

Digital Literacy and Student Engagement as Factors of Flexible Thinking in Learning

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Abstract. The rapid integration of digital technologies in education demands that students develop both digital literacy and active engagement to navigate complex learning environments, yet the combined influence of these factors on flexible thinking remains underexplored among students in Davao City. This study aimed to determine the combined influence of digital literacy and student engagement on flexible thinking in learning among students in Davao City. Using a quantitative, non-experimental descriptive–correlational research design, the study assessed the levels of students’ digital literacy, student engagement, and flexible thinking, as well as the relationships among these variables. Using Slovin’s formula at a 5% margin of error, a sample size of 184 was drawn from the total population of 338. Data were gathered through validated survey questionnaires and analyzed using appropriate statistical tools, including the mean, standard deviation, regression analysis, and Pearson’s Product Moment Correlation Coefficient (Pearson’s r) to determine significant relationships and predictive influence, and Multiple Linear Regression. Findings revealed that students generally demonstrated moderate to high levels of digital literacy, engagement, and flexible thinking in learning, with significant relationships identified between digital literacy and flexible thinking in learning, as well as between student engagement and flexible thinking in learning. Moreover, digital literacy and student engagement were found to significantly predict students’ flexible thinking in learning. The results underscore the importance of strengthening digital competencies and active engagement strategies to foster flexible, adaptive thinking among learners. The study offers valuable implications for educators and school administrators in designing instructional practices that support meaningful learning in digital contexts.

Introduction

Flexible thinking plays a vital role in helping learners adjust to evolving academic demands, particularly in post-pandemic education (Shah, 2025). However, many students struggle to develop cognitive flexibility due to rigid teaching methods, standardized curricula, and limited opportunities for open-ended problem-solving, which, in turn, reduces their engagement and motivation (Han, 2021). Getenet et al. (2024) highlighted that students’ digital literacy and attitudes play a crucial role in shaping their self-efficacy, which, in turn, affects various aspects of their engagement. Similarly, Palvia et al. (2020) noted that the global expansion of online learning necessitates that learners be adaptable and resilient when navigating complex digital landscapes. Earlier studies examined its relationship with student engagement and time management, but did not specifically investigate its effect on actual study hours (Tseng et al., 2023).

A study from Union College of Laguna revealed disparities in digital literacy among Grade 11 students, especially in flexible learning environments. Students with limited access to devices and internet connectivity showed lower engagement and adaptability in learning tasks (PHINMA – Union College of Laguna, 2025). According to Karakuş et al. (2020), the use of digital technology affects creative thinking. A study by Kasici (2022) found that digital literacy has a direct positive effect on the creative thinking disposition, including flexible thinking. Indonesia’s competency curriculum increasingly uses digital technology to support learning that is more oriented to the needs of the time (Wafiroh et al., 2020). A study at Kolehiyo ng Pantukan found that students’ attitudes toward online learning were closely tied to their digital literacy levels.

The lack of consistent training and exposure to digital tools limited their ability to adapt and think critically in online settings (Melendres et al., 2023).

Union College of Laguna's study assessed digital literacy and engagement in flexible learning but did not examine cognitive outcomes like flexible thinking. The Kolehiyo ng Pantukan study explored attitudes toward online learning and digital literacy but did not connect them to higher-order thinking skills such as adaptability or problem-solving. The more students are engaged and empowered within their learning community, the more likely they are to channel that energy back into their learning, leading to a range of short and long-term outcomes that can likewise further fuel engagement (Bond et al., 2020). It emphasizes the empowering role of out-of-school digital education, noting that technology-rich environments enable learners to access knowledge anytime and anywhere. This perspective aligns with the concept of flexible thinking, as students who use digital tools beyond traditional classrooms develop autonomy, adaptability, and lifelong learning skills (Pustaka, 2025). However, this optimistic view is challenged by a 2021 Western Governors University survey, which revealed that 20 percent of students struggled to use educational technologies in online courses, highlighting how digital literacy gaps can limit flexibility.

Moreover, Getenet et al. (2024) proposed a model connecting these elements to self-efficacy and learning outcomes, but did not fully examine their combined effect on cognitive flexibility. Likewise, Harry (2025) found that digital literacy can enhance engagement in hybrid learning, though its joint influence on flexible thinking was not clearly identified. Digital literacy and student engagement align with SDG 4 (Quality Education), where students use technology wisely and actively engage in learning, fostering flexible thinking that enables them to adapt, reflect, and solve problems in new ways (Demir, 2025). This highlights the need for deeper research into how digital literacy and engagement work together to enhance adaptability. As education continues to evolve in the post-pandemic era, clarifying this relationship is essential for building inclusive, responsive, and future-ready learning systems.

