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Digital Competencies And Educational Technology Integration: A Study Of Computer Literacy Among Secondary School Students In Shillong

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Abstract: *This* study examined computer literacy levels and educational technology integration among secondary school students in Shillong, India. Digital literacy has emerged as a fundamental competency in contemporary education, yet significant gaps remain in our understanding of student competencies in regional contexts. Using a descriptive research design, data were collected from 80 students across different educational institutions through structured questionnaires and semi-structured interviews. The findings reveal both achievements and critical challenges in computer education. While students demonstrated strong proficiency in Microsoft Office applications (90%) and basic hardware operations (70%), significant infrastructure limitations emerged as a major barrier to effective technology integration. Most concerning was the finding that only 12% of students had access to internet-connected computers at their schools, despite 78% using the Internet for educational purposes at home. This digital divide highlights substantial inequities in educational opportunities and poses challenges for implementing the objectives of India's National Education Policy 2020, particularly in terms of digital literacy. The results contribute to understanding digital competency development in educational settings and provide empirical evidence for technology integration policies in secondary education, particularly in the context of bridging digital divides in developing nations.

Keywords: Digital Literacy, Computer Education, Secondary Education, Technology Integration, Educational Technology.

1.1 Introduction

The digital revolution has fundamentally transformed educational paradigms, making digital competency as essential as traditional literacy skills. Computer literacy now serves as a cornerstone for academic success and future career prospects (Hargittai, 2010). The European Computer Driving Licence Foundation (2014) defines computer literacy as "the ability to use computers and related technology efficiently with a range of skills covering levels from elementary use to programming and advanced problem-solving."

The integration of information and communication technology (ICT) in educational settings has evolved from a luxury to a necessity, particularly in developing nations striving to bridge the digital divide (Warschauer, 2003). The COVID-19 pandemic has further underscored this critical importance, as educational institutions worldwide have rapidly transitioned to online and hybrid learning models (Mishra et al., 2020).

In the Indian educational context, the National Education Policy 2020 explicitly mandates that "all students will be provided with digital literacy". It emphasizes the use of educational technology to improve learning outcomes and reduce inequalities (Ministry of Education, 2020, pp. 43-44). However, significant disparities exist between urban and rural areas, as well as between different socioeconomic groups, creating what researchers term the "digital divide" (Ragnedda, 2017).

2.1 Literature Review

Research on computer literacy in educational settings has grown substantially over the past two decades. This review examines key studies that have shaped our understanding of computer literacy among secondary school students, with a particular focus on factors influencing the development of digital competency.

Early investigations focused primarily on basic technical skills and programming competencies. Hoffman and Blake (2003) examined the relationship between computer experience and computer literacy among college students, revealing that exposure alone did not guarantee proficiency, highlighting the importance of structured learning environments.

Gender differences in computer literacy have been extensively studied, with mixed findings across different contexts. Kubiatko (2007) examined information and computer literacy among high school students, finding statistically significant gender differences favouring boys only in internet usage, while general computer use showed no significant gender differences. Tondeur et al. (2008) investigated factors influencing computer literacy among elementary and secondary school students in Belgium, revealing that socioeconomic status, parental education levels, and home computer access significantly influenced students' digital competencies.

The relationship between computer literacy and academic achievement has received considerable attention. Papanastasiou and Ferdig (2006) conducted a large-scale study examining computer use and mathematics achievement among 15-year-old students across multiple countries. The study found that computer use for

educational purposes was positively associated with mathematics performance, whereas recreational computer use showed negative correlations. Lei and Zhao (2007) found that the quality of technology integration, rather than the quantity of use, was the primary determinant of educational benefits.

The digital divide remains a significant barrier to the effective implementation of educational technology. Warschauer (2003) examined global perspectives on technology access and digital inclusion, identifying infrastructure limitations, economic barriers, and cultural factors as primary obstacles to digital inclusion. Hohlfeld et al. (2008) investigated the second-level digital divide, focusing on differences in the quality of technology use rather than mere access, and revealed that significant disparities existed in the types of activities and learning opportunities available, even among students who had access to computers.

Social and cultural factors have gained increasing attention in computer literacy research. Wighting (2003) explored the effects of computer use on high school students' sense of community, revealing that classroom computer use had a positive impact on students' sense of learning within a community environment.

Despite extensive research, several gaps remain in the literature. Limited research has been conducted specifically on computer literacy among secondary school students in Northeast India, where unique cultural, linguistic, and socioeconomic factors may influence technology adoption patterns. Additionally, most existing studies have focused on developed nations or major urban centres. The current study addresses these gaps by examining computer literacy among secondary school students in Shillong, providing insights into regional variations in digital competency development.

