

ICT Self-efficacy and Learning Styles As Determinants of Digital Literacy of STEM Senior High School STUDENTS

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ABSTRACT

This study aimed to determine the level of Information and Communication Technology (ICT) self-efficacy, dominant learning styles, and the extent of digital literacy among senior high school students in Science, Technology, Engineering, and Mathematics (STEM) fields. Further, the study determined the domains of ICT self-efficacy that predict digital literacy. A quantitative research method, specifically a descriptive-correlational research design, was employed, utilizing adapted questionnaires validated by a panel of experts. These questionnaires were answered by senior high school students from selected private sectarian basic education institutions in Davao City, who were selected through stratified random sampling as respondents in the study. The data gathered were analyzed using the mean, standard deviation, Pearson product-moment correlation, Chi-square test, and linear regression. The results showed that the level of ICT self-efficacy of students was high. Using the Visual, Aural, Reading, and Kinesthetic (VARK) model, the dominant learning style among STEM students was found to be kinesthetic. The results indicated that the student's level of digital literacy is high. Furthermore, the study revealed no significant relationship between learning style and digital literacy among STEM students. However, a significant positive relationship was found between ICT self-efficacy and digital literacy among STEM students. Specifically, communication and learning applications were among the domains of ICT self-efficacy that significantly influenced digital literacy. Based on the results, an enhancement program was crafted to improve digital literacy among STEM students.

KEYWORDS: *Education, ICT self-efficacy, learning styles, digital literacy, technology, quantitative, descriptive-correlational, Philippines*

INTRODUCTION

Digital literacy is considered a crucial skill for individuals to thrive in today's digital age. In the educational context, learners must acquire digital literacy to enhance their knowledge and skills for future success. It is essential to recognize that digitally literate individuals may experience adverse effects on their learning performance and behavior if they are unable to effectively regulate their use of digital tools or software (Manalao, 2022). Nevertheless, many educational institutions have not fully adopted digital literacy as a fundamental literacy skill equivalent to reading, writing, and counting (Coffin & Pérez, 2017). Lastly, Techataweewan and Prasertsin (2018) emphasized that the adoption of digital literacy skills to improve quality is an essential problem for the digital learning environment.

The United States Department of Education's 2018 report stated that 16 percent of adults aged 16 to 65 were digitally illiterate. In Japan, although the country is recognized as very digitally connected, it is well-documented that Japanese youths' digital literacy is falling behind that of other developed (and developing) countries (Gobel & Kano, 2014). In 2015, the Organization for Economic Co-operation and Development (OECD) released a critical report on the digital literacy of Japanese, noting that 25 percent of Japanese youth (aged 16–29) lack literacy skills. In Yogyakarta, Indonesia, 80.2 percent of students have a deficient level of digital literacy. Students face challenges in digital literacy skills, ranging from knowledge assembly to internet searching (Perdana et al., 2019). Moreover, the Digital Economy and Society Index (DESI) for 2022 shows that 4 out of 10 adults and every third person working in Europe lack basic digital literacy skills.

Shifting to the national perspective, the Philippines aspires to nurture globally competitive individuals through educational reforms. Despite technological advancements, not all students entering higher education institutions in the Philippines possess the same level of digital and technological competencies (Inskip, 2014). In senior high school, under the K to 12 curriculum in the Philippines, Media and Information Literacy has been included as part of the core subject under the Communication Learning Area, with one semester allocated to develop further students' digital literacy (Commission on Higher Education, 2016).

Studies have shown that STEM students generally possess a high level

of digital literacy and self-efficacy; however, there is limited research explicitly linking these aspects to their learning styles. For example, a study of Grade 12 STEM students in Davao City revealed a very high level of digital literacy and self-efficacy, with a significant relationship between these two variables. The study found that areas such as the utilization and management of information, as well as interaction through technology, have a significant impact on students' sense of self-efficacy. This implies that improvements in digital literacy can moderately enhance ICT self-efficacy among STEM students, although the influence of specific learning styles was not directly addressed (Baylon, 2025)

On one hand, ICT self-efficacy serves as a crucial motivational factor, strongly linked to the acceptance, utilization, and proficiency of ICT among students. The self-efficacy of students in utilizing information and communication technology (ICT) ranks among the most significant motivational factors associated with their acceptance, usage, and literacy of ICT (Rohatgi et al., 2021). In Hortelano et al.'s 2021 study, the findings suggest that having self-efficacy in using ICT enhances the likelihood of developing digital competence. Furthermore, Hatlevik et al. (2018) and Senkbeil and Ihme (2017) noted that students who possess greater confidence and comfort in their ability to navigate new technologies are better equipped to face future challenges and are more likely to enhance their digital skills throughout their lives.

While recognizing that individual learning styles can be helpful, the primary focus should be on developing essential digital literacy skills and effective learning strategies for all students. This ensures that everyone gains the tools to confidently navigate the digital world (Almeida et al., 2016). According to Albeta (2021), students' ability to adapt to new conditions is important because there is no difference in learning performance, even though students' learning styles are different. Meanwhile, Permanasari et al. (2021) explained that the apparent improvement in each learning style provides evidence that the e-learning method can be employed to enhance students' digital literacy learning abilities.