Methodology

Research Design

The study employed a descriptive-predictive design assessing digital literacy and student engagement as factors influencing flexible thinking in learning among students. A descriptive research design is used to assess students' digital literacy, student engagement, and flexible thinking in learning in Davao City. On the other hand, a correlational research design was conducted to determine the significant relationship between digital literacy and flexible thinking in learning in Davao City, the significant relationship between student engagement and flexible thinking in learning in Davao City, and the significant influence of digital literacy and student engagement as factors influencing flexible thinking in learning in Davao City.

Research Locale

The research study was conducted in a sectarian school located in Davao City, Philippines. It was founded in 1958 and collaborates with the Department of Education. The institution has the following departments, as recognized by the entities: Basic Education, Junior High School, Senior High School, and College. This is because it has modern, appropriate facilities and licensed general and technical teachers who help the institution achieve its goal of becoming a premier sectarian institution. This religious institution offered a variety of college-level courses, including Bachelor of Science degrees in Information Technology, Social Work, Hospitality Management, and Business Administration, as well as a Bachelor of Elementary and Secondary Education.

Population and Sample

The study's respondents were three hundred thirty-eight (338) education students in a private higher education institution in Davao City who were enrolled across all programs in the Academic year 2025-2026 and willing to participate. Students who did not meet the criteria, such as BSSW, BSHM, BSIT, and BSBA, were excluded. Moreover, the researchers used stratified random sampling to ensure fair representation of all population subgroups while maintaining randomness in respondent selection. Using Slovin's formula with a 5% margin of error, a sample of 184 was drawn from a total population of 338. This calculation ensured sufficient statistical power to analyze relationships among the variables. A random sampling method was employed to avoid bias and provide equal chances for all eligible students to be selected.

Research Instrument

Three adapted survey questionnaires were used as a research instrument in this study. The first part is a questionnaire on digital literacy, adapted from the study by Amin et al. (International Journal of Distance Education and E-Learning, 2021), which covers communication, copyright, critical thinking, character, curation, connectedness, creativity, and collaboration. The second part is the student engagement questionnaire, adapted from Reeve's (2013) study, which includes behavioral,

agentic, cognitive, and emotional engagement. The third part is the questionnaire on flexible thinking in learning, adapted from the study by Barak and Lavenberg (2016), which assesses learner technology acceptance, open-mindedness in learning, and adaptation to new learning situations. A five-point Likert scale (from 1 strongly disagree to 5 strongly agree) indicates the respondent's agreement or disagreement with each statement.

Data Gathering Procedure

To ensure this research was conducted systematically, the following procedures were implemented by the researchers: a letter was addressed to the Academic Head/Dean of the College School Department requesting permission to conduct the study. After the study was approved, the researchers adapted a questionnaire and submitted it to their adviser for review. Based on the adviser's feedback, revisions were made, and the updated version was presented to the evaluation panel for validation. Once validated, the questionnaires were distributed to selected education students in Davao City, with respondents given sufficient time to complete them. Finally, after the survey was completed, the researchers collected the completed questionnaires and checked them for completeness. The gathered data were organized, encoded, and prepared for statistical analysis to address the study's objectives.

Statistical Tool

To process the gathered data, the researchers employed several statistical tools. The mean was used to determine the level of digital literacy and student engagement in flexible thinking in learning among the students in Davao City. A standard deviation (or σ) measures how digital literacy and student engagement affect the students' flexible thinking in learning in Davao City. Regression Analysis was used to determine that digital literacy and student engagement significantly influenced the students' flexible thinking in learning in Davao City. Moreover, Pearson's Product-Moment Correlation Coefficient (r) was used to determine the significant relationship between digital literacy and student engagement towards flexible thinking in learning in Davao City. Lastly, Multiple Linear Regression was used to determine whether digital literacy and student engagement significantly influenced flexible thinking in learning in Davao City.

Results and Discussion

The Level of Digital Literacy

Presented in Table 1 is the level of Digital Literacy among college students. The results showed that Digital Literacy was high, as indicated by an overall mean of 4.12, suggesting that Digital Literacy in Davao has often been evident. The standard deviation of 0.49, which was less than 1.00 and indicated low variability, indicated that data points were closely clustered around the mean and showed a high level of consistency, suggesting that individuals in the area were well equipped with the skills and abilities needed to use the internet and technology effectively.

Indicator	SD	Mean	Descriptive Level
Citizenship	0.55	4.44	Very High
Copyright	0.66	4.28	Very High
Character	0.65	4.24	Very High
Curation	0.62	4.21	Very High
Collaboration	0.68	4.13	High
Communication	0.60	4.09	High
Critical Thinking	0.77	4.06	High
Connectedness	0.84	3.83	High
Creativity	0.88	3.74	High
Overall	0.49	4.12	High

Table 1. The Level of Digital Literacy of College Students

This aligns with the study by Bayrakci and Narmanlioğlu (2020), which introduced a Digital Literacy Scale to assess proficiency levels among university students. Their study revealed distinctions in how learners perform across fundamental operational tasks and more advanced evaluative skills. In line with the European Commission (2020), it reinforced this by framing digital competence as a multi-level construct essential for participation in modern society. Furthermore, as Hanafie and Halik (2021) noted, teachers were expected to integrate digital tools and foster digital environments in classrooms.

