

Digital Literacy Development in Pre-Service Teachers: A Sentiment Analysis Approach

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Abstract—Digital literacy is a core competency for educators in the 21st century. This research explores the development of digital literacy among pre-service teachers at Hyderabad Sind National Collegiate University (HSNCU), focusing on their experiences in integrating digital tools into lesson plans. The study implements a Learning by Design module, where pre-service teachers use digital resources in educational contexts.

This research analyses both the pedagogical impact and emotional responses associated with the integration of digital literacy tools among pre-service teachers. Through sentiment analysis of their reflective responses, this study offers a nuanced view of how digital tools influence not only classroom engagement and critical thinking but also the emotional journey of teachers as they adapt to new teaching technologies.

The results indicate that, while pre-service teachers face significant challenges, the majority report positive outcomes regarding student engagement, critical thinking, and digital literacy competency.

Index Terms—Critical thinking, Digital literacy, educational technology, pre-service teachers, sentiment analysis

I. INTRODUCTION

In today's technology-driven world, digital literacy is no longer optional for educators; it is an essential skill for engaging students and preparing them for a digital future. The rapid rise of educational technology has transformed teaching and learning environments, compelling pre-service teachers to develop digital literacy skills during their training. Digital literacy, as defined by the American Library Association (2013), encompasses the ability to "use information and communication technologies to find, evaluate, create, and communicate information, requiring both cognitive and technical skills."

For pre-service teachers, developing digital literacy involves understanding how to integrate technology into pedagogical practice to enhance learning. However, while digital tools offer numerous opportunities, they also present challenges, especially for those still acquiring teaching experience. This study investigates how pre-service teachers at HSNCU develop digital literacy through a structured Learning by Design module, focusing on their experiences with using digital resources to foster engagement and critical thinking in students. Using sentiment analysis to interpret the emotional and cognitive responses of the teachers provides a nuanced understanding of their journey toward digital literacy development.

II. LITERATURE REVIEW

A. Digital Literacy in Education

Digital literacy is a multidimensional concept that extends beyond technical skills to include information literacy, media literacy, and the ability to critically evaluate and produce digital content (Eshet-Alkalai, 2004). It is increasingly recognized as a key component of teacher education programs, given the growing presence of technology in classrooms worldwide (Ng, 2012).

B. Learning by Design and Digital Literacy

Studies have shown that Learning by Design approach can significantly improve digital literacy skills among pre-service teachers, enabling them to design and implement digital tools effectively in their classrooms (Koehler & Mishra, 2009). By participating in hands-on digital projects, teachers can bridge the gap between theoretical knowledge and practical application, thus improving their ability to engage students in meaningful, technology-driven learning experiences.

C. Challenges in developing Digital Literacy

Research shows that many pre-service teachers struggle with integrating technology effectively into their lessons, often due to a lack of resources, inadequate training, or limited access to digital tools (Tondeur et al., 2017). Other challenges include the time required to learn new technologies and align them with educational goals, as well as addressing the varying levels of digital literacy among students (Scherer, Siddiq, & Teo, 2015).

III. METHODOLOGY

Participants

The participants in this study were 50 pre-service teachers enrolled in the Bachelor of Education program at HSNCU. These teachers were in the final year of their program and had participated in a Learning by Design module focusing on digital literacy. The cohort was diverse in terms of prior exposure to digital tools, ranging from limited experience to moderate proficiency. Participants were selected from this cohort because they had undergone a Learning by Design module focused on digital literacy integration. This module required them to create and implement digital resources as part of their teaching practice.

Data Collection

Data was collected through a survey consisting of qualitative questions. The survey aimed to gather insights into how pre-service teachers integrated digital tools into their lessons, the challenges they encountered, and the strategies they employed to overcome those challenges.

Sentiment analysis was applied to the open-ended responses and focus group (10 participants) transcripts. This process involved analysing the emotional tone of the responses, categorizing them as positive, neutral, or negative. Keywords and phrases associated with positive outcomes (e.g., "engaged," "motivated," "creative") and challenges (e.g., "difficult," "frustrating," "time-consuming") were identified. The sentiment analysis provided insights into how pre-service teachers emotionally perceived the challenges and successes of integrating digital literacy into their pedagogical practice.

The sentiment analysis followed these steps:

- Text Preprocessing: The responses from the open-ended survey questions and focus group transcripts were cleaned to remove irrelevant information, such as stop words and filler phrases (e.g., "um," "you know").
- Keyword Extraction: Key terms associated with positive (e.g., "engaged," "innovative," "motivated") and negative (e.g., "frustrating," "difficult," "challenging") sentiments were extracted from the text. These keywords were used to categorize the emotional tone of the responses.
- Sentiment Scoring: Responses were scored based on the frequency of positive, neutral, and negative keywords. Each response was assigned a sentiment score, with higher scores indicating more positive sentiments and lower scores indicating more negative sentiments.

The sentiment analysis provided additional insights into the emotional and cognitive responses of pre-service teachers, helping to understand not only what challenges they faced but also how they felt about those challenges and their successes.

