> Textbook units and topics are decided by the CDC committee and they were supposed to write only on those topics provided by CDC. Curriculum designer intends to accommodate several topics from various domains, and even wants to retain QBasic programming language… The present CS curriculum is not goal oriented. There is no specific direction for molding students in a two-year Computer Science academic programme.
>
> Textbooks need to be redesigned with engaging and interactive learning materials that would help students to explore and learn in depth programming. Digital learning materials are required where more diverse learning resources with several programming examples can be mentioned. In

the print version of the textbook, QR Code could be mentioned from where students can access digital learning materials.

School Principals' Views on the Adequacy and Appropriateness of the CS Curricula

School principals are responsible for implementing CS curriculum within their school educational programme that requires human and physical resources. The interviews were conducted with school principals (see Appendix D, Set III questions) to understand the effectiveness of CS curriculum that includes both theory and practical class. Principals have emphasized on *customizing curriculum* for Computer Science subject as per school infrastructure and student ability. Education policy requires an inclusive system that can accommodate diverse school infrastructures, and students from different financial and educational backgrounds. They further mentioned that it is very difficult to find a good CS teacher even in Kathmandu valley. Teacher development programmes are required to train new generations of teachers. There is no teacher guidebook for the CS curriculum. Principal mentioned in an interview:

> Teaching careers require encouragement and initiatives from the government to make them more appealing and rewarding, offering incentives and benefits that align with those in corporate professions. Moreover, to retain a CS teacher seems to be a challenging task for school management.

Perception of CS Students on the Adequacy of the Contents of the CS Curricula

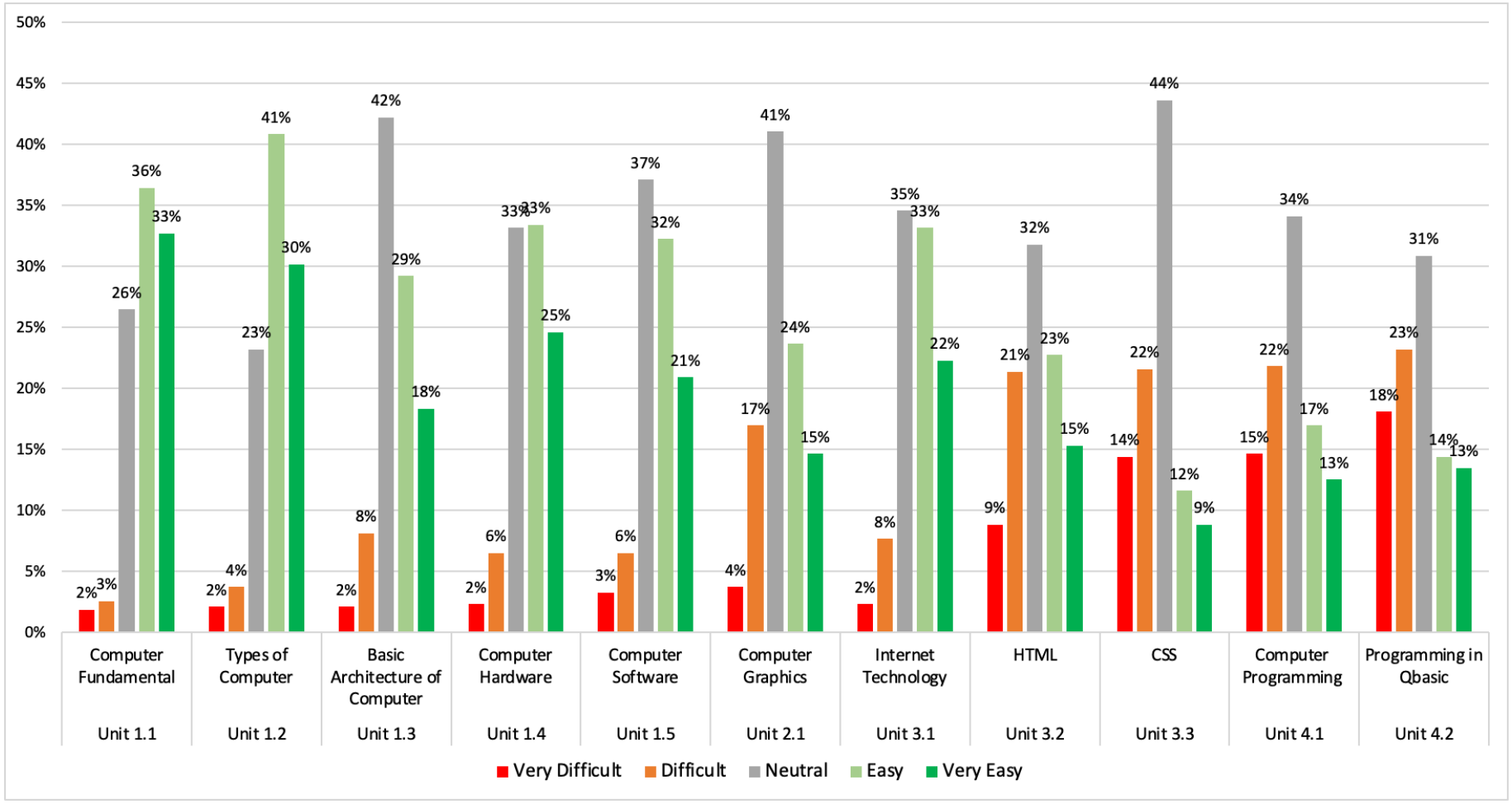
The purpose of including *easy and difficult units* in the student survey was to understand whether the Computer Science textbook has contents gradually organized from foundational concepts to advanced topics. Also this question tests whether the textbook provides sufficient and adequate examples to cover a wide range of learners. The questions were designed using a five-point Likert scale (refer to survey questions

16 and 17 in Appendix C - Set II). The curriculum consists of a total of 22 units, with 11 units each for Grade 9 and Grade 10 (see Table 10 and Table 11).

CS Grade 9 Easy to Difficult Units. The perception of the students relating to the easy to difficult units in the textbook are presented in a Figure 10. The *red* color in a graph signifies the difficulties in units, *green* color signifies the easy, and *gray* color signifies the neutral. (Appendix H - Set I) mention student survey responses in detail for Grade 9 easy to difficult units.

Figure 10:

Students Perspective on Easy and Difficult Units of Grade 9 CS Textbook



Note: Grouped bar chart shows the variation for CS units.

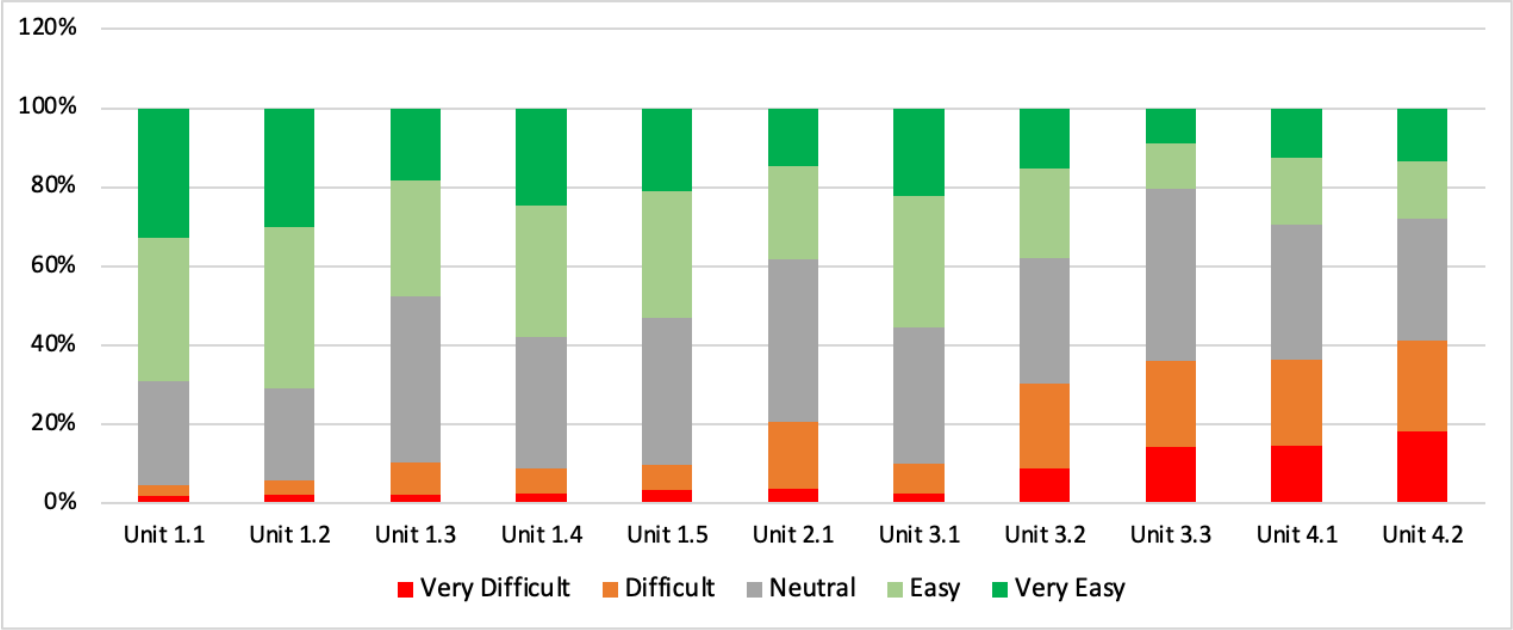
From the student survey, the easy units for Grade 9 are: Unit 1.1 Computer Fundamental, Unit 1.2 Types of Computer, Unit 1.3 Basic Architecture of Computer, Unit 1.4 Computer Hardware, Unit 1.5 Computer Software, and Unit 3.1 Internet Technology. The units categorized as *'easy'* primarily focus on theoretical content.

The order of difficult units increases as - Unit 2.1 Computer Graphics, Unit 3.2 HTML, Unit 3.3 CSS, Unit 4.1 Computer Programming, Unit 4.2 Programming in Qbasic. The pattern of difficulty increases with the CS “programming and graphic topics”.

Figure 11 presents the easy to difficult percentage share in the *stacked column chart*. For example - In Unit 1.1, the easy portion contributes around 70%, difficulty contributes to less than 10%, and the rest is neutral. This stacked column graph helps to understand the approximate percentage for easy and difficult units.