Febaliza and Oktariani (2020) emphasized that many schools in countries such as Bangladesh, Kyrgyzstan, and Nepal—about 90%—and around 50% in Indonesia still lack ICT equipment and internet connectivity, underscoring the urgency of addressing digital access gaps. They argue that digital literacy is a mandatory competency in higher education and a key element in professional development. Similarly, Voda et al. (2022) highlighted that with the deep integration of digital technologies into everyday life, digital literacy provides transversal skills that enhance activities ranging from banking operations to civic participation. However, they also noted that these skills are diverse and continually evolving in response to technological advancements and societal changes, making digital literacy a dynamic capability that requires ongoing development.

The indicator for Digital Literacy, which received the highest mean rating of 4.44, was *Citizenship*, described as very high, with a standard deviation of 0.55 or less, indicating moderate variability. This implies that respondents demonstrate a high level of digital citizenship by actively and responsibly engaging in online spaces, and they are aware of their rights and responsibilities in digital environments. These findings support Isin and Ruppert's (2020) claim that individuals exercise rights and responsibilities through online activism, communication, and participation. This result also aligns with Choi (2020), who emphasized that digital citizenship requires skills such as critical thinking, ethical use of technology, and collaborative problem-solving, which directly support the development of flexible thinking in education.

Hoskins and Kerr (2020) emphasized that citizenship today requires not only civic knowledge but also the ability to address challenges and contribute to democracy critically. In education, this competency equips learners to act responsibly in diverse communities, especially in digital contexts where literacy and ethics are essential. Biesta (2020) added that citizenship education should foster agency and responsibility, enabling individuals to navigate complex realities and make meaningful contributions to collective well-being.

Copyright had a very high level in Table 1, with a mean of 4.28. Kenton (2022) defines copyright as the legal right of intellectual property owners to control reproduction of their work. When understood at a high level, copyright serves as a key indicator of digital literacy because it reflects awareness of ownership, attribution, and the ethical use of resources. Bacalja (2022) adds that embedding copyright literacy within critical digital frameworks fosters responsible digital citizenship and ensures ethical participation in online spaces. Darvin (2025) stresses that copyright literacy intersects with issues of power and access, shaping participation and equity in digital environments. Its role as a digital literacy marker is to promote ethical engagement and protect creative integrity, ensuring learners navigate technology-enhanced spaces responsibly and inclusively.

Character had also obtained a mean of 4.24 at very high levels. This implied that students had consistently demonstrated strong moral values and ethical behavior, even within digital environments. This finding supported Fleming's (2023) view of character as a guiding set of moral principles. It aligned with Alfiah et al. (2021) and Laksana (2021), who emphasized the need to strengthen character education amid the moral challenges posed by technological advancement. Furthermore, the result reinforces studies by Suardi et al. (2022), Dewi et al. (2021), and Surianti and Hadi (2022), indicating that well-developed digital literacy competencies help learners act ethically, responsibly, and morally, highlighting the importance of integrating character formation within digital literacy and educational practices.

Curation resulted in a mean of 4.21 at a very high level, indicating that students were capable of organizing, evaluating, and preserving meaningful digital content, supporting the University of Florida's (2025) emphasis on purposeful digital preservation. This finding aligned with Johnston et al. (2024), who had highlighted the growing relevance of digital curation practices in information-related fields, suggesting that students had actively applied these skills. Moreover, the result addressed concerns raised by Garstki (2022) about underutilized data due to low digital literacy, as students demonstrated the ability to manage and reuse digital information effectively. Finally, the strong curation skills observed supported Rod's (2023) assertion that collaborative, sustained partnerships are essential for long-term digital curation success, indicating that students were ready to participate in shared digital management practices.

Collaboration was also high, with a mean of 4.13, indicating that students actively engaged in sharing ideas, valuing diverse perspectives, and providing constructive feedback, supporting the collaborative learning processes described by Liu and Pásztor (2022). This finding suggested that learners had benefited from collaborative practices supported by teachers, families, and other stakeholders, aligning with Statti and Torres' (2020) emphasis on partnerships in strengthening digital literacy.

The result also supports Asmayawati's (2023) assertion that effective collaboration, when combined with appropriate use of technology and educator guidance, fosters supportive and enriching digital learning environments. However, consistent with the OECD (2020), the findings also imply the need to enhance further, deeper, more interactive forms of collaboration, such as reflective feedback and cross-class activities, to maximize the impact of collaborative digital learning.