Furthermore, the findings above regarding ICT self-efficacy, learning styles, and digital literacy among SHS STEM students indicate that few studies have addressed these combined variables. Additionally, most studies were conducted in Junior High School and Tertiary Education, without specificity to the STEM strand in Senior High School. Specifically, the study by Manalao (2022) focused solely on the relationship between learning styles and digital

literacy among public Senior High School students. Nevertheless, the researcher found no studies that specifically addressed learning styles, ICT self-efficacy, and digital literacy among students in the STEM strand in sectarian private schools.

Moreover, it is due to the gaps mentioned earlier in the literature that the researcher felt the need to conduct a study focusing on identifying the dominant learning styles of STEM students and the level of ICT self-efficacy. Additionally, the study aims to determine if there is a significant correlation among ICT self-efficacy, learning style, and digital literacy among private sectarian Senior High School STEM students in Davao City.

This study provides valuable insights for the education sector by examining the impact of ICT self-efficacy and learning styles on digital literacy among local senior high school students in STEM fields. It benefits policymakers, teachers, and curriculum developers by offering clear, data-driven indicators to guide targeted improvements in digital literacy programs and teaching methods. The findings support evidence-based decisions to prepare students for STEM careers better. To maximize impact, results will be shared with participating schools and the University of the Immaculate Conception, presented at research conferences, and published in respected academic journals to reach a wider audience of professionals.

Theoretical Lens

This study is grounded in several key theoretical perspectives that provide a comprehensive framework for understanding the complex interplay between ICT self-efficacy, learning styles, and ICT digital literacy among STEM students. Two pertinent theories for the study are the Connectivism Theory (2005) and the Self-efficacy Theory (1986).

The Connectivism theory, presented by Siemens in 2005, delineates its principles as follows: the bedrock of learning and knowledge lies in the diversity of opinions. The learning process entails establishing connections among specialized nodes or information sources, extending even to non-human entities. Connectivism, a relatively modern learning theory, advocates for students to integrate thoughts, theories, and general information proficiently. According to connectivism, learning extends beyond our internal construction of knowledge; it encompasses what we can access in our external networks. Within this framework, two terms, namely nodes and links, are commonly employed to

describe how information is acquired and interconnected in a network.

The research is grounded in Siemens' (2005) principles of connectivism. Regarding the study's context, these principles of digital literacy among STEM senior high school students are enhanced by considering a range of connecting nodes that refer to ICT self-efficacy and learning styles. This concept suggests that in acquiring digital literacy learning, connections between specialized nodes or information sources must be established. In the study, these specialized nodes may represent the domains of ICT self-efficacy and learning styles. Recognizing the significance of this variable and highlighting connections between specialized nodes (ICT self-efficacy and learning styles) to provide a framework for the digital literacy of STEM senior high school students.

Another theory utilized in this study is the Self-efficacy theory (1986). The theory of self-efficacy (SET) was a component of Bandura's social cognitive theory in 1986. It posits that perceived self-efficacy and outcome expectancies are the primary influences on behavior. Outcome expectancies involve the perceived positive and negative consequences associated with a particular behavior. While self-efficacy theory emphasizes the importance of personal factors, it acknowledges that behavioral and environmental factors also significantly impact outcomes.

Self-efficacy theory posits that individuals with higher self-efficacy are more likely to engage in a task, expend effort, and persist in the face of challenges. In the context of this study, the investigation examines how STEM students' confidence in their ICT abilities (ICT self-efficacy) affects their development of digital literacy. Students who believe they can effectively use ICT tools may be more motivated to explore and apply digital literacy skills.

METHODS

Research Design

This research employed a quantitative research method, specifically a descriptive-correlational design, to address the research problems and attain its purpose. According to Creswell (2014), quantitative research uses objective measurement to gather numeric data that can be used to answer questions. The study is quantitative, as the researcher employed a design to describe the levels of digital literacy, learning styles, and ICT self-efficacy among STEM students.

Furthermore, correlational research identifies the relationship or

association between the two variables under investigation, where ICT self-efficacy and learning styles serve as independent variables, and digital literacy of STEM students acts as the dependent variable. A quantitative descriptive correlational design is suitable for this study, as the researcher aims to investigate the significant impact of ICT self-efficacy and learning styles on digital literacy among STEM students. A descriptive correlational design is employed to evaluate the relationships among the specified variables in detail. This study employs a deductive approach, utilizing a questionnaire to investigate the correlation between variables.

Research Respondents

The respondents of this study were the 316 STEM students from selected schools in Davao City. The researcher set the inclusion criteria for selecting the respondents that they must be officially enrolled in the STEM strand during the school year 2023-2024 at Private Senior High Schools A, B, and C. Stratified random sampling was used to select respondents, ensuring that every member of the population has an equal chance to be part of the sample. This sampling method was appropriate for the study because the actual number of students was determined by the estimated ratio and proportion of students from the target schools selected to participate, taking into account the inclusion criteria. Each member of the population has an equal chance of being selected. The study's exclusion criteria encompass senior high school students in the specified schools who were not enrolled in the STEM strand, as the research focused on STEM students who have greater familiarity with digital technology. Additionally, STEM students at the selected schools who did not have a signed informed consent form (ICF) were excluded from the study.