Figure 11:

Students' Perspective on Easy to Difficult Units in CS Grade 9 Contents in Percentage Distribution

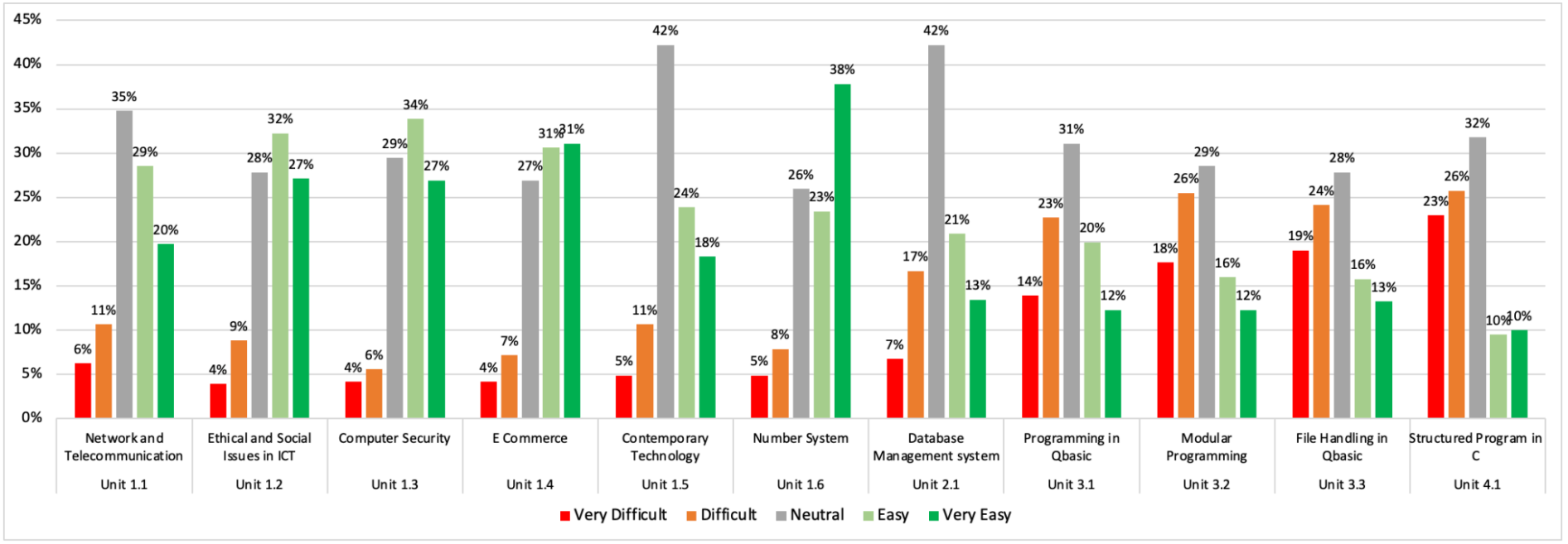


From the stacked column graph in Figure 11, the difficult contents in the CS textbook are usually present after the intermediate position of textbook pages for Grade 9. This was verified from the student group discussion where they mentioned that the difficult contents in the textbook are usually present after the mid-point pages in the textbook. These difficult units are taught generally after the midterm exam. There is not enough time to learn about these programming concepts. Before midterm, the units are usually theory based and it is comparatively easier.

Grade 10 Easy to Difficult Units. The easy to difficult units from the CS textbook are presented in a *grouped bar chart* in Figure 12. The trends patterns for the easy and difficult units can be visualized from the graph. The *red* color in a graph signifies the difficulty units, *green* color signifies the easy units, and *gray* color signifies the neutral. (Appendix H - Set II) mentions survey responses for students.

Figure 12

Students Perspective on Easy and Difficult Units of Grade 10 CS Textbook



Note: Grouped bar chart shows the variation for CS units.

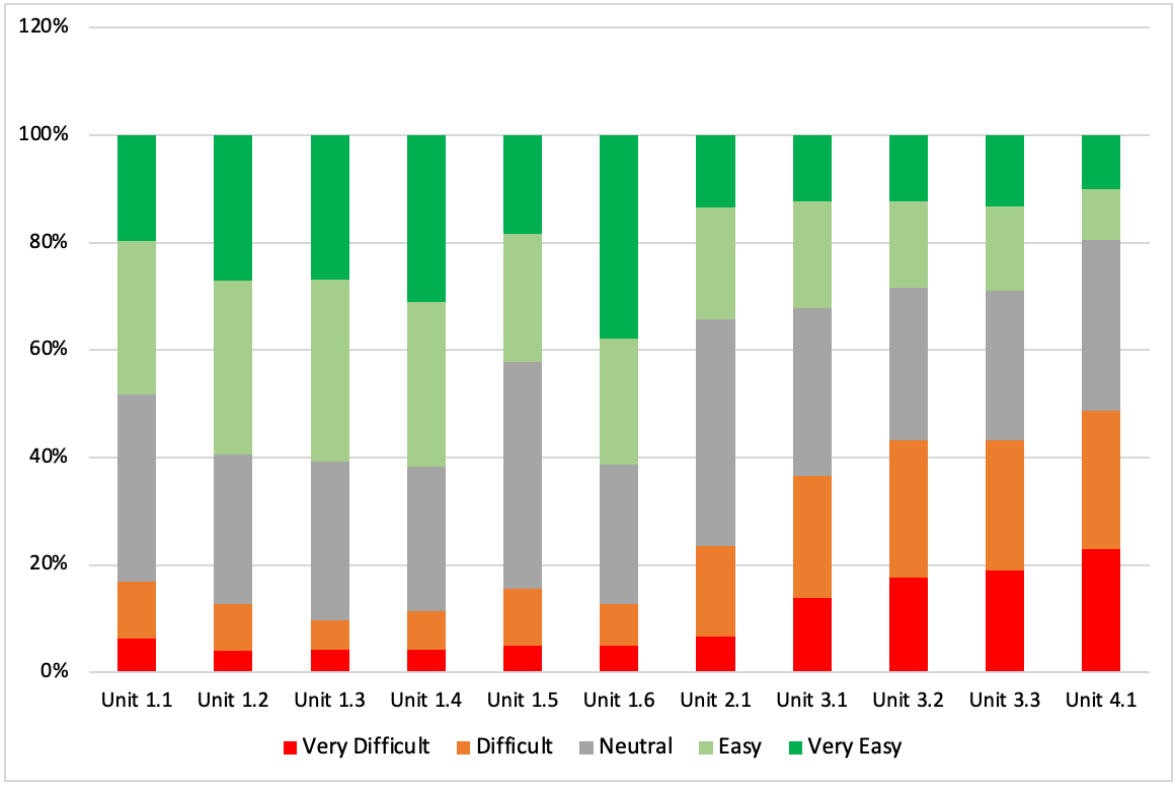
The shift in direction for easy to difficult units can be visualized in Figure 12. The pattern of difficulty increases with the CS "*programming and database"* module. The easy units for Grade 10 are - Unit 1.1 Network and Telecommunication, Unit 1.2 Ethical and Social Issues in ICT, Unit 1.3 Computer Security, Unit 1.4 E-Commerce, Unit 1.5 Contemporary Technology, and Unit 1.6 Number System. The units categorized as *'easy'* are primarily related to *"theoretical"* contents.

The order of difficulty units increases as - Unit 2.1 Database Management system, Unit 3.1 Programming in Qbasic, Unit 3.2 Modular Programming, Unit 3.3 File Handling in QBasic, and Unit 4.1 Structured Program in C. The difficulty units are related to programming and MS Access database queries.

Figure 13 presents the easy to difficult percentage share in the *stacked column chart*. This graph helps to visualize percentage share for each unit in the textbook for Grade 10.

Figure 13:

Students' Perspective on Easy to Difficult Units in CS Grade 10 Contents in Percentage Distribution



Thus, the difficult units (red color) are usually present after the intermediate position of textbook pages in Grade 10. As per students, these difficult units are generally taught after mid-term exams in school.

Comparison of Teachers' and Students' Perspectives in Terms of Contents Adequacy

This section compares teacher and student surveys related to textbook content sufficiency and interdisciplinary subject integration.

Sufficiency of the Contents. The parameters for sufficient content include having adequate learning resources to cover a wide range of learners, practical exercise, and easy and difficult units in the textbook. From the teacher survey, CS textbook provides adequate learning resources for all units in Grades 9 and 10. However, from a student survey they are facing difficulty in programming, graphics, and database units for Grades 9 and 10. The trend of difficult units increases for programming, graphics, and database units.

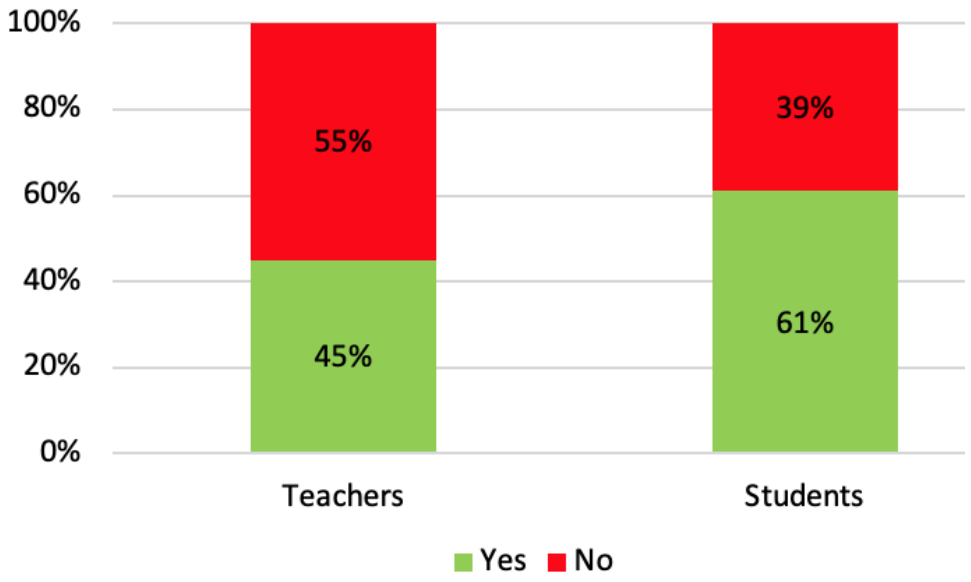
Based on the Figure 10, Figure 11, Figure 12, and Figure 13, the CS textbooks require additional supporting learning resources for programming, graphics, and database units for Grades 9 and 10 to cover the wide range of students. Thus, the inference from this study shows that the present CS textbook has not been sufficiently designed with students' perspective to address their needs.

Interdisciplinary Subjects Integration in Computer Science. Based on the data analysis from the teacher survey, (45%) of CS teachers agreed for the interdisciplinary subject integration in the CS curriculum (Appendix C, Set I - question 13). About (61%) of CS students agreed for the interdisciplinary subject integration in the CS curriculum (Appendix C, Set II - question 10). Hence, teachers would have taught CS subject by incorporating examples from interdisciplinary subjects, even beyond what is provided in the textbook. Therefore, revising the CS textbook for including comprehensive examples from interdisciplinary subjects would

enhance the learning experience. Figure 14 presents the *stacked column graph* to compare teachers and students survey data for interdisciplinary subjects integration.

Figure 14:

Teachers and Students Perspective for Interdisciplinary Subject Integrations



Module-Based Analysis of the CS Textbooks on the Adequacy of Contents

The contents in the CS textbook are categorized into three modules - Theory, Graphics, and Program (see Appendix C, Set III). These modules are used for numerical analysis of content coverage in textbook. The parameter for modular analysis is based on the number of pages that covers the modular contents. The "theory" contents provide foundational concepts in CS subject, "graphics" content for presenting in a visual way, and "program" for instructing computers to perform specific tasks and application development. The graphic contents includes multimedia technologies such as images, videos, sound, and animations. The program content includes programming languages (HTML, CSS, QBasic, C) programs and Database system. The modular based analysis is mentioned in Table 9 for Grade 9 and Table 10 for Grade 10.