A high level of *communication*, as an indicator of digital literacy, with a mean of 4.09, implied that individuals had not only been able to use digital tools but were also adept at navigating the complexities of meaning-making in online environments. This meant they had effectively managed challenges such as the absence of non-verbal cues, asynchronous exchanges, and the need to adapt to diverse communication platforms. Such proficiency reflected a deeper understanding of how digital communication had differed from traditional face-to-face interaction, aligning with Strauss et al. (2024). In this sense, strong communication skills demonstrated that digital literacy had extended beyond technical know-how to include the ability to sustain meaningful interactions in professional and personal contexts, as Kovaité et al. (2020) had emphasized.

Critical thinking was high, with a mean of 4.06. This implied that students had carefully analyzed information, recognized biases, and evaluated digital sources using consistent standards, thereby supporting effective decision-making in the learning process. This finding aligned with Ryan (2022) and Prakoso and Tae (2020), who had emphasized that critical thinking was essential for academic success and informed judgment.

The result reinforces the studies of Mosquete and Libago (2025) and Hauck (2025), suggesting that strong digital literacy—particularly in critical thinking—enhances learners' analytical, reflective, and ethical engagement with digital content, thereby supporting flexible and adaptive learning in technology-enhanced environments.

Connectedness was high, with a mean of 3.83, indicating that students experienced a strong sense of belonging, acceptance, and inclusion in their learning environment, consistent with Too et al.'s (2022) definition. This finding suggested that students were less likely to have felt isolated or disengaged, reinforcing Arslan's (2021) claim that connectedness had served as a protective factor, promoting better health and well-being.

Additionally, the result aligns with Ramella et al. (2023), indicating that strong connectedness enhances intrinsic motivation, which, in turn, positively influences academic performance and socio-emotional development. Consistent with Raniti et al. (2022), the high connectedness observed highlights the importance of supportive relationships and engagement in schools as a modifiable factor that can help safeguard students' mental health.

On the other hand, the indicator for Digital Literacy, which received the lowest mean rating of 3.74, was *Creativity* and was described as high, indicating that it often manifested. This suggests that while students are capable, their creative outputs may not yet reflect the depth of lived experiences or unique perspectives that digital creativity ideally captures.

This aligns with the study by Janse van Rensburg (2022), who emphasizes that assessment should not only measure technical skills but also analyze students' creative outputs and lived experiences. This gap suggests opportunities for educators to design learning experiences that prioritize creative exploration and personal expression, ensuring that digital literacy is not only about responsibility but also about innovation and cultural contribution.

The Level of Student Engagement

Presented in Table 2 is the level of Student Engagement of College Students. Overall results show that the level of Student Engagement is very high, as indicated by the obtained overall mean of 4.27, indicating that the Student Engagement in Davao City is always manifested, with a standard deviation of 0.50 to 1.00, indicating moderate variability, which implies that the data points showed spread from the mean and reflected balanced diversity with moderate differences across values. These findings support Alqurashi's (2022) claim that actively participating in learning activities is strongly associated with improved academic performance, as students who engage meaningfully tend to achieve better results than those who are less involved.

The result also reinforces the need highlighted by Lattanze (2025), encompassing the levels of attention, curiosity, interest, optimism, and passion that learners demonstrate during the learning process, which reflect their motivation to acquire knowledge and progress academically.

Indicator	SD	Mean	Descriptive Level
Behavioral Engagement	0.55	4.42	Very High
Cognitive Engagement	0.58	4.29	Very High
Emotional Engagement	0.59	4.25	Very High
Agentic Engagement	0.62	4.13	High
Overall	0.50	4.27	Very High

Table 2. The Level of Student Engagement of College Students.

The Student Engagement indicator with the highest mean rating, 4.42, was *Behavioral Engagement*, described as very high, indicating consistent observation. The standard deviation of 0.55 was less than 1.00, indicating moderate variability in the responses. This implied that students had not only been motivated but had also been capable of sustaining effort and adapting flexibly to various learning demands. This aligns with the study by Olivier et al. (2020), encompasses students' effort, persistence, and participation in learning tasks, and is shaped by teaching practices that foster autonomy, competence, and task value.

As highlighted in Lanuza (2022), positive teacher-student relationships are significant, as students who feel respected and valued are more likely to exhibit constructive behaviors and actively engage in class activities. Tao et al. (2022) emphasized the importance of adaptive and responsive teaching approaches that maintain students' motivation, effort, and concentration.

Cognitive Engagement also yielded very high scores, with a mean of 4.29, indicating that respondents in Davao City were consistently engaged. The findings support the study by Li et al. (2021), which found that students are mentally invested in their learning, consistently apply effort, and effectively regulate their approach to complex tasks, a pattern that research shows is more likely to lead to solving complex problems and achieving higher academic performance. As Pohl (2020) emphasizes, students' investment and interest in their learning, motivation to learn, goal setting, perception of relevance of learning, effort directed toward learning, and use of self-regulated learning strategies.