Research Instruments

The study employed three adapted survey questionnaires to assess ICT self-efficacy, learning styles, and digital literacy among high school students in STEM fields. The first, a 24-item ICT Self-efficacy questionnaire from Li et al. (2018), measured confidence across four components—security/privacy, differentiation learning, communication, and learning/application—using a 5-point Likert scale with strong reliability ($\alpha = 0.89$). The second instrument, adapted from Fleming's VARK 8.02 (2002), identified students' dominant learning styles (visual, aural, reading/writing, kinesthetic) through 16 items, with good to acceptable reliability across styles ($\alpha = 0.77$ – 0.85). The third questionnaire, adapted from Baterna et al. (2020), assessed digital literacy through 30 items covering six domains, including information access, media

creation, and technology interaction, on a 5-point scale, with excellent reliability ($\alpha = 0.904$). Experts validated the combined instrument and pilot-tested it with STEM students, demonstrating acceptable internal consistency.

Data Gathering Procedure

The study followed specific procedures in gathering the data. First, the researcher secured a letter of permission from different offices. A letter was also submitted to the UIC Ethics and Review Committee, requesting approval to conduct the study by obtaining ethical clearance. The researcher then sent a letter addressed to the President and School Principals of the research locations, which were purposefully chosen for this study, to seek approval to conduct the survey.

After the letter of intent was approved by the principals, prior to the selection of students, informed consent forms (ICF) were released to the parents of the respondents at Schools A, B, and C. They were asked to review the forms before agreeing to voluntarily participate in the study, with both the respondents and one of their parents signing the same ICF. Upon gathering the ICFs, the researcher set a schedule with the class adviser for distributing the instrument. The students were gathered in a covered court with the assistance of their class adviser; minimum health protocols were observed during the distribution of survey questionnaires, including the wearing of face masks and maintaining social distancing. The researcher explained the study procedures, confidentiality measures, and the respondents' rights to them. As soon as the respondents finished answering the questionnaire, retrieval followed. Finally, the data was obtained and analyzed.

RESULTS

Level of ICT Self-efficacy

Table 1
Level of ICT Self-Efficacy

Privacy and Security	Mean	SD	Description
1. Hiding easily any post that someone shared/tagged on their profile on social networking sites that they mostly use (i.e., Facebook, Instagram, etc.)	4.32 4.29	0.98 1.00	Very High Very High
2. blocking easily block or restrict anyone on social networking sites that they mostly use or apps (i.e., Facebook, Twitter, Skype, WhatsApp, Viber, etc.)			
3. Setting pins/password on their mobile phone to Keep it secure.	4.60	0.76	Very High
4. changing easily change password of their email/social.	4.34	2.63	Very High
5. dissolving easily friendship with anyone on their most used social networking sites or apps. (i.e., Facebook, Twitter, Instagram, Viber, etc.).	3.96	1.05	High
6. reporting easily a fake account that claims to be them.	3.98	1.15	High

7. reporting easily any ID, post, image or video as abusive content on any online sites or apps that they mostly use (i.e., Facebook, Wiki, Twitter, Instagram, etc.)	3.82	1.03	High
8. changing easily privacy settings of online applications that they mostly use (i.e., can easily recover my email/social networking account if they forget the password. Facebook, Zoom, Gmeet, Instagram, Viber, etc.)	4.12	0.99	High
9. recovering easily their email/social networking account if they forget the password.	4.02	1.05	High
Category Mean	4.16	0.68	High

Differentiation and Learning

1. dealing easily with spam messages in emails or on social networking sites (i.e., Facebook, WeChat, Twitter, Skype, etc.).			
2. judging easily whether or not the message posted by other people on social networking sites is correct.	3.73	1.07	High
3. identifying easily which information on social networking sites is trustworthy.	3.65	1.01	High
	3.85	1.00	High
4. being fully aware of the possible consequences of their actions on the Internet.	4.29	0.94	Very High
Category Mean	3.88	0.74	High

Communication	3.54	1.03	High
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1. expressing my point of view in any online discussion forum.	3.92	0.92	High
2. learning easily learn its features and functions in a short time when they open any social networking site (i.e., reply, like, etc).			
3. using easily chat rooms on the Internet.	4.02	1.03	High
4. Using the webcam easily to chat with others.	3.63	1.12	High
5. communicating efficiently with friends in a social media group (i.e., WeChat group, WhatsApp group, etc).	4.23	0.94	Very High
Category Mean	3.87	0.69	High
Learning and Application			
1. editing and modifying easily edit any picture using software on their computer or cell phone (i.e., photoshop, meitu, Snapseed, etc.)			
2. Expressing their point of view easily using emojis or pictures when chatting with friends online.	3.84	1.08	High
3. finding easily digital resources that interest them if they want to.	4.20	0.96	Very High
4. Making and editing short videos easily using their computer or mobile phone.	4.05	0.92	High
5. learning a programming language and doing	3.94	1.07	High
	3.59	1.04	High
Category Mean	3.93	0.71	High
Overall Mean	4.00	0.58	High

Table 1 shows the level of ICT self-efficacy of STEM students. The table shows that the overall mean of ICT self-efficacy is 4.00, which is described as high. This suggests that senior high school STEM students often exhibit high

ICT self-efficacy. This suggests that most STEM students feel confident in their abilities across various domains of ICT self-efficacy. In addition, the overall standard deviation is 0.58, which is less than one, indicating that the respondents' ratings are practically the same. In addition, Hero (2022) conducted a study on Junior High School students, finding that their level of ICT self-efficacy is moderately high in all dimensions of ICT self-efficacy.

