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Boosting Digital Literacy: Empowering Mathematics Students of Bachelor Degree for Learning C Programming

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Abstract

This study explores the impact of a general digital literacy module on students pursuing a bachelor's degree in Mathematics under Humanities and Social Sciences at Tribhuvan University. The module was targeted to develop fundamental skills for learning C Programming. Employing a participatory action research approach, a module was developed based on the students' prior knowledge and their ICT course. A ten-day instructional intervention was conducted, utilizing cooperative techniques. The module aimed to establish a foundation for learning the ICT component within the mathematics program. To assess the module's effectiveness, classroom observations and students interviews were employed. The results indicate that the module successfully connects the ICT component with the mathematics program, equipping students with essential digital literacy skills crucial for comprehending the course content. Additionally, the findings emphasize the significance of providing a bridging module to support students' prior knowledge and adequately prepare them for the program's curriculum. This study contributes to enhance digital literacy skills in mathematics education for students in humanities and social sciences, facilitating their academic growth and future success.

Keywords: communication technology, information, mathematics, participatory action research

Introduction

In academia, ICT and its concept and implication are heard in a significant way. Classroom practice, curriculum designs, administration, lesson plans etc. are done keeping ICTs in mind. ICT simply means information and communication technology, it includes the internet, browser, wireless networks, phones, social media and other communication mediums. It can be used in every sphere of life and education specifically. Ratheeswari (2018) observes that by recognizing the impact of new technologies on the workplace and everyday life, today's teacher education institutions try to restructure their educational programs and classroom facilities, to minimize the teaching and learning technology gap between today and the future. As a teacher teaching ICTs course at Dhawalagiri Multiple Campus of Tribhuvan University, I have faced many due to the lack of digital inconveniences for students. In Bachelor of Arts (BA), the students are introduced to ICTs Courses, but few students are very weak. In this regard, I have conducted action research to solve the problem. In this context of Dhawalagiri Multiple Campus (DMC)

being the teacher, from the time of the pandemic COVID-19 to till now, while taking the class for BBA, B.SC, BA etc. and many other classes. I found that they are not being able to understand the basic concept of digital literacy, which is very important in today's digital world. For the past 2 years since the pandemic, I have entered several time in different classes, but I have not been able to make the students to understand the importance and value of digital literacy. It will be a wonderful opportunity for the students to learn more about the research and other tasks when they come to collect information on digital literacy.

It will be interesting research in the digital world. I have come with the idea of carrying out action research after being severely impacted by the vulnerable condition of students regarding access to digital technologies. Furthermore, digital literacy skills are essential for success in today's world. The ability to use digital tools and technologies effectively and efficiently is critical for the education, employment, and daily life of students of Dhawalagiri Multiple Campus (DMC). Digital literacy refers to the ability to use digital technology and tools effectively and efficiently to communicate, access information,

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and solve problems in a variety of contexts. It encompasses a range of skills and competence, such as navigating digital devices and software, evaluating the credibility of online sources, communicating effectively through digital channels, and protecting one's privacy and security online. Digital literacy is becoming increasingly important in today's digital age, where technology is an integral part of everyday life, and many aspects of work, education, and social interaction are conducted online. Developing digital literacy skills can enhance one's ability to participate in modern society and succeed in a wide range of personal and professional endeavours.

Bachelor' of Arts (BA) program of Tribhuvan University launching a mathematics program with one paper on ICT which includes the fundamental of C Programming. Dhawalagiri Multiple Campus assigned me to instruct this course. When I started, teaching that paper, I felt that students feel difficulty learning the course. The lack of students' prerequisite for learning this subject has made learning difficult to teach. This scenario motivates them to conduct action research to improve the prior knowledge of the students. The following research questions were considered to conduct the study:

- 1) Why do mathematics students of BA feel difficult to learn C programming?
- 2) How can basic digital literacy skill be developed for learning C programming?