Table 9:

Grade 9 Computer Science Textbook Units

Units	Contents	Page no	Category
Unit 1.1	Computer Fundamental	1	Theory
Unit 1.2	Types of Computer	12	Theory
Unit 1.3	Basic Architecture of Computer	22	Theory
Unit 1.4	Computer Hardware	29	Theory
Unit 1.5	Computer Software	57	Theory
Unit 2.1	Computer Graphics	77	Graphics
Unit 3.1	Internet Technology	99	Theory
Unit 3.2	HTML	113	Program
Unit 3.3	CSS	157	Program
Unit 4.1	Computer Programming	174	Program
Unit 4.2	Programming in Qbasic	186	Program
	Last page number	266	

Source: From Gharti, Upreti, & Thapa (2020a).

There are 266 total pages in the Grade 9 textbook. Theory based contents comprises 89 pages that represent (33.5%) of overall contents. Similarly, Graphics comprises 23 pages, representing (8.5%) of overall contents, and Program comprises 154 pages, representing (58%) of overall textbook. Hence, programming constitutes a major portion in Computer Science textbook. Graphic has the least content representing only (8%) of textbook.

Table 10:

Grade 10 Computer Science Textbook Units

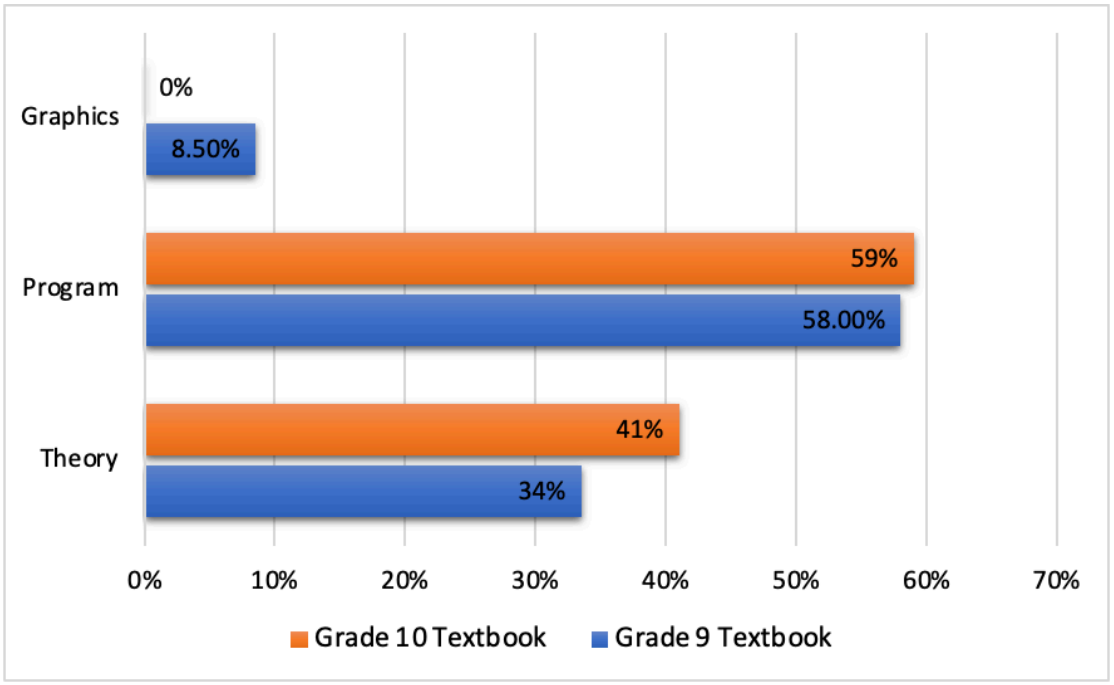
Units	Contents	Page no	Category
Unit 1.1	Network and Telecommunication	1	Theory
Unit 1.2	Ethical and Social Issues in ICT	34	Theory
Unit 1.3	Computer Security	47	Theory
Unit 1.4	E Commerce	64	Theory
Unit 1.5	Contemporary Technology	73	Theory
Unit 1.6	Number System	83	Theory
Unit 2.1	Database Management system	103	Program
Unit 3.1	Programming in Qbasic	150	Program
Unit 3.2	Modular Programming	157	Program
Unit 3.3	File Handling in Qbasic	187	Program
Unit 4.1	Structured Program in C	209	Program
	Last page number	250	

Source: From Gharti, Upreti, & Thapa (2020b).

The Grade 10 textbook has a total of 250 pages. Theory based contents comprises 102 pages that represent (41%) of the textbook. Program comprises 148 pages, representing (59%) of the textbook. Figure 15 represents the content comparison for Grades 9 and 10 in a *bar graph* format.

Figure 15:

Computer Science Textbook Content Comparison for Grades 9 and 10



Graphic content constitutes (8.5%) in a Grade 9 CS textbook. There is an absence of graphic-based content in a Grade 10 Computer Science textbook

CHAPTER V

Suggested Computer Science Curriculum

This study proposes a revised framework for developing the Computer Science (CS) curriculum from the feedback of CS students, CS teachers, curriculum designers, textbook authors, and school principals. This chapter addresses the research questions- What elements are necessary for developing a Computer Science curriculum?

Suggested Computer Science Curriculum Framework

Based on the research findings, Table 11 suggests enhancing the Computer Science curriculum framework at Grades 9 and 10 in Nepal. The computer graphics require revision with images, audio, video and animations that are useful for creating interactive presentations. The programming language is suggested to be updated with application oriented languages such as Python, Javascript which are useful for real-world application development. The artificial intelligence learning resources are required to be incorporated in the CS curriculum. Computation thinking is suggested to be taught in an unplugged programming approach and afterwards implement the solution by using Programming Language. The curriculum is suggested to incorporate digital content creation in the Nepalese local language. The CS textbook is suggested to revise examples from interdisciplinary subjects. The language readability of the textbook requires it to be judged by readability tools as per grade level.

Table 11:

Suggested Revision of Computer Science Curriculum Framework

S.N.	Existing CS framework	S.N.		Revised/suggested CS framework
1	Basic Computer Knowledge	1	Same	Basic Computer Knowledge
2	Computer Graphics	2	Revised	Computer Graphics
3	Networking, Internet, Web technology	3	Same	Networking, Internet, Web technology
4	Computer programming (QBasic, C)	4	Revised	Computer programming (Python, Javascript)
5	Database Management System	5	Same	Database Management System
-	–	6	New	Artificial Intelligence
-	–	7	New	Computational Thinking and Unplugged Programming
-	–	8	New	Digital Content Creation
-	–	9	New	Interdisciplinary Subject integration
-	–	10	New	Language Readability

Source: CDC (2019).

Revised Competencies for Computer Science Curriculum

The revised competencies for CS curriculum emphasize digital content creation, graphics, application-oriented programming language, data analysis and visualization, computational thinking, and artificial intelligence. These competencies are suggested to design in a student-centric that guides them to learn CS concepts through application-developing experience. The CS curriculum is suggested to incorporate both text and visual-based programs to cover a wide range of learners. Based on research findings, Table 12 suggests enhancing the existing competencies at

secondary school level for Grades 9 and 10 in Nepal.

Table 12:

Suggested Revision of Competencies for Computer Science Curriculum

S.N.	Existing CS competencies	S.N	Revised/suggested CS competencies	
1	Evolution, importance, and utility of Computer Technology.	1	Same	Evolution, importance, and utility of Computer Technology.
2	Classification of Computers based on size, data processing capacity etc. Computer usage in application and daily life.	2	Same	Classification of Computers based on size, data processing capacity etc. Computer usage in application and daily life.
3	Hardware and software used in computers.	3	Same	Hardware and software used in computers.
4	Knowledge to select software required for a specific purpose by getting information about application software, system software etc.	4	Same	Knowledge to select software required for a specific purpose by getting information about application software, system software etc.
5	Graphics software usage to edit images.	5	Revised	Graphics software to create images, video, and interactive presentation.
6	Internet technology, and HTML knowledge to develop web sites.	6	Same	Internet technology, and HTML knowledge to develop web sites.
7	Learn programming languages - QBasic and C language.	7	Revised	Learn programming languages - Python or Javascript.
8	Knowledge about Computer Networks, file system, and required hardware and software usages in the network.	8	Same	Knowledge about Computer Networks, file system, and required hardware and software usages in network.
9	Aware of cyber crime and ethical usage of Computer technologies.	9	Same	Aware of cyber crime and ethical usage of Computer technologies.

10	Data security measure at hardware and software level.	10	Same	Data security measure at hardware and software level.
11	knowledge about electronic business, electronic banking facilities which are used at contemporary times.	11	Same	knowledge about electronic business, electronic banking facilities which are used at contemporary times.
12	Build application using database management system	12	Same	Build application using database management system
13	Basic knowledge of C language and develop small applications	13	Revised	Application development with Python or Javascript
14	Basic skills required for Higher education in Computer technology	14	Same	Basic skills required for Higher education in Computer technology
-	–	15	New	Text and Visual Based Program.
-	–	16	New	Computational Thinking
-	–	17	New	Digital Content Creation
-	–	18	New	Data Analysis and Visualization
-	_	19	New	Artificial Intelligence
-	_	20	New	Application based Learning

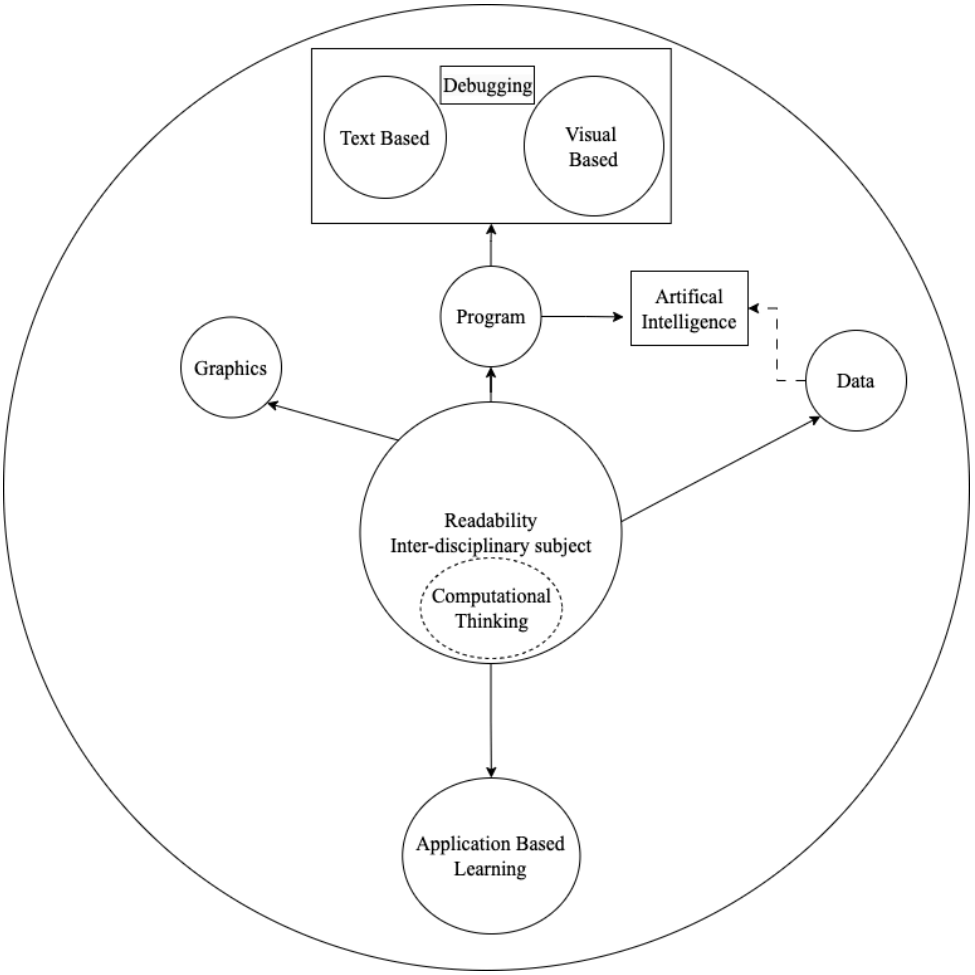
Source: CDC (2019).