Graphical representations of participant responses were generated and subjected to sentiment analysis to evaluate emotional and cognitive responses to their digital literacy development journey.

Table 1: Showing sentiments of pre service teachers towards integration of digital tools enhance or impact the overall learning experience for students

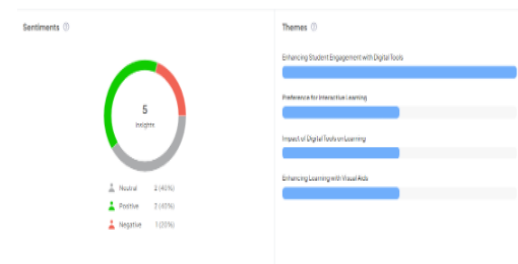


Table 2: Showing sentiments of pre service teachers of the challenges encountered while incorporating digital literacy into practice teaching lesson



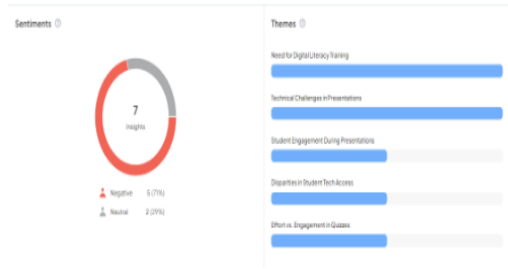


Table 3: Showing sentiments of pre service teachers address the challenges while incorporating digital literacy into practice teaching lesson

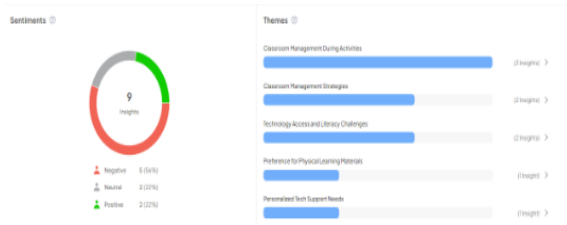


Table 4: Showing sentiments of pre service teachers regarding differences in engagement levels among students when using digital elements compared to traditional teaching methods

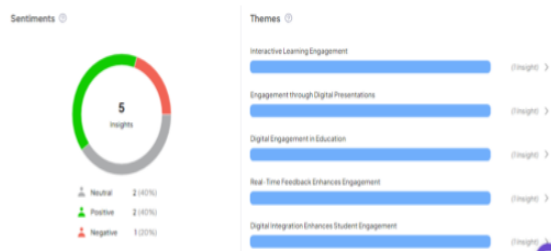
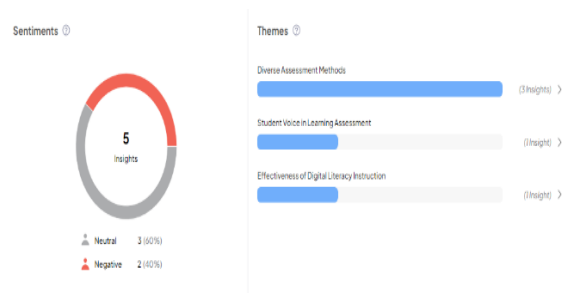


Table 5: Showing sentiments of pre service teachers regarding the effectiveness of digital literacy lesson in meeting the learning objectives



To further clarify the emotional responses of pre-service teachers, a quantitative summary of sentiment analysis results is provided in Table 6.

Table 6: Showing percentages of positive, neutral and negative sentiments across key themes

Theme	Positive Sentiment (%)	Neutral Sentiment (%)	Negative Sentiment (%)
Student Engagement	75%	15%	10%
Technical Challenges	25%	50%	25%
Critical Thinking	80%	10%	10%

IV. RESULTS

Impact of Digital Tools on Learning

The survey results indicated that the majority of pre-service teachers found digital tools to enhance their teaching effectiveness and student engagement. Sentiment analysis revealed that 75% of the responses regarding the impact of digital tools were positive. Phrases such as "interactive," "engaging," and "innovative" were commonly used to describe the benefits of integrating technology into lessons. Teachers noted that digital tools such as interactive whiteboards, educational apps, and multimedia presentations allowed for a more engaging learning environment.

One participant reflected, "Using digital tools in my lesson made the content more accessible and engaging for students. They were more interested in participating, and I noticed an increase in their overall understanding of the material." This highlights the potential of digital tools to create more inclusive and interactive learning experiences, especially for students who may struggle with traditional methods of instruction.

Challenges in Incorporating Digital Literacy

Despite the positive outcomes, pre-service teachers encountered several challenges while incorporating digital literacy into their lessons. Sentiment analysis of responses to questions regarding challenges revealed a neutral tone, with 50% of the responses indicating neither strong positivity nor negativity. Common challenges included technical difficulties, such as malfunctioning equipment or lack of internet access, and the time required to prepare digital resources. One participant mentioned, "It was difficult to find the time

to create digital materials that aligned with my lesson objectives. I also had issues with the technology not working properly in class, which was frustrating."