Literature Review

Digital literacy skills are essential in today's world, where technology plays a crucial role in our daily lives. These skills are crucial for success in education, employment, and daily life. In the current digital age, digital literacy skills are not only desirable but also necessary for individuals to participate fully in society. With the rapid advancement of technology, the need for digital literacy skills is increasing. Roy (2015) claims ICT cannot replace the teacher; it can aid the teacher in the process of teaching and make the teaching-learning process more interactive. The effective use of ICTs in the teaching-learning process also depends on teachers' ICT competency and skill.

Digital literacy skills are essential in the fields such as IT, engineering, healthcare, education, and many others. Moreover, digital literacy skills are also essential for people who are self-employed or entrepreneurs, as they need to use digital tools to promote their businesses and reach out to customers. In addition to employment opportunities, digital literacy skills are also necessary for individuals to participate in the democratic process. People need digital literacy skills to access and evaluate information from multiple sources, participate in

online discussions and debates, and engage with political and social issues. Teachers need to be IT-friendly and digitally sound. Regarding the definition of teachers' digital competence, the review points out a consensus that teachers must have didactic and technological skills that enable them to use digital technologies in higher education (Engel, 2023).

In the same way, Ogiegbaen et al. (2005) observe that in the more advanced industrialized nations, there has been a staggering amount of research and publication related to ICT use for educational purposes during the past decade. Gibson (2018) states that ICT can maintain a good relationship between teacher and student. The interaction between the teacher and the learner is also being transformed and expanded by technology-enabled interactions and capabilities. Brun(2014) says that teachers tend to use ICT consistently across their educational management-related activities and in most of their teaching practices, without showing any evidence of ICT contributing to the implementation of some specific activities over others. Nonetheless, the use of ICT by students shows some evidence of differentiated roles in particular learning activities. These observations tell us that ICT is necessary for teaching and learning goals.

Constructivist learning Theory

One theory that focuses on prior knowledge for learning is the constructivist theory. Constructivism is a learning theory that suggests learners construct their knowledge and understanding of the world based on their prior experiences and existing mental frameworks (Mayer, 2004). According to constructivism, learning is an active process where learners engage with new information and integrate it into their existing knowledge structures or schemas (Vygotsky, 1978). These schemas are developed through previous experiences and interactions with the environment. Learners use their prior knowledge as a foundation to make sense of new information, fill in gaps, and construct new understandings. Constructivism emphasizes the importance of building on learners' prior knowledge and experiences to promote meaningful learning (Ausubel, 1968). It suggests that effective instruction should consider students' existing knowledge, beliefs, and misconceptions and provide opportunities for learners to actively engage in constructing their understanding. An influential constructivist, Jean Piaget, proposed that learners undergo cognitive development through the process of assimilation (fitting new information into existing schemas) and accommodation (modifying existing schemas to incorporate new information). This process is guided by learners' interactions with the environment and their active exploration and reflection.

Methods

The participatory action research (PAR) methodology was utilized in conducting the study, which aimed to address the challenges faced by both students and teachers in the context of learning and teaching C programming in mathematics students of BA third. The following steps were adopted to complete the study.

The first step in the PAR process was the identification of the problem. Through discussions, interviews, and observations, the researcher identified the specific challenges faced by students and teachers when it came to learning and teaching Programming, with a particular focus on C programming.

Once the problem was clearly defined, the researchers proceeded to develop a module specifically designed to enhance students' preparedness for learning C programming. This module was developed in collaboration with the teachers and students, ensuring that their input and insights were taken into consideration. The module likely included various learning materials, exercises, and interactive elements to engage and motivate the students. The module covered Word, excel, commands, login, downloading and installing programs, variables, string, programming language, a flowchart for preparing the program, etc.

After the development of the module, it was implemented in the classroom setting. The researchers, along with the teachers, delivered the module to the students, providing instructions, guidance, and support throughout the learning process. The implementation phase was not only focused on teaching the content but also on observing the outcomes and effects of the module.

During the implementation, data collection methods such as observations, surveys, interviews, and assessments were used to gather information about the student's progress, engagement levels, and any changes in their learning experiences. These data allowed the researchers to assess the effectiveness of the module and identify areas for improvement.

Through the participatory nature of the research process, both the researchers and the participants had an active role in the study. Teachers and students were not merely passive subjects but were actively involved in shaping the research and its outcomes. This collaboration helped ensure that the research was relevant, meaningful and had the potential to bring about positive change in the teaching and learning of Programming.