Furthermore, Adeoyo (2017) disclosed that a considerable number express confidence in their information literacy skills, especially in using others' online work without resorting to plagiarism, with a substantial percentage of respondents exhibited confidence in their media literacy skills when utilizing media-capture devices such as video. Likewise, the findings support the view of Senkbeil and Ihme (2017), who pointed out that ICT self-efficacy plays a crucial role in empowering students to adapt to technological advancements, fostering continuous learning. It is increasingly recognized as indispensable, potentially rivaling competencies and skills in shaping the future.

Examining the dimension of privacy and security in relation to ICT self-efficacy among senior high school STEM students reveals that the category has a mean rating of 4.16, which is described as high, indicating that students' self-efficacy towards privacy and security is often evident. This means that the students have high confidence and are aware of the importance of privacy and security. The high confidence indicates positive self-efficacy among the students, suggesting they can perform this task effectively.

The table further reveals that the mean rating ranges from 3.82 to 4.60. Notably, the item indicating that students' statements can easily report any ID, post, image, video, or abusive content got a mean of 3.82, interpreted as ICT self-efficacy being oftentimes evident. Meanwhile, the item can set passwords/pins on their mobile phone to keep it secure. It has a mean rating of 4.60, which is very high, indicating that the students' self-efficacy is consistently evident.

This finding aligns with the study by Hero (2022) on junior high school students' ICT self-efficacy, revealing that students largely agree with the privacy and security aspects, with a weighted mean value of 3.61, which is described as high. Additionally, this supports the proposition of Hong et al (2018) and O'Brien and Jones (2017) regarding the crucial role of ICT self-efficacy in handling privacy and security concerns that students with higher self-efficacy in

this area demonstrate a proactive use of privacy settings, awareness of online threats, and adequate protection of their information, thereby maximizing their technology use and learning opportunities.

The table shows that the student rated the dimension, differentiation, and learning as high, with a category mean of 3.88, which is interpreted as the ICT self-efficacy of the students, which is oftentimes evident. This suggests that students feel confident in their ability to adapt different tools for learning. The mean rating of different items ranges from 3.65 to 4.29.

On the one hand, the item stating that students can easily judge whether or not the message posted by others on social networking sites is correct has a mean rating of 3.65, which is described as high. Furthermore, the item indicating that students are fully aware of the possible consequences of their actions on the Internet reflects a mean of 4.29, described and interpreted as a very high ICT self-efficacy level.

This supports the findings of Heron (2021), who found that students possess a moderate level of knowledge and understanding regarding the information available on social networking sites and other online applications, including the ability to determine whether the information is accurate or not. This supports the idea of Leader (2019) that students who effectively identify misleading news tend to employ specific information-processing strategies. These strategies include scanning websites listed in search engines to verify information, dedicating sufficient time to examining webpages, evaluating online content critically, and consulting fact-checking sites.

In terms of self-efficacy in communication, the data show a high category mean of 3.87, indicating that this domain of ICT self-efficacy among students is often evident. This suggests that the respondents, most of the time, have positive self-efficacy in their ability to express themselves online using different social networking sites. Further, the mean rating of different items ranges from 3.54 to 4.23. The item reflecting students' ability to express their point of view in any online discussion forum has a mean rating of 3.54, which is described as high, indicating that students generally perceive themselves as confident and proficient in articulating their perspectives in such forums. Meanwhile, the item reflecting students' self-efficacy in communicating with friends in a social media group has a rating of 4.23, described as very high and interpreted as very high ICT self-efficacy in communicating with friends in a

social media group.

Moreover, Yildiz and Ozdemir (2016) found that individuals who demonstrate confidence in using these tools to connect with others, express themselves clearly, and participate in online communities that exhibit high ICT self-efficacy.

Consequently, the learning and application are described as high, with a category mean of 3.93, which is interpreted as a high level of ICT self-efficacy. The mean ratings of different items range from 3.59 to 4.20. The item, if they want, allows them to learn a programming language and engage in programming development, has a mean rating of 3.59, which is described as high and interpreted as indicating that ICT self-efficacy is often evident. This means that students are confident in their ability to express their points of view using different icons and tools of online applications. The item can easily express their point of view using emojis or pictures when chatting with friends online. It has a mean rating of 4.20, described and interpreted as very high, suggesting that users find it easy and practical to express themselves visually when interacting with friends online.

