

Qualitative Research Design in Teaching and Learning of Computer Education

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Abstract

The study examines qualitative research design that has grown more important in investigating the intricacies of teaching and learning in computer education. In contrast to quantitative methods that focus on measuring specific variables, qualitative approaches offer detailed, contextual insights into students' experiences, teachers' instructional methods, classroom interactions, and the socio-cultural influences that affect learning. This article explores the importance, techniques, advantages, and obstacles of qualitative research design in computer education's teaching and learning processes. This research indicates that qualitative approaches-like interviews, observations, focus groups, and document analysis, are especially useful for grasping learners' views, pinpointing obstacles to digital literacy, and improving teaching methods. The research finds that qualitative studies are crucial for enhancing computer education particularly in Nepal and generally in the global education system especially in order to cope with the changing digital environments. The status of computer education in Nepal has been explored a bit complicated compared to that of India, a neighboring country that is digitally booming.

Keywords: qualitative research, approach, computer literacy, Nepalese education system

Introduction

The swift growth of digital technologies has altered contemporary education systems, rendering computer education an essential part of academic progress. Grasping how students acquire computer skills, how educators present technological material, and how learning settings affect digital literacy necessitates methodologically rigorous research. Qualitative research design offers an appropriate framework for examining these domains as it emphasizes meaning-making, human experiences, and interactions in the classroom (Creswell & Poth, 2018). Computer education is fundamentally hands-on, focused on problem-solving, and collaborative in nature. As a result, qualitative methods uncover more profound understandings of the learning difficulties, cognitive mechanisms, and socio-

cultural factors that quantitative approaches frequently miss. This paper examines the importance of qualitative research design in computer education teaching and learning, highlighting its methodological impacts and practical implications. In Nepal, computer education has steadily grown over the last twenty years, shaped by globalization, technological progress, and national policies that encourage digital literacy. Despite visible advancements, the overall situation is still inconsistent, featuring significant disparities between urban and rural areas, private and public institutions, as well as policy and implementation.

Private schools typically offer mandatory ICT classes starting from primary levels. Government schools have included ICT as a subject, but numerous institutions lack the necessary infrastructure for complete execution. Computer education is part of the curriculum from grades 1 through 12. The curriculum focuses on essential skills like typing, MS Office, internet browsing, email usage, and the basics of hardware and software. At the secondary level, subjects encompass C programming, HTML, foundational networking, and digital citizenship. Tribhuvan University, Kathmandu University, Pokhara University, Mid-Western University, and Purbanchal University provide programs including: BSc.CSIT, Computer Engineering, Bachelor's degree in Computer Application (BCA), BIT, Master of Science, CSIT, M. Tech, and PhD programs available for a select number of students.

Qualitative research is context-dependent, naturalistic, and interpretive. It aims to comprehend human behavior from the viewpoint of the participant (Merriam & Tisdell, 2016). In educational settings, qualitative design helps researchers explore interactions, learning processes, and teaching experiences. Computer education includes a variety of learning experiences-ranging from fundamental digital skills to complex programming. Qualitative research in this area frequently examines students' views on computer-aided lessons, educators' teaching methods, interaction with digital tools in the classroom, difficulties in technology integration, and perspectives on digital and computational thinking.

Scholars like Selwyn (2016) contend that qualitative research is crucial for comprehending how students interpret technologies and how social contexts affect digital learning. Research indicates that the adoption of ICT is greater in private educational institutions than in public ones, primarily because of superior infrastructure (Sharma & Kumar, 2020). At the university level, India provides various computer-related degrees such as BCA and B.Sc. Computer Science, B. Tech in Computer Science Engineering, MCA, and higher-level research initiatives. NEP 2020 highlights the importance of coding, computational thinking, and digital abilities starting in early grades (Government of India, 2020). Nonetheless, real-world application differs significantly. Research results emphasize

the necessity for revised curriculum frameworks and ongoing teacher professional development (Sarkar, 2019). Prior research consistently highlights comparable issues: insufficient infrastructure, a lack of trained computer educators, restricted internet availability, and differences between rural and urban schools (Nair & Menon, 2019).

Method

This study has used a qualitative research design based on the literature. Peer-reviewed articles, books, and research reports related to qualitative research, computer science education, and technology pedagogy were reviewed. Themes were developed through content analysis to answer the research questions. The study has been based on secondary sources of information. The data are related to the computer and its application in education system of Nepal.

Results

The study has explored that challenges include subjectivity in interpretation, labor-intensive data collection, difficulty generalizing results, and technical limitations in low-resource schools. Opportunities include a deeper understanding of students' lived experiences, cultural awareness, flexible data collection in digital environments (e.g., online courses), and holistic perspectives of learning and teaching. Qualitative research designs provide an in-depth understanding of computer science education by focusing on learner-centered experiences. Unlike numerical data, qualitative information shows how students conceptualize programming, how they collaborate on digital problems, and how teachers change their teaching methods. As IT education increasingly incorporates digital collaboration, virtual classrooms, and self-paced learning tools, quality information is essential to developing effective pedagogies.