Suggested Computer Science Curriculum Development Structure

The proposed structure in Figure 16 guides the development of the CS curriculum within the above mentioned framework.

Figure 16:

Computer Science Curriculum Development Structure



This structure emphasizes a student-centric curriculum. The fundamental elements of the Computer Science curriculum are Computation thinking, language readability, and interdisciplinary subjects integrations at school level. Computational thinking involves breaking down a problem into smaller sub-problems, identifying patterns within the problem, selecting an algorithm, and proposing solutions. Students learn computation thinking in an unplugged programming method and afterwards implement the solution in programming language. Unplugged programming should be taught using a problem-solving approach that eliminates the need for a physical computer. The CS curriculum requires to incorporate examples from interdisciplinary subjects such as Math, Science, Statistics, and Arts.

CS curriculum requires to include both visual and text-based programs to cover a wide range of learners. Visual block-based programs are used to scaffold learners to understand CS concepts. Text-based programs require prerequisite knowledge of syntax and semantics related to programming language. Debugging skill ensures whether programs perform specific tasks as per requirement. Artificial intelligence are programs that rely on data. The basic knowledge of data types required by AI systems is required in the CS curriculum.

The graphic content requires emphasis on digital art, image and video editing, and animation skills that are essential for content creation and interactive presentations. The pedagogy should be application-based where students pursue projects based on their individual interest that are usable in real-world scenarios. The application can be created using programming language or Office tools such as documents, presentation, and spreadsheet. The background space represents the local social context that modifies the curriculum plan and content materials aligned with social culture.

This structure focuses on designing CS curriculum by giving equal priority to basic knowledge of program, graphics, and data (content creations). The curriculum should be flexible enough where students can explore depth knowledge on either technologies such as programming, graphics or content creations depending on their individual interest.

The textbook is an integral component of the Computer Science educational plan. Textbooks require to be designed and written as student-centric. Readability tools are used to judge the language of a textbook that ensures language standard as per grade level. The easy and difficult units in the textbook requires equal distribution for all exams in a school. Programs need to be printed in an understanding format as

whitespace characters (Space, Tab, Indent, etc) have meaning in programming. The CS curriculum structure requires to include both print and digital version of textbook and supplementary learning materials. The digital version would have diverse examples, problem-solving assignments where students can self assess skills and progress from easy to difficult questions.

This structure emphasizes the 21st century skills of creativity and innovation, critical thinking and problem-solving, communication, and collaboration, information, media, and technology skills. Life and career skills are emphasized through exploratory learning based on students' areas of interest, such as programming, graphics, and content creation. The leadership skills are cultivated by encouraging students to present group project work using interactive graphics tools.

The creativity and innovation is highlighted in digital arts and paintings, animations. The problem-solving skill is highlighted by using appropriate algorithms in the programming language to develop applications, or create specific problem solving applications through office tools.

Students can enhance their communication and collaboration skills by working in a team to create workable applications for their usage. By collaborating, they can test each other's applications and provide feedback. They are recognized and rewarded for their participation in knowledge sharing forums within and outside school.

Suggested Committee for CS Curriculum Development

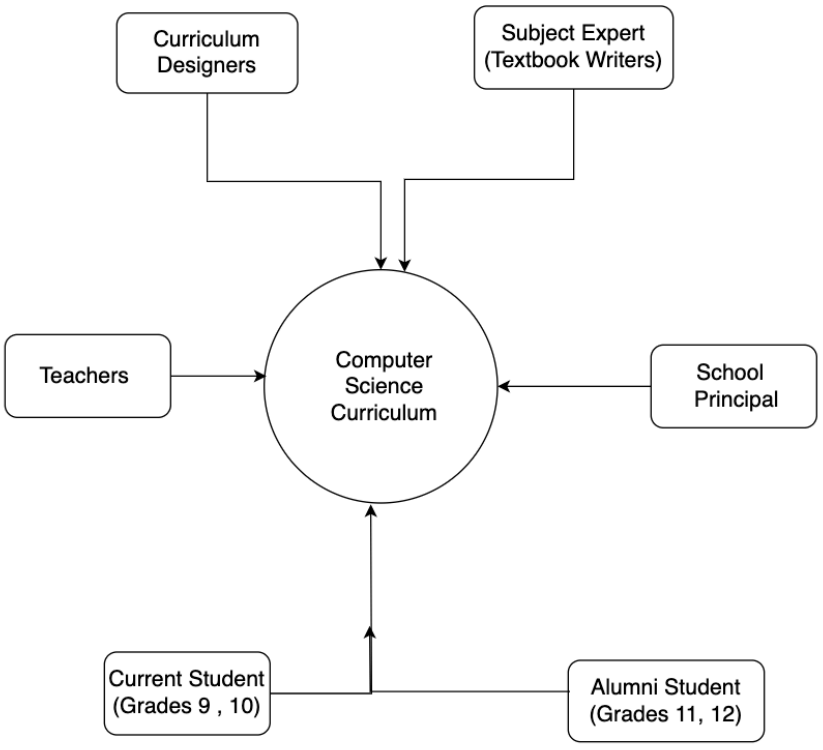
The present committee members for CS curriculum development comprise teachers, subject experts, and curriculum designers. This committee is often known as the Roster committee in CDC, Nepal. There were 13 members in this roster

committee for CS curriculum development in 2023/2024 year (CDC, 2023a; CDC, 2023b).

Based on study findings, there needs to be clear roles and responsibility for committee members. The members in a committee should include from several backgrounds such as teacher, school principal, subject expert, textbook writer, curriculum designers, present and alumni students. Figure 17 illustrates the model for incorporating these members into the committee for developing a student-centric curriculum and textbook.

Figure 17:

Suggested Committee for Computer Science Curriculum Development



The committee members include- present CS students (Grades 9 and 10), alumni students (Grades 11 and 12), CS teachers, school principals, curriculum designers, and subject experts (textbook authors). The present CS student is required to understand the adequacy of course contents and pedagogical instruction in

Computer Science. The alumni students are required to understand the usefulness and knowledge application of the CS curriculum.

Teachers understand the student's interest, their requirements and difficulty in the subject. Teachers can share their teaching experience within a social level. These experiences and examples can be useful in a teacher guide book. This guide book is useful for the school management and teachers educational program.

Curriculum designers are responsible for providing guidelines and outlines to create textbooks. The role of designers is to plan and develop the necessary materials for the curriculum. The designers are required to provide adequate resources to authors so that they write contents by including examples from interdisciplinary subjects. The language readability of the textbook needs to be judged by readability tools to ensure it is standard as per grade level in social context. The designers need to ensure that the CS curriculum is designed in a balanced marks weightage (theory, and practical) with other horizontal subjects at the same grade level. The designers are required to provide print guidelines for CS textbooks. The whitespace characters (Space, Tab, Indent etc.) have a meaning in programming. The designer ensures that difficult contents in the textbook are equally distributed in academic year. There should be both print and digital versions of the textbook. The print version of the textbook should have a website URL or quick response (QR) code to access additional learning resources in the digital platform. Digital textbooks can incorporate a wide range of programming, graphics examples from social context covering a wide range of interest of students.

Textbook authors are selected from subject experts to create contents on provided topics by curriculum designers. Textbook requires an assessment from a student. Principal implements the CS subject within their school's educational

program. Thus, they know the actual resources (human and physical) required and the effectiveness of the CS subject in school educational programs.

Suggested Units for Computer Science Curriculum

With reference to the revised CS framework and competencies, the suggested revisions to the Computer Science units for Grade 9 is mentioned in Table 13 and Grade 10 at Table 14.

Table 13:

Suggested Revised Units for Grade 9 Computer Science Textbook

Units	Contents	Revised
Unit 1.1	Computer Fundamental	Same
Unit 1.2	Types of Computer	Same
Unit 1.3	Basic Architecture of Computer	Same
Unit 1.4	Computer Hardware	Same
Unit 1.5	Computer Software	Same
Unit 2.1	Computer Graphics	Revised
Unit 3.1	Internet Technology	Same
Unit 3.2	HTML	Same
Unit 3.3	CSS	Same
Unit 4.1	Computer Programming	Same
Unit 4.2	Programming in QBasic	Remove
–	Digital Content Creation	New
–	Application	New
–	Python Programming	New

Source: Revised and Adapted From Gharti, Upreti, & Thapa (2020a).

The Computer graphic needs to be revised by incorporating contents related to audio, video editing, and animations that are useful for interactive presentations. The programming language needs to be revised with the Python programming language. Digital content creations are required to be incorporated in the curriculum that includes Nepalese scripts. The applications include office documents, spreadsheet, and presentations or by implementing programming language used to create utility applications. The units mentioned as “same” need to be revised with contemporary knowledge for both Grades 9 and 10.

Table 14:

Suggested Revised Units for Grade 10 Computer Science Textbook

Units	Contents	Revised
Unit 1.1	Network and Telecommunication	Same
Unit 1.2	Ethical and Social Issues in ICT	Same
Unit 1.3	Computer Security	Same
Unit 1.4	E Commerce	Same
Unit 1.5	Contemporary Technology	Same
Unit 1.6	Number System	Same
Unit 2.1	Database Management system	Same
Unit 3.1	Programming in Qbasic	Remove
Unit 3.2	Modular Programming	Remove
Unit 3.3	File Handling in Qbasic	Remove
Unit 4.1	Structured Program in C	Same
–	Javascript Fundamental	New
–	Python Programming	New
–	Graphics	New

–	Artificial Intelligence and Data	New
–	Application development	New

Source: Revised and Adapted From Gharti, Upreti, & Thapa (2020b).

The programming language is suggested to be revised with Python or Javascript. The learning resources regarding graphics, AI and data are required to be added in the curriculum. Students will showcase their projects either by developing applications in programming languages or Office applications.