The ICAP of Guo et al. (2023) framework further supports this, emphasizing that the depth of mental effort—rather than mere participation—determines learning quality, with high performers demonstrating stronger engagement in deep learning activities. This suggests that students are not only completing tasks but are also actively analyzing and applying knowledge in meaningful ways.

Emotional engagement, identified as very high with a mean of 4.25, indicates that respondents in Davao City consistently reflect students' feelings about their learning. According to Wilson (2021), this can be observed through behaviors such as active participation, curiosity, help-seeking, and the nature of questions they pose. These findings align with the research by Camacho-Morles et al. (2021), which suggests that achievement emotions are linked to motivational, self-regulatory, and cognitive processes crucial to academic success.

Additionally, the use of self-regulated emotion strategies, such as reappraisal or suppression, can help students manage negative emotions and maintain consistent engagement, particularly in innovative learning environments like VR-based instruction (Dubovi, 2024). On the other hand, the indicator with the lowest mean rating is *Agentic Engagement*, at 4.13. It is described as high, revealing that such an indicator is oftentimes manifested. The standard deviation of 0.62 is less than 1.00, indicating moderate variability. Although this indicator obtained the lowest rating, it still implies that students are generally willing to take initiative, express their preferences, and contribute actively to shaping their learning experience, which supports the study of Shin (2020) and Reeve and Jang (2022), and reflects students' initiative and motivation to shape their educational experience. Moreover, Patall (2024) emphasized that maintaining a high level of agentic engagement supports personal growth, deeper learning, and academic achievement, underscoring the importance of encouraging students to take greater initiative in the learning process. As Armas et al. (2025) highlight, strengthening project-based learning (PjBL) practices can further deepen students' motivation, initiative, and sense of responsibility, ultimately improving the quality of EFL education across diverse contexts.

The Level of Flexible Thinking in Learning

Presented in Table 3 is the level of Flexible Thinking in Learning of College Students. Overall results showed that the level of Flexible Thinking in Learning is very high, as indicated by the obtained overall mean of 4.25, which indicates that respondents are always manifested with a standard deviation of 0.48 to 1.00, indicating low variability, meaning that data points were closely clustered around the mean and showed a high level of consistency. It is established that the respondents rate all indicators of Flexible Thinking in Learning as very high, as reflected in their respective mean scores.

Indicator	SD	Mean	Descriptive Level
Open-Mindedness in Learning	0.53	4.30	Very High
Adapting to New Learning Situations	0.56	4.25	Very High
Learning Technology Acceptance	0.56	4.21	Very High
Overall	0.48	4.25	Very High

Table 3. The Level of Flexible Thinking in Learning of College Students

Mann et al. (2021) emphasized that flexible thinking is essential for fostering self-directed, autonomous learners, as it cultivates independence, inquiry skills, and behaviors necessary for lifelong learning. Karakuş (2024) noted that cognitive flexibility enables individuals to adjust their thoughts and responses in the face of new information or unexpected situations. Diamond (2021) highlights that this skill enables learners to approach challenges from multiple perspectives, supporting effective problem-solving.

Additionally, Luchini et al. (2025) demonstrated that flexible thinking, as reflected in the generation of novel word associations, improved outcomes in language acquisition tasks. Collectively, these findings suggest that very high levels of flexible thinking enable students to adapt their learning strategies, think critically, and generate innovative solutions, fostering deeper understanding and academic success.

The indicator for flexible thinking in learning that received the highest mean rating, 4.30, is *Open-Mindedness in Learning*, described as very high, indicating consistent manifestation. This implies that students consistently demonstrate adaptability, critical reflection, and a willingness to consider new ideas, which fosters deeper understanding, creativity, and academic growth. Sadeghi et al. (2020) emphasize that open-mindedness is a key quality for both teachers and students, forming the foundation for reflective thinking and critical analysis. This suggests that students with very high open-mindedness are more likely to critically evaluate ideas, consider alternative perspectives, and reflect on their own learning processes. AL-Abrow et al. (2021) further note that open-mindedness indirectly fosters innovation, suggesting that highly open-minded students can approach challenges creatively, generate novel solutions, and adapt to dynamic learning environments.

Additionally, Dolbier (2025) explains that open-mindedness can be nurtured through targeted interventions, including cognitive and motivational strategies, emotion regulation, and social skills training. This highlights that students with high open-mindedness are not only receptive to new ideas but also capable of sustaining this mindset even when their beliefs or prior assumptions are challenged. Billa (2025) reinforces that open-mindedness contributes to both cognitive and social growth, shaping how students approach learning, interact with peers, and navigate collaborative tasks.