Dominant Learning Style of STEM Students

Table 2
Dominant Learning Style

Learning Style	Frequency	Percentage
Visual	23	7.3
Aural	47	14.9
Reading/Writing	102	32.3
Kinesthetic	120	38.0
Bimodal	24	7.6

The results shown in Table 2 indicate that among 316 respondents, 38.0 percent have a kinesthetic learning style (K), followed by 32.3 percent who prefer a reading/writing learning style (R). The aural learning style (A) has 14.9 percent of the participants who are more inclined to learn with the auditory learning style (A), followed by 25.0 percent of participants who prefer the visual learning style. Meanwhile, 7.6 percent of the respondents have a bimodal

learning style, and 7.3 percent of the respondents are visual learners (V).

These findings are similar to Manalao's (2022) results, which showed that kinesthetic learners make up the majority of senior high school students. This suggests that, among the various learning styles, the kinesthetic learning style is the most preferred among students. Kinesthetic learners learn best through hands-on experiences, such as acting, touching, and moving. Projects that involve hands-on activities work best for them, but they often experience frustration when required to sit still for extended periods. They enjoy carrying out tasks, investigating, and conducting tests.

Meanwhile, the visual learning style, which is the least preferred learning style among respondents, has similar findings to the study by Godfy (2023), which found that the visual learning style was the least dominant among Grade 11 senior high school students specializing in technology, as measured by the VARK model. This reinforces Yip's (2022) theory that engaging fully in an activity requires the emotional body, which promotes conditions for meaningful learning to take place because the emotional core is a potent behavioral modulator.

The Extent of STEM Students' Digital Literacy

Table 3 shows the extent of students' digital literacy, which recorded an overall mean of 3.90, described as high. This means that the digital literacy of STEM students is often observed. The results indicate that students can access, interact with, and apply different online applications effectively. The standard deviation value of 0.60 is less than one, denoting that the respondents have ratings that are practically almost the same.

The results contrast with the findings of Morgan (2022), where the digital literacy skills of 324 undergraduate students were examined. The study concluded that students' Digital literacy regarding the use and access of digital information, and their competence in etiquette, was low.

Likewise, the result agreed with the agreement of Demirbag and Bahcivan (2021) that digital literacy is believed to be a multidisciplinary field that broadly covers various other types of literacy, including information literacy, information and communication technology (ICT) literacy, media and the Internet literacy, digital science, and computer literacy.

In particular, this dimension has a category mean of 3.83, which is interpreted as high, which means that in terms of access and evaluation of information, the level of digital literacy of the student is often observed. The mean ratings of items range from 3.61 to 4.07. The item can spread science-related news, content, and resources proactively, reflecting a mean rating of 3.61, which is described as high, indicating that digital literacy among students is oftentimes observed.

Similarly, the item protecting own devices (cellular phone, laptop, etc.) and understanding online risks and threats received a mean rating of 4.07, also described as high, suggesting that digital literacy among STEM students is oftentimes observed. These results imply that students oftentimes demonstrate a high level of proficiency in accessing and evaluating science-related information, protecting their devices, and understanding online risks.

These findings are consistent with the perspective of Alt and Raichel (2020), who highlighted the importance of students possessing the ability to evaluate information, verify its credibility, distinguish between opinion and fact, and identify the specific information they need. These skills are crucial, and effective filtering is essential for knowledge building. However, the study by Baterna et al. (2020) suggests that STEM students demonstrate a moderate level of literacy in accessing and evaluating information. While they exhibit an understanding of safeguarding their devices and recognizing online risks, there is a lower mean in the indicator related to accessing credible science information websites.

The domain utilization and management of information literacy reflects a category mean of 3.74, which is described as high, indicating that the level of digital literacy among STEM students is often observed. The mean score suggests that STEM students are proficient in using and managing data information and have the ability to utilize information effectively. The mean ratings of the different items range from 3.60 to 3.84. The item that manipulates and stores scientific information and content for easier retrieval has a mean rating of 3.60, which is described as high, and digital literacy among STEM students is often observed. Similarly, items that require a fundamental understanding of the ethical and legal issues surrounding the access and use of information, as well as the accurate and creative application of information to current issues and problems in STEM, received high mean ratings, indicating

that digital literacy is often observed. The consistently high rating indicates well-rounded proficiency not only in accessing and evaluating information but also in organizing and storing information.

These results align with the study of Coccoli (2014), which emphasized the importance of having the right competencies to utilize learning management systems effectively as online repositories of learning materials, providing content sharing and video conferencing capabilities. Additionally, they correspond with the findings of Baterna et al. (2020), which revealed that STEM students are moderately digitally literate in terms of utilization and management of information. This suggests that students can use the given information fairly accurately and creatively with an understanding of the ethical and legal issues.

The media analysis dimension has a category mean of 3.95, which is described as high, indicating that the digital literacy of STEM students is often observed. The high mean rating for this dimension demonstrates that STEM students acquire significant digital literacy in this area, recognizing a strong foundation, specifically in the aspect of the influence of media. The mean ratings of the different items range from 3.88 to 4.08. Specifically, the item applying a fundamental understanding of the ethical and legal issues surrounding media analysis has a mean rating of 3.88, which is described as high, suggesting that digital literacy levels are often observed. Similarly, the item examining how media can influence beliefs and behaviors regarding issues in science and technology reflects a mean rating of 4.08, which is described as high, indicating that the digital literacy level is still often observed.