CHAPTER VI

Results and Discussion

The primary goal of this study is to analyze the Computer Science (CS) curriculum based on the students' and teachers' perspective. This chapter discusses the study findings with reference to literature reviews and theories.

Findings of this study revealed that students have various interests in their education field that are aligned with the CS technological domain. In the interviews with students, they expressed their interest in artwork drawing pictures, programming, artificial intelligence, creating contents, mathematics, and leading teams. The study findings align with pragmatist philosophy, which emphasizes practical solutions for real-world problems.

The curriculum is an educational plan governed by a statutory body that builds the foundation of knowledge for the students at the school level (Ornstein & Hunkins, 2018). These knowledge and skills are supposed to be inline with the social context where students can apply knowledge to create usable applications. Therefore, students who have interest in artworks drawing pictures, for them the relevant learning area would be "graphics" to create creative arts. Similarly students having interest in programming the "program" domain would be relevant for them. The students interested in "creating contents" such as poems, essays for them content generations would be relevant. Students interested in mathematics "data analysis and data visualization" would be relevant for them to solve the real-life problems. The students interested in community activities and leadership roles, "interactive graphics" tools would be relevant for them to showcase their team work. Thus, the study findings suggest enhancing the CS curriculum by incorporating learning resources encompassing the diverse interests of students. As stated by Pinar (2004), curriculum

is not a fixed body of knowledge and it evolves in response to social, political, and cultural changes. Pinar emphasized that curriculum should be lived experience that engages students with their own histories, experiences, and emotions.

The study findings highlight an opportunity for CS students to be familiar with Nepalese language typing skills. Additionally, the CS curriculum requires hands-on practice related to Nepalese language typing skill. The study findings revealed that there is more than (50%) content in the programming for both Grades 9 and 10. Graphics constitutes (8.5%) content at Grade 9, have a basic introduction to the topic and insignificantly incorporated into the Grade 10 CS curriculum. Therefore, the suggested CS curriculum provides an opportunity to include contents from essential technological areas to formulate a holistic education plan.

Graphics contents need to be emphasized as similar to programming contents. As Nepalese society is rich in culture, graphics play a key role in presenting our cultural values. We pray to several gods and goddesses, and pictures are used as a means to pray to them. Graphic knowledge is used to create creative images that can be used to present in cultural festivals. Students having interest in arts and drawing can create creative drawing, paintings, videos, and animations related to their culture. The study findings are inlined with 21st century skills of creativity and innovation, critical thinking skills. Graphics skills help to create innovative arts empowering both creative and critical thinking.

The findings from student surveys revealed that the easy and difficult contents are not equally distributed in textbooks. The difficult contents are aligned after mid-point of textbook pages that usually come after mid-term examinations in school. During an interview with students, they often feel pressure since all the difficult contents are taught after mid-term examinations. The TPACK model focuses on

technology integrations to pedagogical and content knowledge (Mishra & Koehler, 2006). The TPACK model can be used by integrating technologies and tools for teaching-learning education plans. The study findings from students' survey provides a valuable opportunity to provide additional learning resources and pedagogy for programming, graphics, and database units. These units are considered as difficult by students. The textbook requires both print and digital versions. The learning resources and assessment in digital format would help students to explore more learning resources and tackle problems based on their ability. The digital version of the textbook can provide examples of programming where students' can easily execute programs to understand CS concepts.

The study highlights an opportunity to strengthen the CS curriculum by providing teachers' guide books and expanding existing teacher training programmes. Teacher training is required to train new teachers and update knowledge and skills of existing teachers. Teaching-learning process can be enhanced by training teachers on various learning theories such as …. Through cognitivism theory, teachers understand the student's ability to understand and solve problems, and their brain processing ability. Students can use a digital learning platform, where order of difficult questions increases as per their ability to solve problems in required time.

Constructivism is based on students' understanding and knowledge from their experience and practice. Connectivism theory is related to digital platforms where students learn more from social media, elearning platforms and forums. Students are required to share their artwork, presentation of projects, and application development in digital forums fostering participation and exchange of ideas. Therefore, the finding of this study is inline with 21st century skills of communication, collaboration, information, media, technology skills, and leadership skills.

The study findings highlight a significant opportunity to enhance the CS curriculum by increasing the focus on hands-on project and skill development. The present CS curriculum has equal teaching of 64 hours for theoretical and practical classes. The allocation of more teaching hours towards hands-on practical activities provide an opportunity for application-oriented learning.

The study revealed that the CS curriculum requires to incorporate topics such as artificial intelligence, robotics, and cloud computing. Webb et al. (2017) stated that Computer Science is the subject of computation systems that process various data and information. The advantage of computers is that they process data and give the results in a short span of time compared to human ability. Nepal's secondary education at the school level is required to prepare students to understand and appropriately use technologies to solve their problems (CDC, 2019a, p. 48). They are required to learn contemporary technologies so that they are aware of proper usage of technologies in their personal life and academic career. Without knowing the proper use of technologies, these technologies may be a disaster for them.

The study found that additional support is required for students to understand and excel in programming although programming constitutes more than (50%) of the CS curriculum. Ericson (2022) emphasizes visual block-based programming to understand algorithms and programming concepts. Students are required to learn Computation thinking in an unplugged programming technique that uses algorithms to solve problems without requiring a physical computer (Code.org, 2016). They can use contemporary programming languages like Python, Javascript that are used to develop real-world applications. These programming languages have an abundance of libraries to solve problems that engage learners with critical thinking and problem-solving abilities. They can use artificial intelligence (AI) tools for effective

learning. AI tools can serve as support systems for various tasks and decision-making processes. Although AI tools provide almost of all answers, human judgment remains critical to validate the AI responses that train the AI systems. Therefore, the study findings aligns with problem-solving skills of 21st century.

Overall Reflection

We all believe that being educated is good and leads to an optimistic future in life. Formal education is supposed to enhance knowledge and uplift the knowledge of society, and refinement of our understanding. Formal education acts as a guiding path for students to build knowledge and skills and to become a good human being.

With the advancement of AI and robotics technologies several tasks will be performed by machines that may result in an employment crisis for humans. It is often predicted that there will be future jobs' scope into two categories- those who design AI systems and those who follow AI instructions to perform tasks. Designing AI systems requires the ability to ask the right questions and provide feedback on AI responses, thus enabling the AI to be trained rigorously for a greater degree of accurate responses. Therefore, the education system requires an attention to cultivate knowledge and wisdom that challenges thinkable machines.

Each student is different and has different subjects to study. Thus, all students can not be incorporated by one teaching method and one printed textbook. Teachers are required to use various learning theories in their teaching plans. Digital materials are required that incorporate several examples and learning techniques for students with specific teaching methods.

As a scholar, I aim to seek knowledge and truth that foster a proactive learning platform and cultivate critical thinking for new generations that lead to betterment of society. I believe one can learn more while participating and sharing their opinions

rather than just following. Education is a means that you are understanding more about yourself and the world. You are identifying your own weakness in terms of knowledge or skills that are required to solve problems, and hence to find a solution one explores by learning through various means (school, institutions, book, etc).

CHAPTER VII

Conclusions and Implications

The present CS curriculum is content-oriented focusing on HTML, CSS, QBasic, C, and MS Access databases, providing students' with foundational exposure to programming concepts and database management. The CS curriculum has equal weightage of teaching hours for theoretical and hands-on practical sessions. The study concludes that the present CS curriculum at grades 9 and 10 has limited options for students' to learn and explore knowledge as per their interest in programming, graphics and content creations. The curriculum does not have a customizable education plan to cover a wide range of schools across Nepal having different facilities and infrastructures. The easy and difficult units in the CS textbook are not evenly distributed across academic sessions.

The study also presents a revised framework for developing a student-centric CS curriculum. The core components of CS curriculum frameworks are programming, graphics, data, and artificial intelligence (AI) that are required to be designed by incorporating computational thinking, interdisciplinary subject integration, and language readability standards appropriate to the grade level. The framework focuses on application-based learning, where students create workable projects aligned with their individual interests either on graphics, programming, or content creations.

The structure of the curricula design committee seems to be inappropriate in order to develop student-centric CS curriculum. There is also a lack of a teacher guide book and insufficient teacher training programme required for the effective implementation of CS curricula in schools.

Implications

The study is focused on the CS foundational knowledge and skills required for students. Findings of the study will have implications for various stakeholders.

Curriculum Development Center (CDC)

The educational objectives for secondary schools in Nepal underscore the importance of aligning textbook content with local culture and national values. (CDC, 2019b, p. 1). The school education provides the foundational knowledge and skills required at a social context, and future career. The CS students are required to be included in the committee members to assist in pretesting the curriculum, ensuring alignment with students' backgrounds and needs.

Curriculum Designers. The textbook adhering interdisciplinary subject integrations and language readability requires it to be checked as per grade level in a social context. The curriculum requires a balanced distribution of marks between theory and practical components aligned with horizontal subjects. The CS textbook requires print guidelines as whitespace characters (Space, Tab, Indent, and new line) have specific meanings in programming.

Computer Science Teachers. Teacher development programmes are required to develop new teachers and upgrade skills and knowledge in existing teachers. Teachers can share their teaching experience from a social context. These examples are required to be mentioned in a teacher’s guide book that helps to create teaching uniforms across school.

Training requires to focus on computational thinking, unplugged programming, and the TPACK model. Teachers are required to teach CS concepts in unplugged programming methods, and later implement those concepts in programming language. Unplugged programming is a method of teaching Computer

Science concepts without the use of a physical computer. There should be test assessments for CS teachers to upgrade knowledge and skills with new technologies and pedagogy.

Textbook Authors. The textbook authors are required to incorporate examples from interdisciplinary subjects (horizontal and vertical) that would help students to correlate knowledge and implement in a programming language. The easy and difficult units in the textbook should be equally distributed for all examinations. The instruction step for program execution needs to be mentioned in detailed steps in both print and digital versions of the textbook. The print version of the textbook should have a website URL or quick response (QR) code to access additional learning resources in the digital platform.

Education Technology (EdTech)

EdTech companies design and develop courses covering a broad range of students from various backgrounds. This study is useful for EdTech companies to develop student-centric curriculum and learning resources. The committee members can be customized for EdTech depending upon the course structure. For short term courses, the committee could include only students, teachers, and subject experts as part of curriculum development. The feedback from two categories of students is necessary- one who is currently pursuing a course and second who has already completed. The subject expert fulfills the roles and responsibility of both curriculum designers and authors for creating content materials.

Education Policy Managers

Schools across the nation have different capacity of physical, human resources, and budget. Inclusive policy is required to accommodate various categories of schools and students. Educational policy managers need to provide provision for

customizing curriculum that depends on availability of school infrastructure and resources, and students ability. The provisions of customizing curriculum would help principals to effectively implement Computer Science subject in their educational programmes.

Areas for Further Studies

This study has opened related areas for future study in Computer Science (CS) education at the school level. The following areas are suggested for further studies:

CS Curriculum Development Structure. The proposed CS curriculum development structure can be studied further with a wider range of CS students and CS teachers perspectives.