The second-highest indicator of flexible thinking in learning, *Adapting to New Learning Situations*, obtained a mean score of 4.25, described as very high, indicating it has always been manifested. This implies that students possess a strong capacity to adjust their cognitive strategies and behavioral responses when confronted with unfamiliar or shifting academic demands. Such adaptability is particularly vital in today's educational landscape, where instructional modalities, assessment formats, and content delivery systems frequently undergo rapid transformation.

Alsaif et al. (2024) point out that cognitive flexibility helps students cope with academic stress, particularly when learning environments become less structured or predictable. In the same vein, Stambuk-Castellano et al. (2024) found that when students can tailor their learning strategies to their metacognitive awareness, they tend to perform better academically and feel more engaged in their studies.

Furthermore, *Learning Technology Acceptance*, an indicator of Flexible Thinking in Learning, received the lowest mean rating of 4.21. It is described as very high, indicating that this indicator has always been manifested. This implies that while students generally embrace and use learning technologies, they may show less enthusiasm or confidence than in other engagement indicators, suggesting a need for continued support, training, and encouragement to maximize their effective use of digital learning tools.

Zhu et al. (2020) suggested that technology acceptance positively influences students' self-regulated learning, while Zuo et al. (2022) highlight its close link with learning motivation. Granić (2022) emphasizes that factors such as self-efficacy, perceived enjoyment, and system accessibility affect the adoption of educational technology, and Oyetade et al. (2020) note that perceptions of benefits or risks shape students' willingness to use these tools.

An et al. (2023) further indicated that positive perceptions of technology can enhance intrinsic motivation, engagement, and self-regulated learning. Therefore, the result implies that while students are generally receptive to learning technologies, efforts to strengthen their confidence, motivation, and access could further maximize the benefits of technology in the learning process.

Significance of the Relationship between Digital Literacy and Flexible Thinking in Learning

Presented in Table 4 were the results of the significant relationship between Digital Literacy and Flexible Thinking in Learning among college students. The findings revealed an r-value of 0.763, indicating a strong positive relationship, with a p-value of < .000, below the 0.05 level of significance. Therefore, the relationship was significant, and the null hypothesis was rejected. This implied that Digital Literacy had positively correlated with Flexible Thinking in Learning. The r-value also indicated a moderately strong correlation among the variables, and the relationship was significant.

Digital Literacy	Flexible Thinking in Learning			
	Learning Technology Acceptance	Open-Mindedness in Learning	Adapting to New Learning Situations	Overall
Communication	.546** (.000)	.514** (.000)	.458** (.000)	.574** (.000)
Copyright	.466** (.000)	.537** (.000)	.501** (.000)	.568** (.000)
Critical Thinking	.524** (.000)	.453** (.000)	.535** (.000)	.573** (.000)
Character	.542** (.000)	.566** (.000)	.452** (.000)	.589** (.000)
Citizenship	.442** (.000)	.537** (.000)	.426** (.000)	.530** (.000)
Curation	.533** (.000)	.516** (.000)	.461** (.000)	.571** (.000)
Connectedness	.498** (.000)	.441** (.000)	.467** (.000)	.533** (.000)
Creativity	.437** (.000)	.386** (.000)	.323** (.000)	.433** (.000)
Collaboration	.463** (.000)	.504** (.000)	.439** (.000)	.531** (.000)
Overall	.696** (.000)	.688** (.000)	.634** (.000)	.763** (.000)

* $p < .05$, ** $p < .01$, *** $p < .001$

Table 4. Significance of the Relationship between Digital Literacy and Flexible Thinking in Learning of College Students

This study suggests that the significant relationship between digital literacy and flexible thinking is well supported by Social Cognitive Theory, which posits that learning arises from the continuous interplay among cognitive processes, behavioral actions, and environmental conditions (Bandura, 1986).

While environmental influences are acknowledged, this investigation focuses on the cognitive domain, where digital literacy plays a central role. Digital literacy is widely recognized as a cognitive skill that enables learners to access, evaluate, and apply digital information effectively. The Museum and Library Services Act (2010) defines digital literacy as the ability to locate, evaluate, and communicate information using digital technologies. In the same review, the authors caution that learners often expend significant cognitive capacity on technological tools themselves, which can reduce their ability to engage deeply with new concepts. This perspective contrasts with the optimistic view, suggesting that digital literacy may sometimes hinder rather than enhance flexible thinking when cognitive load is misallocated (Caton et al., 2022). This capacity directly supports flexible thinking, which requires learners to adapt, reorganize, and apply knowledge across diverse contexts. By cultivating digital literacy, learners strengthen their ability to navigate complex information landscapes, thereby fostering cognitive flexibility essential for problem-solving, innovation, and lifelong learning.