3.1 Statement of the Problem

This study aimed to assess computer literacy levels among secondary school students and evaluate the effectiveness of computer education programs in Shillong, India. The research addressed the need for empirical data on digital competencies in the regional educational context, particularly given the increasing emphasis on technology integration in Indian education policies.

4.1 Research Objectives

1. To determine computer literacy levels among secondary school students in Shillong
2. To examine the effectiveness of computer education on secondary school students
3. To identify factors influencing computer literacy development in the regional educational context
4. To provide recommendations for improving computer education programs

5.1 Research Design

This study employed a descriptive research design with a mixed-methods approach to comprehensively examine computer literacy among secondary school students.

5.1.1 Sampling

The sample consisted of 80 students from Classes IX and X, selected using a purposive sampling technique. This approach ensured representation from different educational institutions while focusing on students at critical transition points in their secondary education.

5.1.2 Data Collection Tools

A self-constructed questionnaire was developed based on established computer literacy frameworks and validated through expert review. The questionnaire consisted of 25 items that covered various aspects of computer literacy, including hardware knowledge, software proficiency, internet usage, and attitudes toward technology.

A semi-structured interview schedule was developed to gather qualitative insights into students' experiences with computer education, challenges faced, and suggestions for improvement. This qualitative component provided a deeper understanding of the quantitative findings.

5.1.3 Ethical Considerations

The study followed comprehensive ethical protocols, including obtaining institutional approval from school authorities, securing informed consent, maintaining strict participant anonymity and confidentiality, and ensuring participants' right to withdraw at any time.

6.1 Data Analysis

Quantitative data were analyzed using descriptive statistics, including frequencies and percentages. Qualitative data from the interviews were analyzed using a thematic analysis approach, where themes were identified through the systematic coding and categorization of responses.

The analysis presents both quantitative findings from the questionnaire and qualitative insights from interviews, providing a comprehensive understanding of computer literacy levels and the effectiveness of educational technology.

7.1 Computer Literacy Assessment Results

7.1.1 Overview of Competency Levels

The comprehensive assessment revealed a complex picture of computer literacy among secondary school students in Shillong. Table 1 presents the detailed breakdown of competency levels across thirteen key areas of computer literacy.

Table 1: Computer Literacy Competencies Among Secondary School Students (N = 80)

Sl no	Computer Literacy Competency	Proficient N (%)	Not Proficient N (%)
1	Understanding basic computer hardware operations	56 (70%)	24 (30%)
2	Proficiency in keyboard shortcuts	64 (80%)	16 (20%)
3	Email account ownership and management	45 (56%)	35 (44%)
4	Internet access at home	44 (55%)	36 (45%)
5	Internet-connected computer access at school	10 (12%)	70 (88%)
6	Ease of learning from computer screens	62 (77%)	18 (23%)
7	Word processing skills (Microsoft Word)	72 (90%)	8 (10%)
8	Presentation creation (Microsoft PowerPoint)	72 (90%)	8 (10%)
9	Perceived benefits of computers for learning	65 (81%)	15 (19%)
10	Internet use for educational purposes	62 (78%)	18 (22%)
11	File management and navigation skills	48 (60%)	32 (40%)
12	Basic troubleshooting abilities	28 (35%)	52 (65%)
13	Understanding of Internet safety principles	52 (65%)	28 (35%)

8.1 Analysis and Interpretation of Findings

8.1.1 Technical Competencies: Hardware and Software Skills

Hardware Knowledge and Operations

The assessment revealed that 70% of students demonstrated proficiency in understanding basic computer hardware operations, including identification of components such as CPU, monitor, keyboard, and mouse. This foundational knowledge provides a solid base for further technical skill development. However, upon closer examination of technical understanding, significant gaps emerged. Only 35% of students demonstrated basic troubleshooting abilities when encountering computer issues, indicating a substantial disconnect between operational knowledge and problem-solving capabilities.

Qualitative insights from student interviews revealed that hardware knowledge was primarily derived from practical experience rather than systematic instruction. As one student explained, "I know what each part

does because I use the computer, but I do not understand how it works inside." This observation highlights the need for more comprehensive technical education that goes beyond surface-level familiarity.

Software Proficiency Patterns

Moving from hardware to software competencies, the findings revealed notably stronger performance. An impressive 90% of students demonstrated proficiency in Microsoft Office applications, particularly Word and PowerPoint. This high level of competency reflects the emphasis placed on these applications in current computer education curricula and represents a significant achievement in basic productivity software skills.