CS Curriculum for Grades 11 and 12. A study can be conducted to understand the effectiveness of the CS curriculum for Grades 11 and 12 at the secondary school level.

CS Curriculum Having Localized and Globalized Contents. A study can be conducted to propose/establish the quantitative benchmark standard for the distribution of contents required in relation to localized and globalized learning resources at secondary school (Grades 9 to 12).

CS Education and Country's Laws. It has been noted that the technology innovation has evolved very fast and impacted our lifestyles without much control from society and nation's governance system. As laws govern the overall aspects in human life and society, the evolution of laws with respect to technology innovations need to be studied. Additionally, how the law should be formulated so that it does not inhibit the student experiments with technological innovations. Thus, further study can be conducted to understand the educational policy with Artificial intelligence, robotics, and drones.

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Appendices

Appendix A

Nepal is geographically divided into seven provinces.

Set I: Nepal

List of Provinces in Nepal	
1	Koshi
2	Madhesh
3	Bagmati
4	Gandaki
5	Lumbini
6	Karnali
7	Sudurpashchim

Source: *From Government of Nepal*

Set II: Bagmati Province

Districts of Bagmati Province	
1	Sindhuli
2	Ramechhap
3	Dolakha
4	Bhaktapur
5	Dhading
6	Kathmandu
7	Kavrepalanchok
8	Lalitpur
9	Nuwakot
10	Rasuwa

11	Sindhupalchok
12	Chitwan
13	Makwanpur

Source. From Government of Nepal

Set III: Center for Education and Human Resource Department

School List Web Reference:

https://www.doe.gov.np/assets/uploads/files/094e44803cff92f49923bea8ff25b2bd.pdf

Appendix B: School Details

Set I: School List for Student Survey

S.N.	Kathmandu valley	School Name
1	Kathmandu	Durbar High School
2	Kathmandu	Reliance Public School
3	Kathmandu	Lyceum Model School
4	Kathmandu	Viswa Niketan Secondary School
5	Kathmandu	Kavya School
6	Kathmandu	Don Bosco School
7	Bhaktapur	Sainik Awasiya Mahavidyalaya
8	Bhaktapur	SOS Hermann Gmeiner School
9	Bhaktapur	Orchid school
10	Bhaktapur	Omshanti Academy
11	Lalitpur	Little Angels' School
12	Lalitpur	St. Xavier's School
13	Lalitpur	St. Mary's Secondary School
14	Lalitpur	GEMS School
15	Lalitpur	Rato Bangala School

16	Lalitpur	St. Xavier's School
17	Lalitpur	Moonlight Secondary School

Set II: School List for Teacher Survey

S.N.	School Name
1	Little Angels School, Hattiban
2	Lyceum Model School, Sifal
3	St. Xavier's School, Jawalakhel (Lalitpur)
4	St. Xavier's School, Godavari, Lalitpur
5	St Xavier's school , Lalitpur
6	St.Mary`s High School, Lalitpur
7	Sainik Awasiya Mahavidyalaya, Bhaktapur
8	Reliance Public School, Kathmandu
9	Kavya School
10	SOS Hermann Gmeiner School Sanothimi
11	Kavya School +2, Kathmandu
12	GEMS,lalitpur
13	Rato Bangala School
14	Charles darwin academy, kathmandu
15	Lyceum International Model School
16	Gyandarshan English Boarding School
17	Prabhat Secondary School, Lalitpur
18	Omshanti Academy
19	Orchid school

Appendix C: Quantitative Research Tool

Set I: Teachers Survey Questionnaire

This research survey pertains to finding the suitable curriculum for computer science IX and Xth grade as per Nepalese societal needs. This research study helps to find the impact of current curriculum on student life and career. The proposal of a new Computer Science curriculum to CDC will be formulated through this research survey study that will have skill based education for society well-being. Data collected during this survey will be used only for Academic Research purposes and analysis of the new curriculum plan at the Curriculum Development Center. I (Ajay Yadav) am a research scholar from Graduate School of Education, Tribhuvan University, Nepal.

1) Full Name (optional) _____

2) Email Address (optional) _____

3) School Name, District _____

4) Pradesh * (Mark only one oval.)

- ☐ Koshi
- ☐ Madhesh
- ☐ Bagmati
- ☐ Gandaki
- ☐ Lumbini
- ☐ Karnali
- ☐ Sudurpashchim

5) Academic Qualification * Mark only one oval.

- ☐ Bachelor Degree
- ☐ Master Degree
- ☐ M. Phil Degree

☐ PHD Degree

6) Teaching Work Experience *

☐ Up to 2 years of Teaching Experience

☐ 2 to 5 years of Teaching Experience

☐ 5 to 10 years of Teaching Experience

☐ 10+ years of Teaching Experience

7) Teaching Subject Specialization *

☐ Computer Science

☐ Science and Technology

☐ Math

☐ Other: _____

8) You can write your Suggestion for new curriculum proposal from teaching experience.

_____

9) Class Xth passed out student are expected to have following digital skills as per Society needs. Please put a tick mark.

☐ Operating system knowledge like Android, Windows, Linux etc.

☐ using computer through command line (DOS / Terminal commands)

☐ Software Installations / Uninstallations

☐ File Management

☐ Computer Maintenance (use of memory consumptions by software, shut down computer etc.)

☐ Computer Hardware and Accessory device (printer, scanner)

☐ Typing skill (Nepali)

- ☐ Typing skill (English)
- ☐ Internet Security (Antivirus)
- ☐ Image Editing
- ☐ Audio / Video Editing
- ☐ Cloud based work (google drive / google office word, sheet etc.)
- ☐ social media privacy, security, cyberbullying
- ☐ Digital Data, password Safety
- ☐ Office Suite Usage (Word, Excel , Powerpoint)
- ☐ Learning materials search in internet (online learning platforms)
- ☐ Knowledge search & construct
- ☐ Use of Internet & Email
- ☐ web page Design
- ☐ programming Knowledge
- ☐ Digital Finance and Ecommerce
- ☐ Other: _____

10) Which content materials do you suggest to include in New Computer Science curriculum ?

- ☐ Data Analysis Numeric (Descriptive Mean, Median, Mode etc.)
- ☐ Visual Statistical Charts (Pie, Bar, Line charts etc..)
- ☐ Artificial Intelligence concepts with programming language
- ☐ Audio / Video Editing
- ☐ Student Generated Contents (Blogs, Forum)
- ☐ Social media data
- ☐ Application Programming Interface (API)

☐ Robotics Programming

☐ Framework , lIbrary Programming Language

☐ Game based Development

☐ Other: _____

11) Which programming language is preferred to teach students? Select your priority for the programming language. Please put 1 box tick per row.

	Python	Javascript	HTML CSS	Qbasic	Database program
1st Priority					
2nd Priority					
3rd Priority					
4th Priority					

12) How can Computer science curriculum be made more relevant towards student life.

☐ By introducing application examples from student life

☐ programming examples to solve problems

☐ more practical towards project works

☐ Other:_____

13) Computer science textbook contents covers Horizontal integrations of subjects with examples like Mathematics, Statistics, Science, Arts, Literature (Nepali, English).

☐ Yes

☐ No

☐ Other_____

14) Please give suggestions on how we can make the Computer Science curriculum more practical oriented towards market employment ?

☐ Computer application should be taught in more Skill based

☐ Graphics Knowledge (Image, Video editing) should be provided which helps students to make short videos.

☐ programming knowledge should be provided in functional ways

☐ Student should have option to do Project Work in the Company

☐ Other:_____

15) How CDC will help teachers to equip them with more knowledge for teaching Computer Science?

☐ Provide Teaching Guide book

☐ Provide Teachers Training

☐ Taking Exam of Teachers to assess knowledge capability on subject

☐ Other:_____

16) Mention any top 5 skill set that students show possess with Nepalese society standard after studying Computer Science subject at Grade Xth. These skill sets might be expected from parents, industry market, society.

—----------

17) Sufficient Content materials and examples are provided in the Grade 9th Text book prescribed by CDC . Please put a tick mark for 1 box each row.

Computer Science Grade 9 Contents		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Unit 1.1	Computer Fundamental					
Unit 1.2	Types of Computer					
Unit 1.3	Basic Architecture of Computer					
Unit 1.4	Computer Hardware					
Unit 1.5	Computer Software					
Unit 2.1	Computer Graphics					
Unit 3.1	Internet Technology					
Unit 3.2	HTML					
Unit 3.3	CSS					
Unit 4.1	Computer Programming					
Unit 4.2	Programming in Qbasic					

18) Sufficient Content materials and examples are provided in the Grade 10th Text book prescribed by Curriculum Development Center. Please put a tick mark for 1 box each row.

Computer Science Grade 10 Contents		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Unit 1.1	Network and Telecommunication					

Unit 1.2	Ethical and Social Issues in ICT					
Unit 1.3	Computer Security					
Unit 1.4	E Commerce					
Unit 1.5	Contemporary Technology					
Unit 1.6	Number System					
Unit 2.1	Database Management system					
Unit 3.1	Programming in Qbasic					
Unit 3.2	Modular Programming					
Unit 3.3	File Handling in Qbasic					
Unit 4.1	Structured Program in C					

Set II: Students Survey Questionnaire

This research survey pertains to finding the suitable curriculum for computer science IX and Xth grade as per Nepalese societal needs. This research study helps to find the impact of current curriculum on student life and career. The proposal of a new Computer Science curriculum to CDC will be formulated through this research survey study. Data collected during this survey will be used only for Academic Research purposes. I (Ajay Yadav) am a research scholar from Graduate School of Education, Tribhuvan University, Nepal.

1.Student Name (Optional) _____

2.Gender

☐ Male

☐ Female

☐ Other _____

3.Name of School, District

4.Grade

☐ Class 9

☐ Class 10

☐ Class 11

☐ Class 12

5.Pradesh

☐ Koshi

☐ Madhesh

☐ Bagmati

☐ Gandaki

☐ Lumbini

☐ Karnali

☐ Sudurpashchim

6.Are the Computer Science textbook contents of Grade IX and Xth self understandable by students ?

☐ Yes

☐ No

☐ Other:_____

7.Do computer science text book contents help students in self learning and self-exploring digital reading materials ?

☐ Yes

☐ No

☐ Other:_____

8.Did the teacher cover all the units of the Computer textbook in prescribed time as per routine ?

☐ Yes, All units were covered in details with practical lab

☐ All units were taught with some examples in practical lab

☐ All units were taught

☐ All units were taught less practical Lab exercise.

☐ No Computer Lab in school

9.Student comfort level with Coding and making applications.

☐ Yes, I can Code and make applications.

☐ Yes, I can Code and Know only the concept of Programming Language. Did not create an application.

☐ Somehow I Can Code.

☐ Coding is difficult.

10. Computer Science practical exercise includes examples from subjects like Mathematics, Science, English, Nepali.

☐ Yes

☐ No

☐ Other:_____

11. I have created a presentation by including the following digital tools of computer technology.

☐ Nepali text

☐ Photos

☐ Audio / Video tools

☐ English Text

☐ Other:_____

12. Mention your experience with "Field visit" related to Computer science ?

☐ I have learned software application usage in field visits.