Explicitly, indicators under Digital Literacy have the following r-values: Communication: 0.574; Copyright: 0.568; Critical Thinking: 0.573; Character: 0.589; Citizenship: 0.530; Curation: 0.571; Connectedness: 0.533; Creativity: 0.433; and Collaboration: 0.531. Furthermore, all the p-values are below the 0.05 significance level, indicating that Digital Literacy, in terms of Communication, Copyright, Critical Thinking, Character, Citizenship, Curation, Connectedness, Creativity, and Collaboration, significantly affects Flexible Thinking in Learning among students.

While indicators under Flexible Thinking in Learning yielded the following r-values: Learning Technology Acceptance (0.696), Open-Mindedness in Learning (0.688), and Adapting to New Learning Situations (0.634), moreover, all p-values are below the 0.05 significance level, indicating that Flexible Thinking in Learning, in terms of Learning Technology Acceptance, Open-Mindedness in Learning, and Adapting to New Learning Situations, significantly affects students' Digital Literacy.

Significance of the Relationship between Student Engagement and Flexible Thinking in Learning

Presented in Table 5 were the results of the connection between Student Engagement and Flexible Thinking in Learning. The overall r-value of 0.811 indicated a very strong positive relationship, with a p-value less than .000, which was lower

than the 0.05 significance level; therefore, the relationship was significant, and the null hypothesis was rejected. This implied that Student Engagement had positively correlated with Flexible Thinking in Learning. The r-value also showed a very strong correlation among the variables.

Student Engagement	Flexible Thinking in Learning			
	Learning Technology Acceptance	Open-Mindedness in Learning	Adapting to New Learning Situations	Overall
Behavioral Engagement	.495** (.000)	.611** (.000)	.530** (.000)	.617** (.000)
Agentic Engagement	.597** (.000)	.560** (.000)	.614** (.000)	.670** (.000)
Cognitive Engagement	.652** (.000)	.709** (.000)	.691** (.000)	.775** (.000)
Emotional Engagement	.625** (.000)	.617** (.000)	.572** (.000)	.686** (.000)
Overall	.700** (.000)	.735** (.000)	.710** (.000)	.811** (.000)

* $p < .05$, ** $p < .01$, *** $p < .001$

Table 5. Significance of the Relationship between Student Engagement and Flexible Thinking in Learning of College Students

This finding implies that the significant relationship between student engagement and flexible thinking in learning is well supported by Social Cognitive Theory, which emphasizes that learning arises from the continuous interplay of cognitive processes, behavioral actions, and environmental conditions (Badura, 1986). While environmental influences are acknowledged, this investigation focuses on the cognitive and behavioral domains, where engagement and flexible thinking intersect. According to Zalazar-Jaime et al. (2023), engagement is shaped by cognitive beliefs, such as self-efficacy, which are linked to learners' approaches to academic challenges. Within a regression framework, self-efficacy and engagement may be treated as related predictors that are significantly associated with students' flexible thinking. Flexible thinking, in turn, reflects the cognitive capacity to adapt, reorganize, and synthesize knowledge across diverse contexts. Pangrazio et al. (2020) emphasize its critical role in helping students assess credibility and integrate information, thereby equipping them with stronger cognitive tools for problem-solving and interpretation of academic tasks.

Explicitly, the indicators under Student Engagement have the following R-values: Behavioral Engagement: 0.617; Agentic Engagement: 0.670; Cognitive Engagement: 0.775; and Emotional Engagement: 0.686. Furthermore, all p-values are below the 0.05 significance level, indicating that Student Engagement, in terms of Behavioral Engagement, Agentic Engagement, Cognitive Engagement, and Emotional Engagement, significantly affects Flexible Thinking in Learning among students.

On the other hand, indicators under Flexible Thinking in Learning yielded the following r-values: Learning Technology Acceptance (0.700), Open-Mindedness in Learning (0.735), and Adapting to New Learning Situations (0.710). Moreover, all p-values are below the 0.05 significance level, indicating that Flexible Thinking in Learning, in terms of Learning Technology Acceptance, Open-Mindedness in Learning, and Adapting to New Learning Situations, significantly affects Student Engagement.

The Combined Influence of Digital Literacy and Student Engagement on Flexible Thinking in Learning

Table 6 presents the regression analysis output, showing the combined influence of Digital Literacy and Student Engagement on Flexible Thinking in Learning. Thus, the null hypothesis is rejected. The results indicated that combined Digital Literacy and Student Engagement are significant predictors of Flexible Thinking in Learning among students with an F-value of 38.26 and a p-value less than .001, more or less than 0.05 significance level, implying that the overall multiple linear regression model is statistically significant. The independent variables significantly predict the dependent variable; the relationship is significant.