Furthermore, these findings support the idea of Baterna et al. (2020) mentioned that STEM students are somewhat good at understanding media analysis. This shows that students are good at analyzing content but might struggle with issues related to intellectual property. Interviews with students reveal that they do practice media analysis.

The Creation of Media Products has a category mean of 3.79, which is described as high, indicating that the digital literacy of STEM students is often observed. The high descriptive rating in this domain demonstrated proficiency in creating media products and a high ability to utilize appropriate media tools. The mean rating ranges from 3.73 to 3.86. Specifically, the item, modifying, refining, and mashing up existing resources to create new, original, and relevant content and knowledge in science has a mean rating of 3.73, described as high

and interpreted as the digital literacy of STEM students is oftentimes observed. Similarly, the item can express creatively through digital media and technologies has a mean rating of 3.86, described as high, further indicating a significant level of digital literacy.

These findings align with the study of Binoya (2020), which revealed that digital literacy related to digital content creation among students is high. Key indicators include combining tools for digital content creation, summarizing information from various sources, choosing appropriate Creative Commons licenses, planning and designing solutions in step-by-step instructions, and recognizing when and how programming can be used across different subject areas.

The Effective Application of Technology has a category of 4.07, described as high and interpreted as digital literacy of STEM students, which is often observed. The results suggest that respondents effectively utilize technology for research, communication, collaboration, and cultural diversity, and can navigate technological tools responsibly. The mean ratings of the different items range from 3.88 to 4.22. Specifically, the item applying a fundamental understanding of the ethical and legal issues surrounding the effective application of technologies reflects a mean rating of 3.88, described as high and interpreted as as oftentimes observed by the respondents. The item, using technology as a tool to research, organize, evaluate, and communicate information in science, has a mean rating of 4.22, described as high and interpreted as being oftentimes observed among students. The results suggest that respondents effectively utilize technology for research, communication, collaboration, and cultural diversity.

Furthermore, this result is consistent with research by Baterna et al. (2020), which found that students can effectively comprehend scientific knowledge using technology to benefit a diverse community. The respondents, however, possess some literacy in using media and technologies for teamwork, collaborative processes, and the creation and co-creation of scientific resources, knowledge, and content. This suggests that students can engage in moderately complex interactions when it comes to technology-mediated collaboration.

Concerning interaction through technologies, this dimension has a category mean of 4.07, which is described as high, indicating that STEM students are often observed to be digitally literate. The results indicate that

STEM students are skilled and capable of utilizing scientific communication in various contexts using different digital tools and platforms.

The mean ratings of different items range from 3.88 to 4.28. Specifically, the item that adapts scientific communication modes and strategies to the specific audience has a mean rating of 3.88, which is described as high and interpreted as indicating that students are often observed to be digitally literate. Meanwhile, the item interacting through a variety of digital devices and applications has a mean rating of 4.28, which is also described as high and interpreted as the level of digital literacy often observed.

The finding aligns with the study of Mishra and Mehta (2017), who emphasized that the seamless incorporation and proficient utilization of technology have become imperative in a knowledge-centric society and are essential literacy skills for both students and educators. Additionally, the finding parallels the study by Baterna (2021), in which respondents shared in an interview that interaction through technology is a means of being a digitally literate citizen, suggesting they can effectively utilize various digital devices and applications.

Significance of the Relationship between ICT Self-Efficacy and Digital Literacy of STEM Students

Table 4.1
Significance of the Relationship between ICT Self-Efficacy and Digital Literacy of STEM Students

Digital Literacy	r	p-value	Decision
ICT Self-Efficacy	0.241	.000	Significant

Table 4.1 shows the relationship between ICT self-efficacy and digital literacy of STEM students. It indicates that ICT self-efficacy has a significant relationship with digital literacy among STEM students with a p-value of .000, which is less than the 0.05 level of significance (two-tailed) ($r=0.241, p<0.05$). This means a positive correlation between the two variables; where the level of ICT self-efficacy increases, the digital literacy of STEM students also significantly increases.

These findings agree with the study of Rohatgi et al. (2016), which distinguishes between self-efficacy in digital literacy and examines its relations to students' ICT use for various purposes and their achievement in a CIL test. The results indicate that self-efficacy in basic digital literacy is positively related to digital literacy achievement.

Moreover, the results support the findings of Hero (2022), which demonstrated a significant correlation between the ICT self-efficacy of Junior High School students and their digital literacy to a varying extent. Additionally, this supports the findings of Gudek (2020), which explored computer self-efficacy and attitudes towards digital technology among teacher trainees, revealing significant correlations between the level of computer self-efficacy and general and specialized computer knowledge.

Significance of the Relationship between Learning Style and Digital Literacy of STEM Students

Table 4.2
Significance of the Relationship between Learning Style and Digital Literacy of STEM Students

Chi Square Value	df	p-value	Decision
10.180	12	0.600	Not Significant

Table 4.2 shows the relationship between the learning style and digital literacy of STEM students. The analysis reveals a p-value of 0.600, which is considerably higher than the commonly accepted significance level of 0.05. This indicates that there is no statistically significant relationship between learning style and digital literacy among STEM students. The test statistic chi-square value calculated from the analysis is 10.180. The analysis was conducted with 12 degrees of freedom, accounting for the number of categories in the learning style variable minus the constraints.