☐ I just saw the staff working in front of the computer. have only an overview of the application.

☐ I did not learn anything new in Field visit.

☐ Field visit was boring.

☐ No Field visit.

☐ Other:_____

13. Are computer science course contents and practical exercises and examples mentioned in the textbook relevant to student life ?

☐ Yes

☐ No

☐ Other:_____

14. Mention the skills that you have learned by studying computer science subject

☐ Create a Web page (with HTML , CSS)

☐ Computer maintenance (security, safety etc.)

☐ Programming in Qbasic

☐ Database System

☐ Image editing

☐ Work as Independently for office suite applications (word, excel, powerpoint)

☐ Nepali Typing

☐ Other:_____

15. Select the content material that you like to include in the New Computer Science curriculum ? Add your suggestion in the Other checkbox.

☐ Artificial Intelligence concepts with Python programming language

☐ Audio / Video Editing (useful for social Media platform video like youtube)

☐ Application Programming Interface (API) connects to different applications like Youtube, Facebook.

☐ Robotics programming

☐ Block Based program (Scratch)

☐ Game based Development

☐ Other:_____

16. Which Unit was most Difficulty and Easy in 9th Grade. Put the tick mark for 1 box each row.

Computer Science Grade 9 Contents		Very Difficult	Difficult	Neutral	Easy	Very Easy
Unit 1.1	Computer Fundamental					
Unit 1.2	Types of Computer					
Unit 1.3	Basic Architecture of Computer					
Unit 1.4	Computer Hardware					
Unit 1.5	Computer Software					

Unit 2.1	Computer Graphics					
Unit 3.1	Internet Technology					
Unit 3.2	HTML					
Unit 3.3	CSS					
Unit 4.1	Computer Programming					
Unit 4.2	Programming in Qbasic					

17. Which Unit was most Difficulty and Easy in 10th Grade. Put the tick mark for 1 box each row.

CS Grade 10 Contents		Very Difficult	Difficult	Neutral	Easy	Very Easy
Unit 1.1	Network and Telecommunication					
Unit 1.2	Ethical and Social Issues in ICT					
Unit 1.3	Computer Security					
Unit 1.4	E Commerce					
Unit 1.5	Contemporary Technology					
Unit 1.6	Number System					
Unit 2.1	Database Management					

	system					
Unit 3.1	Programming in Qbasic					
Unit 3.2	Modular Programming					
Unit 3.3	File Handling in Qbasic					
Unit 4.1	Structured Program in C					

18. Any Suggestion or Remarks for curriculum improvement of Computer Science. Mention your experience from teaching mode, learning interactions etc.

_____

Set III: Module-Based Analysis of the CS Textbooks

The textbook topic coverages as per page numbers are categorized in three modules.

Theory Contents: The theoretical contents are supposed to understand foundational concepts in Computer Science. These contents need to be mainly memorized by students and are related to CS conceptual topics, definition, terms, ICT policy.

Graphic Contents: The graphic contents are related to visual presenting and include multimedia technologies such as images, videos, sound, and animations.

Program Contents: The program contents are required for software development. These contents are related to programming languages (HTML, CSS, QBasic, C) and Database system.

Appendix D: Qualitative Research Tools

Set I: Teachers Interview

1. What skills are required to be taught for Grades 9 and 10 for CS students?
2. What localized contents and skills are included in the CS curriculum?
3. What is your opinion about the existing Computer Science (CS) curriculum?
4. Should any content be excluded or included in the present Computer Science curriculum?
5. Why contemporary programming languages like Python, AI, cloud technologies are not included in the CS curriculum?

Set II: Curriculum Designers Interview

1. What are major factors that are considered to design a CS curriculum?
2. How do you consider including Computer Science topics in the curriculum?
3. Any pretesting of the contents before including it in the curriculum?
4. How are the members included in the CS curriculum development committee?
5. Why are local language typing skills not included in the CS curriculum?
6. Why is field visit not included in the curriculum?
7. What is the process of revision for the CS curriculum?

Set III: School Principals Interviews

1. What is your opinion about the present Computer Science curriculum?
2. How feasible to meet requirements of CS for physical and human resources?
3. Any suggestions to improvise CS curriculum?

Set IV: Textbook Authors Interviews

1. What is your opinion about the present Computer Science curriculum?
2. Any checklist is provided for writing textbooks as per student Grade level?
3. What structure do you follow to write contents in a textbook?

4. How do you decide how much coverage is for the content materials?
5. Why does the present curriculum not include contemporary technologies?
6. Is the teacher's guide book provided with a textbook?
7. How is Nepal CS curriculum compared to international standards?
8. Which topics should be excluded and included in the present curriculum?

Set V: Focused Group Discussion (FGD)

1. Survey Presentation
    1.1. Why Survey is required?
    1.2. Current Status of CS Curriculum
    1.3. Student opinions about CS Curriculum
2. Data Analysis & Presentations.
3. Perspective from Curriculum Designer, Teachers and School Principals.

Set VI: Students Group Discussion (Grades 9 and 10)

1. What is your opinion about the current Computer Science curriculum?
2. How helpful is a textbook to learn and explore programming?
3. Which units are difficult and why do you feel difficult?
4. How comfortable are you in programming concepts?
5. How does a teacher teach programming?
6. Any topics required to be included in the Computer Science curriculum?

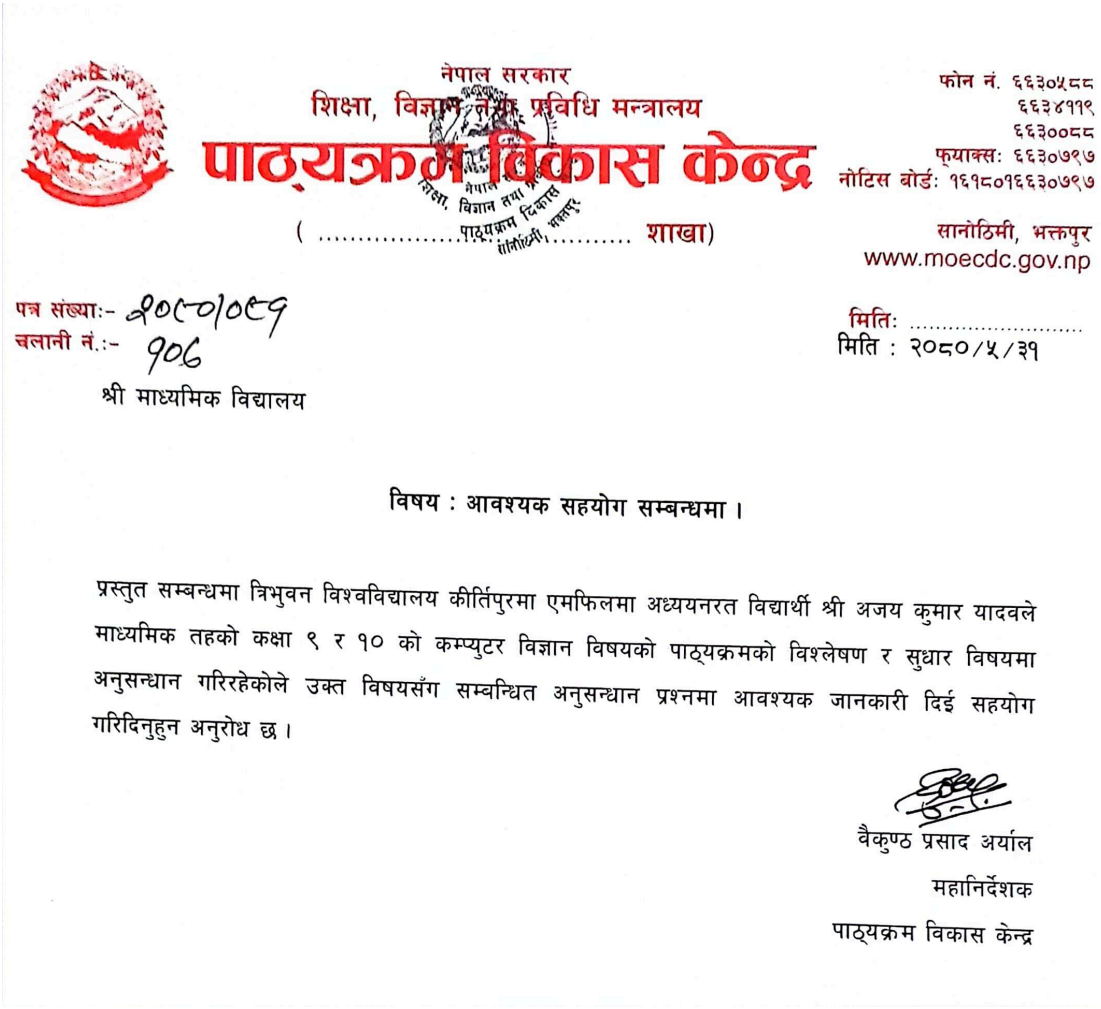
Set VII: Student Interviews (Grades 11 and 12)

7. What knowledge and skills learned from the CS curriculum?

8. What skills would you like to learn at Grade 10?

9. What topics would you suggest to include in the curriculum that would be useful in your life and career path?

Appendix E: Letter from Curriculum Development Center, Nepal



नेपाल सरकार
शिक्षा, विज्ञान तथा प्रविधि मन्त्रालय
पाठ्यक्रम विकास केन्द्र
(..... शाखा)

फोन नं. ६६३०५८८
६६३४११९
६६३००८८
फ्याक्स: ६६३०७९७
नोटिस बोर्ड: १६१८०१६६३०७९७
सानोठिमी, भक्तपुर
www.moecdc.gov.np

पत्र संख्या:- २०८०/०८९
चलानी नं.:- 906

मितिः .....
मिति : २०८०/५/३१

श्री माध्यमिक विद्यालय

विषय : आवश्यक सहयोग सम्बन्धमा ।

प्रस्तुत सम्बन्धमा त्रिभुवन विश्वविद्यालय कीर्तिपुरमा एमफिलमा अध्ययनरत विद्यार्थी श्री अजय कुमार यादवले माध्यमिक तहको कक्षा ९ र १० को कम्प्युटर विज्ञान विषयको पाठ्यक्रमको विश्लेषण र सुधार विषयमा अनुसन्धान गरिरहेकोले उक्त विषयसँग सम्बन्धित अनुसन्धान प्रश्नमा आवश्यक जानकारी दिई सहयोग गरिदिनुहुन अनुरोध छ ।

वैकुण्ठ प्रसाद अर्याल
महानिर्देशक
पाठ्यक्रम विकास केन्द्र

Appendix F: Participant List for Interviews

Name	Role
Sunil Kumar Gharti	Computer Science Textbook writer for Grade 9 and 10
Bimal Thapa	Computer Science Textbook writer for Grade 9 and 10
Sushil Upreti	Computer Science Textbook writer for Grade 9 and 10
Fr. George PM, S.J.	Superior, St. Xavier's School, Godavari
Ms. Geeta Chhetri	Principal of Galaxy Public School
Ganesh Thapaliya	Computer Science Teacher
Yogesh Chhetri	Computer Science Teacher
Baikuntha Prasad Aryal	Curriculum Development Center
Yubraj Adhikari	Curriculum Development Center