1. Insufficient digital infrastructure

Numerous schools, especially in rural and public areas, are missing a lot. In Nepal, a reliable power supply is essential to creating a positive learning environment; ensuring students have access to enough computers to support their education. Additionally, a stable internet connection is essential for students to engage in digital learning using online resources. To further enhance the educational experience, it is important to have the latest hardware and software that can provide students with the tools they need to succeed in a technology-based world. Together, these elements create a strong foundation for education in Nepal, providing students with the opportunity to reach their full potential. A single computer lab often accommodates hundreds of students, making hands-on learning extremely difficult.

2. Limited Teacher Training and Professional Development

Computer teachers in Nepal often face numerous problems. Nepal's educational environment faces serious challenges due to insufficient subject knowledge, especially in critical areas such as programming, networking, and advanced ICT tools. This gap is further exacerbated by a lack of training in the use of modern educational software, preventing educators from effectively integrating technology into their teaching practices. Furthermore, practical training in educational institutions is minimal or inconsistent, limiting students' practical experience and practical application of theoretical knowledge. These problems are further exacerbated by the reliance on rote learning for assessment purposes, which prioritizes memorization over actual performance and understanding. This multifaceted problem highlights the urgent need for comprehensive reform of the education system to align curricula and assessment methods with the current and future needs of society. As a result, students often memorize definitions but lack actual numerical skills.

Qualitative research improves pedagogy by identifying student difficulties in understanding computer science concepts, evaluating the effectiveness of instructional methods, identifying barriers to accessing technology, and informing teacher preparation and program improvement. For example, interviews with teachers often reveal gaps in organizational support and digital resources that cannot be fully captured through quantitative research.

Socio-economic Differences

Rural and marginalized communities face greater barriers. In Nepal, a significant number of students have difficulty accessing personal digital devices at home, limiting their ability to use modern educational resources. This problem is further exacerbated by the fact that many parents lack digital literacy, further limiting their children's ability to benefit from technology-based learning. Additionally, schools operating on tight budgets struggle to maintain up-to-date computer labs, exacerbating the digital divide and limiting students' access to basic technology skills. Together, these factors create barriers to equitable education and highlight the urgent need for targeted measures to improve digital access and literacy in the country. This digital divide creates unequal learning outcomes across regions and socio-economic groups.

Language Barrier

Most computer science educational resources (software, tutorials, and programming languages) are available in English. Students with low English proficiency face many challenges. Understanding technical instructions in Nepal requires a holistic approach, including reading online materials and learning how to navigate various interfaces. As digital resources become more commonplace, individuals need to develop essential skills to

effectively interpret complex technical documents. This includes not only understanding the language being used, but also understanding the context in which these instructions are presented. Additionally, navigating the interface, whether it's a software application, website, or other digital platform, requires a certain level of user experience design knowledge, which can greatly impact your ability to successfully follow technical guidelines. Therefore, the interaction between reading comprehension and navigation in the interface is essential to effectively interact with technical content in the Nepali context. This increases cognitive load and slows down learning.

Lack of Context-specific Learning Materials

Computer science educational content often reflects Western examples, tools, and case studies. Nepal's unique context (local applications, digital issues, indigenous knowledge systems) is rarely integrated. This reduces student engagement and limits relevance to real life. Even when a computer lab exists, the challenge is fraught with obstacles. In Nepal, lab schedule limitations make it extremely difficult for students to access the necessary hands-on learning experiences. This situation is further exacerbated by the use of shared computers. Shared computers typically require three to five students to work together on one computer, creating problems for productivity and learning efficiency. Additionally, poorly maintained machinery increases frustration and inefficiency as technical issues can interrupt the learning process. These problems are further exacerbated by the fact that irregular laboratory classes create a hostile educational environment, making it difficult for students to acquire the necessary skills and knowledge in a timely manner. This combination of factors highlights the urgent need for plans to improve laboratory resources and enhance the educational experience of Nepali students. These limitations prevent students from developing practical computer skills such as programming, typing, and using software.

Technology is advancing faster than curriculum reform. Schools cannot know everything. Recent updates to programming languages in Nepal reflect major changes in the educational landscape due to the integration of new technological tools such as artificial intelligence, coding platforms, and virtual simulations. These advances not only improve the quality of learning, but also prepare students for the challenges of the digital age. Additionally, with the adoption of technology and the increasing need for a secure digital environment, a focus on cybersecurity practices has become paramount. At the same time, the introduction of digital citizenship requirements emphasizes the importance of responsible behavior online, ensuring that students are not only proficient in coding and technology, but also aware of their ethical responsibilities in the digital realm. Taken

together, these developments mark a gradual transition towards a more inclusive and secure digital education system in Nepal. As a result, students end up learning outdated content.