Findings

The findings of the study arranged the scenario of the problem, implementation of the plan and observation.

The Scenario of Problem

The survey conducted in the action research aimed to assess the digital literacy level and usage patterns of the students. The results showed that a majority of the students faced challenges with ICTs, as indicated by 50% reporting moderate digital literacy levels and 37.5% reporting low levels. Only 12.5% felt they had high digital literacy. Regarding devices used for digital classes, 87.5% of students used smartphones, due to their availability and affordability. The remaining 12.5% used desktop computers, which are more suitable for enhancing digital literacy skills.

In terms of confidence with basic computer applications, 62.5% of students reported moderate confidence, while 37.5% felt quite confident. This suggests that students were not fully comfortable with basic computer skills and would benefit from further training.

The survey revealed that 75% of students regularly engaged in social media networking, while 12.5% used email and the remaining 12.5% engaged in streaming videos/music. This highlighted the need to diversify their online activities to promote deeper digital literacy knowledge.

When it came to digital security and privacy, 50% of students reported encountering issues sometimes, indicating a lack of familiarity. Additionally, 25% rarely encountered these issues and the remaining 25% often encountered them. This underscored the importance of digital literacy research to raise awareness of security and privacy concerns.

Regarding training and courses, 62.5% of students had not received any related training. This highlighted the need for more training opportunities to improve digital literacy skills and make students comfortable with using digital devices.

In terms of digital skills, 62.5% of students reported using internet browsing and searching, while the remaining 37.5% used productivity software like Microsoft Office and Google Docs. Concerning software and device updates, 62.5% of students occasionally updated them for security and performance improvement, 25% did so frequently, and 12.5% rarely updated. The survey showed that 62.5% of students were interested in receiving further resources or training to enhance their digital literacy skills. An additional 37.5% expressed interest depending on the content provided.

When asked about the meaning of digital literacy, 37.5% of students associated it with the ability to use digital devices, the same percentage related it to the ability to read and write in a digital format, and 25% mentioned the ability to navigate and critically evaluate digital information.

Finally, when asked to choose the most useful digital device among television, Smartphone, microwave, and bicycle, 100% of students selected the Smartphone.

Overall, the survey results emphasized the need to improve students' digital literacy skills, provide training opportunities, and increase awareness of digital security and privacy issues. It also highlighted the importance of diversifying online activities and using appropriate devices to enhance digital learning experiences.

Reasons of Students' Difficult Feeling in Learning C Programming

Based on the interview, discussion, and observation, it was discovered that students face difficulties in learning C programming due to their low familiarity with terms and lack of knowledge of minor digital knowledge. One of the students BA 1 was completely naïve to open the computer when I met him. And I called him separately to the campus and taught him how to use the computer using my laptop. The second student BA 2 said that he had already used a computer in school but had no idea about browsers, software, or digital literacy. This implies that they have limited exposure to the necessary concepts and skills required for understanding and applying C programming effectively. The lack of familiarity with terms is a significant hindrance for students when learning C programming. Programming languages often have their unique vocabulary and terminology, and without a basic understanding of these terms, students may struggle to comprehend the concepts being taught. For example, without knowing what a "variable," "function," or "loop" is, it becomes challenging to grasp the fundamental building blocks of C programming.

Additionally, the student's lack of knowledge regarding minor digital acknowledgment can further impede their learning process. Digital know-how encompasses basic computer literacy skills, such as file management, operating system navigation, and using common software tools. Proficiency in these areas is crucial for effectively practicing and experimenting with C programming. Without this foundational knowledge, students may face difficulties in setting up the programming environment, executing code, or troubleshooting errors, leading to frustration and hindered progress.