However, this strength in basic productivity applications contrasted sharply with limited exposure to other software categories. Only 25% of students had experience with spreadsheet applications (such as Excel) despite their importance in data analysis and mathematical applications. Even more concerning, fewer than 15% had used any programming software or advanced applications beyond basic productivity tools, suggesting a narrow focus on current computer education approaches.

Students reported regular use of Word and PowerPoint for academic assignments and presentations, with one student noting, "We use Word for almost every assignment now, and PowerPoint for presentations in different subjects." This integration across subjects demonstrates the practical value of these skills while highlighting the potential for expanding software literacy to other essential applications.

8.1.2 Digital Access and Usage Patterns

Internet Connectivity and Educational Use

The analysis of internet usage patterns revealed both promising engagement and concerning disparities. While 78% of students used the Internet for educational purposes, this high percentage masked significant variations in the quality and depth of Internet-based learning activities. Students primarily used the Internet to gather basic information and conduct research, with limited engagement in collaborative online learning and content creation activities.

The educational internet usage patterns showed that students were most comfortable with search engines and educational websites but rarely engaged with more sophisticated online tools. As one student described, "I mostly use Google to find information for projects, but I do not know about other ways to learn online." This suggests that while students have developed basic internet navigation skills, they may not be fully utilizing the educational potential of digital resources.

Home Versus School Access Patterns

A critical finding emerged when comparing patterns of home and school internet access. While 55% of students had internet access at home, enabling them to engage in educational activities outside school hours, this created a bifurcated learning environment where students' digital experiences were largely dependent on home resources rather than school-provided infrastructure.

This access pattern has created what might be termed a "homework digital divide," where students with home internet access can complete assignments and engage in online learning more effectively than their peers who rely solely on school resources. The implications of this disparity extend beyond immediate academic performance to long-term digital skill development and educational equity.

The apparent discrepancy between educational internet use (78%) and home internet access (55%) is explained by students utilizing multiple access points for their educational needs. While only 44 students (55%) have home internet connections, the data reveals a complex pattern of internet access: 52 students (65%) use mobile data/smartphones, 28 students (35%) access internet cafes, 18 students (23%) use friends' or relatives' homes, 15 students (19%) rely on community centers or libraries, and 10 students (12%) utilize school internet when available. The 78% who use internet for educational purposes typically access it through various combinations of these sources, with most students relying on mobile data as their primary means of connectivity. Qualitative interviews revealed that students strategically combine multiple access points depending on availability and affordability, demonstrating their resourcefulness in overcoming connectivity barriers to support their educational activities.

8.1.3 Infrastructure and Equity Challenges

School Infrastructure Limitations

The most significant and concerning finding was the severe limitation in school-based internet connectivity. Only 12% of students had access to internet-connected computers at their schools, representing a critical infrastructure gap that fundamentally limits the effectiveness of computer education programs. This finding stands in stark contrast to the 78% of students who use the Internet for educational purposes at home, highlighting a fundamental disconnect between educational policy aspirations and institutional reality.

The infrastructure limitation extends beyond mere connectivity to encompass the quality and reliability of available technology. Interviews with students revealed frequent frustration with outdated equipment and unreliable connections when available. One student commented, "We learn about the internet in theory, but we cannot practice much because there is no connection in our computer lab, and when there is, it is prolonged."

This infrastructure gap creates multiple pedagogical challenges. Teachers are often forced to provide theoretical instruction on internet-based activities without opportunities for hands-on practice, which limits the effectiveness of digital literacy education. Furthermore, students who lack home internet access are particularly disadvantaged, as they have minimal opportunities to develop practical internet skills.

Equity Implications and Access Disparities

The infrastructure limitations intersect with socioeconomic factors to create compounding equity challenges. Students from higher-income families, who are more likely to have home internet access and updated devices, gain additional advantages in digital skill development. This creates a self-reinforcing

cycle where initial advantages in access lead to enhanced competencies, which in turn provide further educational and eventual economic advantages.

The equity implications extend to rural versus urban distinctions within the study region. Students from more urban areas of Shillong demonstrated slightly higher overall competency levels, suggesting that even within a relatively small geographic area, location-based disparities in infrastructure and access create meaningful differences in educational outcomes.

9.1 Discussion

The findings of this study provide valuable insights into the current state of computer literacy among secondary school students in Shillong. The results reveal both achievements and challenges in the integration of educational technology, contributing to a broader understanding of digital competency development in regional educational contexts.