This finding disagrees with the results shown by Manalo (2022), involving Grade 11 Senior High School students, which indicated a significant relationship between digital literacy and learning style. According to Manalao (2022), variations in learning styles affect digital literacy. Similarly, Bagon and Vodopivec (2016) contradict the findings, revealing a strong correlation between learning styles and ICT learning.

Significant Influence of ICT Self-Efficacy to the Digital Literacy of STEM Students

Table 4.5
Significant Influence of ICT Self-Efficacy to the Digital Literacy of STEM Student

ICT Self-Efficacy	Standard Coefficient Beta	Digital Literacy		Remark
		t	p-value	
Privacy and Security	-0.026	-0.397	0.692	Not Significant
Differentiation	0.042	0.625	0.532	Not Significant
Learning	0.241	3.543	0.000	Significant
Communication				
Learning and Application	0.155	2.309	0.022	Significant

Note: R= 0.362, R-square= 0.131, F= 11.755, p< 0.05

Table 4.5 shows the results of the multiple regression analysis, including the standardized beta coefficients and t-statistic results of the influence of the domains, namely privacy and security, differentiation learning, communication and learning, and application to digital literacy. Based on the results, only the domains of communication and the learning application significantly influence digital literacy since the p-value is less than 0.05. Moreover, the standardized beta coefficient of communication is 0.241, and the p-value is 0.000.

This indicates that for every unit improvement in communication, there is a corresponding increase in digital literacy by 0.241 units. The standardized beta coefficient of learning and application is 0.155, with a t-statistic of 2.309 and a p-value of 0.022. This implies that in individual capacity, learning and application are significant predictors of digital literacy. Thus, for every unit increase in learning and application, there is a corresponding increase of 0.155 units in digital literacy.

Meanwhile, the r-square value is reported at 0.131, indicating that 13.1 percent of the variability of digital literacy can be explained by the predictors: communication and learning application. Relatively, 86.9 percent of the variation

in digital literacy may be attributed to other factors or other variables that are not included in this study. Age and technological preparedness, and digital device use were revealed to be contributing factors to digital literacy.

This agrees with the study of Cabero-Almenara et al. (2022), which emphasized the significance of learning and the application of technology as vital predictors in digital literacy. On the other hand, the results contradict with Cavelry et al. (2022), who found that while students exhibit high confidence in interacting with digital technology, results show that they are not necessarily digitally literate.

Finally, the results of the study support the two pertinent theories anchored in this study. The theory of connectivism by Siemens (2005) indicates that learning extends beyond our internal construction of knowledge; it encompasses what we can access in our external networks. This concept suggests that acquiring digital literacy involves establishing connections between specialized nodes or information sources. In the study, these specialized nodes may represent the domains of ICT self-efficacy and learning styles. Meanwhile, Bandura's (1986) Theory of Self-Efficacy asserts that individuals with higher self-efficacy are more likely to engage in a task, expend effort, and persist in the face of challenges. The study examines the impact of STEM students' confidence in their ICT abilities (ICT self-efficacy) on their digital literacy development. Students who believe they can effectively use ICT tools may be more motivated to explore and apply digital literacy skills.

Proposed Program to Improve the Digital Literacy of Students

Based on the findings, only one independent variable, ICT self-efficacy, had a significant influence on the extent of digital literacy among STEM students. The result showed that ICT self-efficacy had a significantly positive relationship with STEM students' digital literacy. Although the overall mean of the students' level of ICT self-efficacy was high, indicating that students' self-efficacy towards ICT is generally high, the indicators of communication and learning application were the only predictors of a significant influence on digital literacy. Therefore, the researcher recommends the proposed program for this study.

The findings suggest that increasing the level of ICT self-efficacy in STEM students will enhance their digital literacy by facilitating active exploration and experimentation with technology, leading to improved acquisition and proficiency in digital skills (Yildiz & Adigun, 2018). In STEM contexts, high ICT self-efficacy is associated with increased engagement in technology-mediated learning activities, improved problem-solving skills, and

greater academic achievement (Adigwe, 2017). Chuang and colleagues (2015) focused not only on usage, searching, and communication aspects but also included Internet-related metacognitive skills and applications to measure ICT self-efficacy. Hence, in this context, the researcher proposed an enhancement program to improve students' satisfaction with virtual learning.

CONCLUSION

Proposed Enhancement Program to Increase STEM Students' Digital Literacy

Rationale

The digital literacy of students can be associated with their ICT self-efficacy, digital resources, technology, computer, and media skills, as well as teachers' knowledge and skills. Thus, students' digital literacy depends on these factors.

In this context, an enhancement in both teachers' and students' knowledge and skills regarding various digital applications is recommended. Additionally, an empowerment of critical analysis of various media and information literacy concepts is suggested.

Objectives

The primary objective of this enhancement program is to help students become more knowledgeable in computer, media, and achieve information literacy, enabling them to improve their level of digital literacy. The various activities crafted focus on the predictors of digital literacy under the ICT self-efficacy, which are communication and learning, and applications designed to help STEM students become digitally literate, which will give them an advantage in finding professions aligned with their chosen career. This is specifically focused on STEM students.