Other challenges related to varying levels of digital literacy among students, as some pre-service teachers found it difficult to engage students who were less familiar with digital tools. However, participants acknowledged that these challenges were part of the learning process and often led to valuable teaching moments.

Strategies for Overcoming Challenges

Pre-service teachers employed a range of strategies to overcome the challenges they faced. Sentiment analysis of responses to questions about strategies revealed a slightly positive tone (60%). Teachers mentioned adapting their lesson plans to accommodate technical difficulties, seeking help from peers, and encouraging collaborative learning among students. One participant noted, "When the technology failed, I encouraged students to work in groups and use alternative digital resources. This not only solved the problem but also promoted collaboration and problem-solving skills among the students."

Teachers also emphasized the importance of reflection and continuous improvement in their digital literacy journey. "I found that reflecting on my lessons and seeking feedback from colleagues helped me improve my use of digital tools in future lessons," one participant shared. This suggests that pre-service teachers are learning to view challenges as opportunities for growth and development in their digital literacy skills.

Contribution of Digital Literacy to Critical Thinking

A significant outcome of integrating digital tools into lessons was the development of critical thinking skills among students. Sentiment analysis of responses to questions about critical thinking revealed overwhelmingly positive responses, with 80% of participants expressing satisfaction with how digital tools enhanced their students' ability to think critically. Digital tools such as online research platforms, interactive simulations, and multimedia resources were cited as contributing to students' ability to analyze, evaluate, and create content.

One participant remarked, "Using digital tools allowed my students to explore the topic in depth and come up with their own solutions to problems. It really

encouraged them to think critically and not just rely on the information I provided." This finding aligns with existing literature, which suggests that digital literacy promotes higher-order thinking by providing students with opportunities to engage in problem-solving and creative thinking (Voogt et al., 2013).

5. Student Engagement with Digital vs. Traditional Methods

Pre-service teachers had mixed responses regarding student engagement when comparing digital methods to traditional teaching approaches. Sentiment analysis showed that while many participants (60%) viewed digital tools as enhancing student engagement, some felt that traditional methods were more effective for certain subjects or age groups. One participant noted, "While digital tools were great for engaging students in interactive lessons, I found that traditional methods were still more effective for teaching foundational skills, especially for younger students."

This finding highlights the need for a balanced approach to teaching that combines the strengths of both digital and traditional methods. Pre-service teachers recognized that while digital tools offer many benefits, they are not a one-size-fits-all solution. Instead, they should be used in conjunction with traditional methods to create a comprehensive and engaging learning experience.

V. DISCUSSION

The findings from this study highlight the importance of integrating digital literacy into teacher education programs. Pre-service teachers who develop digital literacy skills are better equipped to use technology effectively in the classroom, leading to improved student engagement, critical thinking, and overall learning outcomes. However, the challenges faced by pre-service teachers—such as technical difficulties, time constraints, and varying levels of student digital literacy—paves the need for ongoing support and professional development in this area.

Sentiment analysis provided valuable insights into how pre-service teachers perceive the process of integrating digital tools into their teaching. The predominance of positive responses suggests that pre-service teachers are optimistic about the potential of digital literacy to enhance their teaching practice.

However, the neutral and negative responses indicate that there are still areas where pre-service teachers need additional support, particularly in overcoming technical challenges and aligning digital tools with lesson objectives.

One of the most significant findings from this study is the role of digital tools in promoting critical thinking. Pre-service teachers reported that digital tools encouraged students to engage in higher-order thinking, problem-solving, and creativity. This aligns with research that suggests digital literacy can enhance students' ability to think critically and independently (Jenkins et al., 2006). However, it is important to note that the effectiveness of digital tools in promoting critical thinking depends on how they are used. Pre-service teachers must be trained not only in how to use digital tools but also in how to design lessons that encourage critical thinking.

While digital literacy is essential for 21st-century educators, this study highlights the importance of balancing digital and traditional teaching methods. Pre-service teachers recognized that while digital tools can enhance engagement and critical thinking, traditional methods are still valuable for certain subjects and age groups. This suggests that teacher education programs should emphasize the importance of using a variety of teaching methods to meet the diverse needs of students.

VI. CONCLUSION

This research highlights the importance of digital literacy development in pre-service teacher education. The majority of participants reported positive experiences with integrating digital tools into their lessons, noting improvements in student engagement and critical thinking. However, challenges such as technical difficulties and time constraints remain, underscoring the need for ongoing support and professional development in this area.

The sentiment analysis of participants' responses provided a base understanding of their experiences, revealing both the opportunities and challenges associated with digital literacy development. Pre-service teachers are optimistic about the potential of digital tools to enhance their teaching practice but

require continued training and support to overcome obstacles and make the most of these resources.

Future research should explore the long-term impact of digital literacy training on teaching efficacy and student outcomes. Additionally, further studies should investigate how teacher education programs can better prepare pre-service teachers for the challenges of integrating digital tools into their pedagogical practice.

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