Appendix G: Teacher Survey Response

Set I: Teachers - Grade 9 Adequacy and Sufficient Contents

Computer Science Grade 9 Contents		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Unit 1.1	Computer Fundamental	11	19	6	3	1
Unit 1.2	Types of Computer	10	19	7	2	2
Unit 1.3	Basic Architecture of Computer	11	11	17	1	0
Unit 1.4	Computer Hardware	11	16	8	2	3
Unit 1.5	Computer Software	8	19	8	2	3
Unit 2.1	Computer Graphics	10	14	10	5	1
Unit 3.1	Internet Technology	9	18	10	2	1
Unit 3.2	HTML	10	21	7	2	0
Unit 3.3	CSS	9	14	13	3	1
Unit 4.1	Computer Programming	11	13	10	3	3
Unit 4.2	Programming in Qbasic	9	15	6	4	6

Set II: Teachers - Grade 10 Adequacy and Sufficient Contents

Computer Science Grade 10 Contents		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Unit 1.1	Network and Telecommunication	15	17	6	2	0
Unit 1.2	Ethical and Social Issues in ICT	12	17	8	2	1
Unit 1.3	Computer Security	13	16	7	3	1
Unit 1.4	E Commerce	12	15	10	3	0
Unit 1.5	Contemporary Technology	11	18	9	2	0

Unit 1.6	Number System	19	14	5	1	1
Unit 2.1	Database Management system	12	18	9	0	1
Unit 3.1	Programming in Qbasic	8	15	11	5	1
Unit 3.2	Modular Programming	9	16	8	6	1
Unit 3.3	File Handling in Qbasic	10	13	11	5	1
Unit 4.1	Structured Program in C	13	14	10	0	3

Set III: Teachers - Programming Language Priority

	Python	Javascript	HTML CSS	Qbasic	Database program
1st Priority	17	5	14	3	4
2nd Priority	8	14	9	3	6
3rd Priority	7	9	12	3	8
4th Priority	8	6	2	9	13
Total Count	40	34	37	18	31

Appendix H: Student Survey Response

Set I: Students - Grade 9 Easy to Difficult Units

Computer Science Grade 9 Contents		Very Difficult	Difficult	Neutral	Easy	Very Easy
Unit 1.1	Computer Fundamental	8	11	114	157	141
Unit 1.2	Types of Computer	9	16	100	176	130
Unit 1.3	Basic Architecture of Computer	9	35	182	126	79
Unit 1.4	Computer Hardware	10	28	143	144	106
Unit 1.5	Computer Software	14	28	160	139	90

Unit 2.1	Computer Graphics	16	73	177	102	63
Unit 3.1	Internet Technology	10	33	149	143	96
Unit 3.2	HTML	38	92	137	98	66
Unit 3.3	CSS	62	93	188	50	38
Unit 4.1	Computer Programming	63	94	147	73	54
Unit 4.2	Programming in Qbasic	78	100	133	62	58

Set II: Students - Grade 10 Easy and Difficult Units

Computer Science Grade 10 Contents		Very Difficult	Difficult	Neutral	Easy	Very Easy
Unit 1.1	Network and Telecommunication	27	46	150	123	85
Unit 1.2	Ethical and Social Issues in ICT	17	38	120	139	117
Unit 1.3	Computer Security	18	24	127	146	116
Unit 1.4	E Commerce	18	31	116	132	134
Unit 1.5	Contemporary Technology	21	46	182	103	79
Unit 1.6	Number System	21	34	112	101	163
Unit 2.1	Database Management system	29	72	182	90	58
Unit 3.1	Programming in Qbasic	60	98	134	86	53
Unit 3.2	Modular Programming	76	110	123	69	53
Unit 3.3	File Handling in Qbasic	82	104	120	68	57
Unit 4.1	Structured Program in C	99	111	137	41	43

Appendix I: Specification Grid - Computer Science (CDC, Nepal)

विशिष्टीकरण तालिका

विशिष्टीकरण तालिका, २०७६

सैद्धान्तिक मूल्याङ्कन

विषय : *कम्प्युटर विज्ञान*

पूर्णाङ्क : ५०

समय : १ घण्टा ३० मिनेट

प्रश्न योजना तथा अङ्कभार वितरण																	
एकाइ	क्षेत्र/एकाइ	पाठ्य भार	ज्ञान			बोध			प्रयोग			उच्च दक्षता			जम्मा अङ्कभार		
			अति छोटो	छोटो	लामो	अति छोटो	छोटो	लामो	अति छोटो	छोटो	लामो	अति छोटो	छोटो	लामो	अति छोटो	छोटो	लामो
१	Computer Fundamental	34	3	2		3				2	1				6	4	1
	Dtabase management system	42	1	2			1				2					2	4
३	Programming in Qbasic	61	1				2		2					2	3	2	2
४	Introduction to C Language	29	1											1	1		1
	Total	**170**	**6**	**4**		**4**	**3**		**2**	**4**	**1**			**3**	**12**	**11**	**4**

Appendix J: List of Educators Contributed for Data Collection in Study

Name	Role
Sunil Kumar Gharti	CSTextbook writer for Grade 9 and 10
Bimal Thapa	CSTextbook writer for Grade 9 and 10
Sushil Upreti	CSTextbook writer for Grade 9 and 10
Fr. George PM, S.J.	Superior, St. Xavier's School, Godavari
Ganesh Thapaliya	Computer Science Teacher, St. Mary's Secondary School
Yogesh Chhetri	Computer Science Teacher, Little Angels' School
Dr. Mahashram Sharma	National Examination Board

Appendix K: Present Computer Science Curriculum in Nepal

Set I: CS Curriculum Framework for Grades 9 and 10

कम्प्युटर विज्ञान

१. परिचय

आजको युग सूचना प्रविधिको युग हो । सूचना प्रविधिको विकासले गर्दा आजको विश्व नै एउटा विश्वग्राम (Global Village) का रूपमा रूपान्तरण भइसकेको छ । वर्तमानमा देश विकासको पूर्वाधारका रूपमा सूचना प्रविधिको प्रयोग र पहुँचलाई लिने गरिन्छ ।

प्रविधिको उच्चतम उपयोग गरी यसबाट लाभ लिनका लागि प्रथमत: यसबारे ज्ञान हासिल गर्नुपर्ने हुन्छ । यसै सन्दर्भमा कम्प्युटर विज्ञान विषयलाई माध्यमिक तह कक्षा ९ र १० मा ऐच्छिक विषयका रूपमा समावेश गरिएको छ । यस विषयको पूर्णाङ्क १०० रहने छ । यस विषयको पाठ्यक्रममा कम्प्युटर विज्ञानका विभिन्न पक्षहरूलाई निम्नलिखित भागहरूमा समावेश गरिएको छ :

- कम्प्युटरको आधारभूत ज्ञान
- कम्प्युटर ग्राफिक्स
- नेटवर्क, इन्टरनेट र वेब प्रविधि
- कम्प्युटर प्रोग्रामिङ (QBasic र C-Language)
- डाटाबेस म्यानेजमेन्ट सिस्टम

Set II: CS Educational Competencies for Grade 9 and 10

२. तहगत सक्षमता

माध्यमिक तह (कक्षा ९ र १०) को अध्ययन पूरा गरिसकेपछि विद्यार्थीहरूमा निम्नलिखित सक्षमता हासिल हुने छन् :

१. कम्प्युटर प्रविधिको विकासक्रम, यसको महत्त्व र उपयोगिता बोध

२. कम्प्युटरलाई विभिन्न प्रकारमा वर्गीकरण गरी (आकार, डाटा प्रशोधन क्षमता आदिका आधारमा) तिनीहरूका विशेषता तथा प्रयोग गरिने क्षेत्रका बारेमा विश्लेषण र दैनिक जीवनमा प्रयोग

माध्यमिक शिक्षा पाठ्यक्रम (ऐच्छिक), कक्षा ९ र १० १३७

३. कम्प्युटरमा प्रयोग हुने विभिन्न हार्डवेयर तथा सफ्टवेयरका बारेमा जानकारी

४. एप्लिकेसन सफ्टवेयर, सिस्टम सफ्टवेयर आदिबारे जानकारी प्राप्त गरी कुनै निश्चित प्रयोजनका लागि आवश्यक सफ्टवेयरको छनोट गर्ने क्षमताको विकास

५. ग्राफिक्स सफ्टवेयरको प्रयोग गरी चित्र तथा तस्बिरहरूलाई आवश्यकताअनुसार परिमार्जन

६. इन्टरनेट, वेब प्रविधि र HTML को ज्ञानबाट वेब साइटहरू बनाउने सिपको विकास

७. QBasic तथा C-language को प्रयोग गरी सामान्य प्रोग्रामहरूको विकास

८. कम्प्युटर नेटवर्कबारे जानकारी हासिल गरी नेटवर्कमा फाइल तथा अन्य संशाधन (हार्डवेयर, सफ्टवेयर) को प्रयोग

९. कम्प्युटर प्रविधिको प्रयोग गर्दा ध्यान दिनुपर्ने विभिन्न नैतिक तथा सामाजिक अपराधहरूबारे सजग रही सचेत नागरिकको जिम्मेवारी वहन

१० हार्डवेयर तथा सफ्टवेयर एवम् डाटा सुरक्षाका उपायहरू अवलोकन

११. तत्कालीन समयमा व्यावहारिक रूपमा उपयोग गरिएका विद्युतीय व्यापार, विद्युतीय बैङ्किङ सुविधा आदिका बारेमा जानकारी लिई त्यसको प्रयोग

१२. डाटाबेस मेनेजमेन्ट सफ्टवेयरको प्रयोग गरी ससानो एप्लिकेसन निर्माण र प्रदर्शन

१३. C-Language सम्बन्धी आधारभूत ज्ञान हासिल गरी सामान्य एप्लिकेसन निर्माण गर्ने क्षमताको विकास

१४. कम्प्युटर प्रविधिबारे उच्च शिक्षा हासिल गर्नका लागि चाहिने आधारभूत क्षमता विकास

Appendix L: Survey Data

Set I :Student Participation in Online Survey within Nepal

Pradesh	Grade	Gender			Total
		Female	Male	Other	
Bagmati	Class 9	16	27		43
	Class 10	111	124	1	236
	Class 11	27	94		121
	Class 12	5	14		19
Bagmati Total		159	259	1	419
Karnali	Class 9	1			1
Koshi	Class 9	1	1		2
	Class 10		1		1
	Class 11		3		3
Koshi Total		1	5		6
Madhesh	Class 9		2		2
Sudurpaschim	Class 10		2		2
Grand Total		161	268	1	430

Set II :Teachers Participation in Online Survey within Nepal

Teaching Experience	Bagmati	Gandaki	Koshi	Lumbini	Madhesh	Grand Total
Below 2 years	5		2			7
2 to 4 years	7	1			1	9
5 to 10 years	2					2
Above 10 years	26	1	1	1	1	30
Grand Total	40	2	3	1	2	48