Effective computer-based instruction requires support from teachers, parents, and administrators. However, many parents do not understand the importance of digital literacy. School administrators can prioritize other subjects. This may increase the burden on teachers and reduce the time it takes to prepare lessons that utilize ICT. This creates an environment where computer science education is undervalued. Exams often test theoretical knowledge rather than practical skills. Students rarely get reliable grades.

In Nepal, project-based assessments are increasingly being used to enhance the educational experience, particularly by incorporating coding tasks, digital portfolio submissions, and real-world troubleshooting tasks. These methods not only encourage students to explore the material more deeply, but also emphasize the importance of practical application in the learning process. By integrating programming tasks, students develop important programming skills while working on real-world projects. Presenting a digital portfolio allows students to demonstrate their progress and skills, develop a sense of ownership, and reflect on their work. Additionally, real-world troubleshooting tasks require students to apply their knowledge to practical situations and prepare them for the complexities of the professional world. This multifaceted assessment approach not only more effectively assesses student learning, but also provides students with the skills they need for future success in a rapidly changing environment.

Therefore, the assessment system does not reflect the skills needed in today's digital environment. In some regions, computers are still considered a luxury, or a tool reserved for "smart" or "urban" youth. These beliefs influence students' confidence and motivation. Gender bias also persists, and girls may be less encouraged to enter the ICT field. COVID-19 has exposed critical gaps in Nepal's digital education system. Nepal's digital environment faces significant challenges, primarily due to a lack of devices, making it difficult to access online educational resources. The problem is further complicated by the fact that many people are unfamiliar with online platforms and struggle to navigate digital tools that enhance their learning experience. Additionally, the high cost of internet access is a major barrier, limiting connectivity for both students and teachers. These barriers are further exacerbated by low levels of digital literacy among teachers and students, limiting their ability to effectively use technology for educational purposes. Taken together, these factors create significant gaps in Nepal's digital learning capabilities and highlight the urgent need for targeted interventions to improve digital access and skills. This highlighted the need for long-term digital readiness.

Computer science teaching and learning in Nepal is influenced by a complex mix of infrastructure constraints, educational challenges, socio-economic inequalities, and rapidly changing technological demands. To solve these problems, certain conditions must be met. Improving learning outcomes requires a multifaceted approach that includes ongoing teacher training to provide educators with the latest teaching skills and knowledge. This should be complemented by major investments in digital infrastructure to ensure that all schools are adequately equipped to use technology in the learning process. Additionally, modernizing curriculum and assessment systems is essential to align educational content with modern needs and expectations. We must also pay special attention to supporting marginalized students and ensure that all students have equal access to resources and opportunities. Finally, developing digital literacy policies at the national level is necessary to foster a culture of digital literacy among educators and students, thereby enabling them to meet the demands of a 21st century workforce.

Researchers typically use classroom observations, semi-structured interviews, group discussions, and computer laboratory design tasks. Classroom observation is an important method for analyzing student interactions, learning patterns, and engagement, especially in computer science courses. Additionally, semi-structured interviews provide valuable insight into teachers' experiences with digital tools and shed light on challenges students face when using software or coding concepts. Group discussions further deepen understanding by summarizing collective ideas about collaborative learning, project assignments, and the overall experience in the computer lab. Additionally, document analysis allows you to review lesson plans, digital assignments, and student portfolios. Combining these methods allows researchers to better understand the various contextual factors that influence students' thought processes, teachers' instructional decisions, and the integration of technology into educational environments.

Conclusion and Discussion

Qualitative research designs play a central role in the development of teaching and learning in computer science education. It provides a wealth of contextual information about classroom experiences, student challenges, learning strategies, socio-technical influences, and more. Although qualitative research has limitations such as subjectivity and limited generalizability, its strength in studying complex educational phenomena makes it essential for improving computer science education in today's digital world. Strengthening ICT infrastructure, improving teacher training and promoting digital equality will play a key role in improving IT education. As Nepal moves towards a knowledge-based digital economy, providing accessible, high-quality IT education is essential to the country's development and global competitiveness.

Despite the growth of computer education, numerous students struggle to develop essential digital competencies. Teachers also face challenges in implementing learner-centered computer instruction. This study has explored the role of qualitative research in improving instructional approaches, understanding student experiences, and improving outcomes in computer science education. The research addressed qualitative methods commonly used in computer science education research, how qualitative approaches contribute to understanding instructional practices in computer science education, and the challenges and opportunities that arise when using qualitative designs in computer science education research.

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