Result of Module Implementation

I implemented a module plan which includes browsing, login, registering, email etc. They get ideas one by one which pleased both me and them. The students are now being able to answer all the questions that they were unable to answer while entering as a student of DMC in BA. I took a second interview after a month and they were a bit comfortable in using ICTs. After the interview, I came to know they are now able to access the computer along with the internet, now the students can answer the basic questions being asked about computers. They can easily browse on the internet, they can do programming languages both offline and online which is the major part of computers in this era. They are also convinced in the way that information communication technology (ICT) and digital literacy have wonderful careers in the days to come. From the interview, the students said that with the knowledge of digital literacy, they can easily read and write everything in and around the world, as IT has changed the whole world into a global village. From the interview, it is also known that with the knowledge of digital literacy, the students can be updated about what is happening throughout.

The respondents are now able to take presentation classes by themselves, when I met them the first time at DMC, they even felt shy to present themselves in front of the class. Now the students can create their groups on social media, they can now easily find the solution to problems whenever some tasks are given to them.

They have developed their personal as well as professional career. The students can do basic computer courses as well as advanced courses very comfortably without any problem. Moreover, now they are being able to access different AI tools like of ChatGpt, Caffe, Kers, OpenNN etc. from where they can get lots of information. Starting from zero level from being not able to open the computer, to being able to access new AI tools, this has been a student's huge achievement. As a researcher, I feel proud to be a part of students' achievements. It is also observed that digital literacy impacts curricular goals and the lack of digital literacy hampers classroom activities.

To facilitate the learning of C programming, it is important to develop a module that enhances students' basic skills. This module should be designed to align with the new knowledge they are going to learn. By implementing such a module, students can easily grasp and learn C programming concepts, as it builds upon their existing knowledge and provides practical exercises and support.

Discussion

The students; BA 1, and BA 2, after rigorous interaction, were successful to log in and register. Sending mail, using Teams software, was easy for them. They learnt to search materials on websites. It took almost one month for them to be familiar with the ICTs application in education. This action research did not increase students' enthusiasm for learning using ICTs, but it encouraged me for teaching. ICT is very important because it could enhance all of the curricular goals and active participation of students. The results of this study imparted the point that the level of enthusiasm of students for learning can be increased by integrating ICTs. The lack of ICTs certainly hampers the curricular goals as the curricula is set keeping digital skills in context. The students were motivated after I called them to come separately as well as in a group. They were interested as they were alert that ICT was necessary for life. The problem was they did not have a sufficient level of digital gadgets. After I came into contact with them, I supported those needy students by giving lessons and instructions. Both theoretically and practically They were motivated to get knowledge in curriculum using ICTs.

Based on the results, prior knowledge plays a vital role in learning new things, as emphasized by Vygotsky (1978). Additionally, knowledge anchoring, as mentioned by Ausubel (1968), is essential for acquiring new knowledge. When it comes to learning C programming, students need to be mature not only in terms of age but also in terms of their basic IT knowledge. Without a solid foundation in IT basics, learning C programming becomes challenging due to the immaturity of their knowledge level, as highlighted by Mayer (2004).

To address this issue, additional classes using a module can be implemented to improve student's learning states. These classes would focus on enhancing their basic IT knowledge and provide the necessary foundation for learning C programming. By strengthening their prior knowledge, students can overcome the difficulties associated with immaturity and better comprehend the concepts and principles of C programming.

Conclusion

The findings of the study indicate the need to improve students' digital literacy skills and provide training opportunities to enhance their understanding and usage of ICTs. The study results revealed that a majority of students had moderate to low levels of digital literacy and faced challenges with basic computer applications. Additionally, their limited exposure to digital devices and lack of familiarity with terms and minor digital knowledge hindered their

learning process, particularly when it came to learning C programming. The implementation of a module to enhance students' basic skills and align them with the new knowledge of C programming proved to be effective in improving their learning states. The module facilitated their familiarity with ICTs, including browsing, logins, registrations, and email usage.

The students demonstrated progress in their ability to access computers, browse the internet, and even engage in programming languages, both offline and online. This progress in digital literacy positively impacted their confidence, presentation skills, and ability to solve problems. By addressing students' digital literacy needs and providing them with the necessary foundation, such as through the implementation of a module, educators can overcome the difficulties associated with students' lack of prior knowledge and facilitate their learning journey in areas like C programming.

Declarations

Ethics Approval and Consent to Participate

I declare that this research/review was conducted ethically

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