The finding that 70% of students demonstrated proficiency in basic computer hardware operations aligns with research by Tondeur et al. (2008), who found similar levels of basic technical knowledge among secondary school students in developed nations. However, the current study reveals a significant gap in advanced technical skills, with only 35% demonstrating basic troubleshooting abilities.

The high level of Microsoft Office proficiency (90%) observed in this study exceeds findings from similar research in developing nations. Papanastasiou and Ferdig (2006) reported lower levels of productivity software competency among students in comparable contexts, suggesting that the regional emphasis on these applications in Shillong's educational institutions has been relatively successful.

Digital Divide in Educational Settings

The stark contrast between home internet access (55%) and school-based internet connectivity (12%) exemplifies the digital divide identified in research by Warschauer (2003) and Hohlfeld et al. (2008). This infrastructure gap creates significant inequities in educational opportunities, with students from higher socioeconomic backgrounds having access to richer learning experiences through home technology resources.

This finding is particularly concerning in light of the NEP 2020's mandate for equitable access to technology. Current infrastructure development efforts appear insufficient to meet policy objectives, indicating that targeted policy interventions focusing on infrastructure development are essential for enhancing educational outcomes.

Pedagogical Implications and NEP 2020 Alignment

The finding that 77% of students found computer-based learning easier than traditional methods supports research by Prensky (2001) on the learning preferences of digital natives. However, the limited depth of

technical knowledge suggests that current pedagogical approaches may not fully capitalize on students' natural affinity for digital technologies.

The predominant focus on basic productivity applications, while providing foundational skills, may not adequately prepare students for the diverse technological competencies required in contemporary contexts. This observation contradicts the NEP 2020's vision for integrating coding and computational thinking across all educational levels.

10.1 Limitations and Future Research

Several limitations should be considered when interpreting these findings. The purposive sampling technique, while appropriate for the study's objectives, may limit generalizability to other regional contexts. Additionally, the cross-sectional design provides a snapshot of current competency levels but cannot address the dynamic nature of technology skills development.

Future research should consider employing longitudinal designs to track the development of computer literacy over time and examine the long-term effects of educational technology interventions. Comparative studies across different regions and educational systems can provide valuable insights into the factors influencing the success of computer education programs.

11.1 Recommendations

Based on the study's findings, the following recommendations are proposed for improving computer literacy education and technology integration in secondary schools:

1. Establish reliable internet connections in computer laboratories and classrooms to enable meaningful technology integration and provide equitable access to online resources.
2. Implement regular updating of computer hardware and software to ensure students have access to current technology and can develop relevant skills for contemporary digital environments.
3. Create dedicated technical support systems for schools to maintain equipment and provide troubleshooting assistance, enabling teachers to focus on pedagogical activities.
4. Emphasize practical, project-based learning activities to help students develop a deeper technical understanding and enhance their problem-solving abilities.
5. Integrate computer skills across various subject areas, rather than confining them to dedicated computer classes, to promote the authentic application of digital competencies.
6. Implement comprehensive professional development programs to enhance teachers' technological competencies and pedagogical skills for effective technology integration.
7. Establish regular workshops, mentoring programs, and peer collaboration opportunities to help teachers stay current with technological developments and best practices.

8. Develop specific strategies to implement the National Education Policy 2020's mandates for digital literacy, including computational thinking integration and equitable technology access across all educational institutions.
9. Ensure equitable computer education opportunities between urban and rural schools in the region, reflecting the emphasis of NEP 2020 on bridging educational gaps.
10. Implement regular assessment of computer literacy levels and program effectiveness to identify areas for improvement and track progress toward NEP 2020 objectives.
11. Develop community education initiatives to help parents understand the importance of computer literacy and support their children's technological skill development.

These recommendations, if implemented systematically, could significantly enhance the effectiveness of computer literacy education and contribute to reducing digital disparities among secondary school students in the region.

12.1 Conclusion

The study's findings have significant implications for educational policy and practice, particularly in implementing the digital literacy objectives of NEP 2020. Infrastructure development, particularly improving school-based internet connectivity, emerges as a critical priority for enhancing the effectiveness of computer education and achieving equitable access to technology.

This study provides empirical evidence on the computer literacy levels of secondary school students in Shillong, revealing both strengths and areas for improvement in current educational technology integration efforts. While students demonstrate above-average proficiency in basic computer applications, significant gaps exist in advanced technical knowledge and equitable access to technology resources.

The high level of Microsoft Office proficiency demonstrates that focused educational interventions can successfully develop specific competencies. However, the limited school-based internet access and disparities related to socioeconomic factors highlight systemic challenges that require comprehensive policy responses rather than isolated educational interventions.

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