Combine Influence	Flexible Thinking in Learning			
	B	β	t-value	Sig.
Digital Literacy	.359	.365	6.322	<.001
Student Engagement	.530	.543	9.404	<.001
R-value = .863 R ² = .745				

F-value = 38.26 p-value
=<.001

Table 6. The Combined Influence of Digital Literacy and Student Engagement on Flexible Thinking in Learning of College Students

The analysis aims to investigate the combined influence of Digital Literacy and Student Engagement on Flexible Thinking in Learning, with these variables regressed. It yielded an R^2 of 0.745, indicating that 74.5% of the variance in the dependent variable is explained by the model's predictors. It emphasizes that 25.5% is attributed to other variables not covered in the study. This means that the remaining percent is recommended for future researchers.

The combined influence of digital literacy and student engagement on flexible thinking represents a powerful intersection of cognitive and behavioral dimensions in learning. Social Cognitive Theory emphasizes that learning arises from the continuous interplay of cognitive processes, behavioral actions, and environmental conditions (Bandura, 1986). Within this framework, Bayrakci and Narmanlioğlu (2020) demonstrated that varying levels of digital literacy among university students influence their ability to critically evaluate and apply information, which directly supports cognitive flexibility. Similarly, William et al. (2025) emphasized that technology integration in classrooms enhances literacy skills and critical thinking, showing that digital tools, combined with active engagement, improve adaptability in learning contexts. Wiener and Abuhlimeh (2025) found that adult learners with higher digital health literacy showed greater adaptability in problem-solving, suggesting that digital competence strengthens flexible thinking when paired with active engagement.

Flexible thinking is shaped by the synergy of digital literacy, which equips learners to critically evaluate and adapt knowledge, and engagement, which ensures these skills are actively applied through collaboration and sustained effort. Together, they cultivate resilience, innovation, and adaptive problem-solving.

Moreover, both predictors made highly significant unique contributions. Student engagement was the stronger predictor ($\beta = .543$, $p < .001$), followed by digital literacy ($\beta = .365$, $p < .001$). The standardized coefficients indicate that for each 1-standard-deviation increase in student engagement, flexible thinking increases by 0.543 standard deviations, controlling for digital literacy. Similarly, for each 1-standard-deviation increase in digital literacy, flexible thinking increases by 0.365 standard deviations, controlling for student engagement. Therefore, both variables matter, but Student Engagement is stronger than Digital Literacy.

Conclusion and Implications

Based on the findings, A significant relationship is observed between digital literacy and flexible thinking in learning. All domains of digital literacy, namely communication, copyright, critical thinking, character, citizenship, curation, connectedness, creativity, and collaboration, significantly influence flexible thinking in learning. Meanwhile, all domains of flexible thinking in learning, namely learning technology acceptance, open-mindedness in learning, and adapting to new learning situations, significantly influence digital literacy.

Moreover, a significant relationship is observed between student engagement and flexible thinking in learning. All domains of student engagement, namely behavioral engagement, agentic engagement, cognitive engagement, and emotional engagement, significantly influence flexible thinking in learning. Meanwhile, all domains of flexible thinking in learning, namely, learning technology acceptance, open-mindedness in learning, and adapting to new learning, significantly influence student engagement.

Lastly, digital literacy and student engagement combined influence flexible thinking in learning. Both variables are important; however, Student Engagement has a greater influence compared to Digital Literacy. While the combined model is significant, an analysis of individual contributions shows that communication, copyright, cognitive engagement, and emotional engagement have a positive and significant influence on flexible thinking in learning. In addition, connectedness showed a marginal trend toward significance. However, critical thinking, character, citizenship, curation, creativity, collaboration, behavioral engagement, and agentic engagement do not significantly influence flexible thinking in learning.

Based on this study's findings, future researchers should examine how student engagement and digital literacy interact in higher education. It would help to study how CHED's policies on digital literacy, along with appropriate school administrators' efforts to improve internet access and teacher training, actually affect classroom practice. Researchers should also examine how teachers who use technology and student-centered activities help build students' digital skills, and how students' own willingness to learn and adapt plays a role. To get clearer results, future studies should use a mix of methods, include different types of schools and students, and follow the same groups over time. These studies would help confirm whether the current findings hold in other settings and what really works in practice.

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Competing Interests Statement

The researchers disclosed a possible conflict of interest, as the study took place in the same school where they were students. To mitigate this, they carried out data collection, analysis, and interpretation impartially, free from personal bias or undue influence. Respondents' responses were kept confidential and used exclusively for academic research. Additionally, to maintain ethical integrity, the researchers sought ongoing guidance from their research adviser and strictly adhered to all institutional ethical guidelines.

Data Availability Statement

Data sharing is not applicable to this article as no new data were created or analyzed in this study; all data used were obtained from previously published sources as cited in the reference list.

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Appendices

No appendices are attached to this study.