Specifically, this program aims to:

1. Raise awareness of the importance of digital literacy among students.
2. Enhance students' comprehension of digital literacy concepts.
3. Demonstrate the utilization of various digital tools and methodologies for acquiring reliable information.
4. Facilitate activities for creating media products.
5. Engage in discussions on the effective use of technology.

To better understand how these areas of concern are addressed, Table 6

provides a detailed description of the activities, tools to be used, activities persons involved, and the time frame for each area.

PROPOSED ENHANCEMENT PROGRAM TO INCREASE DIGITAL LITERACY OF STEM STUDENTS	
Launching of the Program	
Objectives	To spread the information about the importance of digital literacy.
Activities	• Positing infographic on Facebook page and website. • Putting up tarps or pamphlets on bulletin boards
Tools	• School Website • Facebook Page • Canva • Printed Materials
Persons Involved	• IT Coordinator • IT Teachers • IT Club Officers
Time Frame	2 nd week of July (Before to the start the school year)
Expected Output	• At least 90% of the students read posted materials • Attendance will be checked.
Addressed Domain: Digital Literacy - Communication	

Objectives	To raise students' understanding on accessing and evaluating information.
Activities	Access It! Group Workshop

Findings

Based on the results of the study, the findings were the following:

1. STEM students' ICT self-efficacy had an overall mean of 4.00, which is described as high, suggesting that the students have a high level of ICT self-efficacy. This means that students' ICT self-efficacy is often evident. The indicators, such as privacy and security, differentiation and learning, communication and learning, and application, all received high ratings with a mean of 4.16, 3.88, 3.87, and 3.93, respectively. The overall standard deviation of 0.58 indicates that students' ratings are almost identical and are almost the same.
2. The learning styles of STEM students under the VARK model consist of Visual, Aural, Reading/Writing, and Kinesthetic. The dominant learning style is Kinesthetic, accounting for 38 percent, followed by Reading/Writing at 32.3 percent and Aural at 14.9 percent. Additionally, there are also bimodal learning styles, comprising 7.6 percent, while visual learning styles represent the least at 7.3 percent.
3. The level of students' digital literacy had an overall mean of 3.90, which is considered high, meaning that STEM students are often observed as digitally literate. The results showed that the indicators received high ratings of 3.83, 3.74, 3.95, 3.79, 3.95, 3.79, 4.07, and 4.07 for access and evaluation of information, utilization and management of information, media analysis, creation of media products, and effective application of technology, respectively. Furthermore, the 0.60 standard deviation value is smaller than one.
4. There is a significant relationship between ICT self-efficacy and digital literacy based on the p-value of 0.000, which is less than 0.05, with a weak positive correlation based on the r value of 0.241. However, the relationship between learning style and digital literacy of STEM students is not significant. The analysis reveals a chi-square value of 0.600, which is considerably higher than the significance level of 0.05. This

indicates that there is no significant relationship between learning style and digital literacy among STEM students.

5. Among the four indicators of ICT self-efficacy, only two are predictors. The results reveal that only certain aspects of digital literacy, specifically communication (p-value = 0.000) and learning and application (p-value = 0.022), are significant predictors. This indicates that in individual capacity, for every unit improvement in communication, there is a corresponding 0.241 increase in digital literacy. On the other hand, for every unit improvement in the learning and application, there is a corresponding 0.155 increase in digital literacy.
6. Based on the study's findings, the proposed enhancement program is aimed at increasing the digital literacy level of STEM students, focusing on the predictors that influenced digital literacy and other statements in digital literacy that need improvement. Consequently, the researcher proposes an enhancement program to improve STEM students' digital literacy.

The research concludes that STEM senior high school students possess a high level of ICT self-efficacy, showcasing strong confidence and proficiency in using ICT tools, particularly in privacy and security, communication, and learning applications. They demonstrate advanced digital literacy skills, excelling in accessing, evaluating, managing, and creating scientific information through digital means, along with awareness of ethical considerations. Kinesthetic learning is the predominant learning style among these students, although visual learning is also present but less common. The study finds no significant relationship between learning style and digital literacy; however, ICT self-efficacy strongly and positively correlates with digital literacy. Within ICT self-efficacy, the communication and learning/application domains significantly influence digital literacy, meaning improvements in these areas lead to higher digital literacy levels. The study suggests that enhancing STEM students' skills in communication and learning with ICT contributes substantially to their digital competence. Finally, the research proposes an enhancement program integrated into media and information literacy courses to further improve digital literacy among STEM students through targeted activities.

REFERENCES

- Adeoye, A. A., & Adeoye, B. J. (2017). Digital literacy skills of undergraduate students in Nigeria universities. *Library Philosophy and Practice*, 1665.
- Adigwe, T. O. (2017). Digital literacy and science achievement: A correlational study of secondary school students in Nigeria. *International Journal of Education and Computer Science*, 4(4), 116–122.
- Albeta, S., Futra, D. F., Haryati, S., & Aisyah. (2021). The effect of learning style on students' learning performance during the COVID-19 pandemic. ResearchGate. https://www.researchgate.net/publication/352963654_The_Effect_of_Learning_Style_on_Students'_Learning_Performance_During_the_Covid-19_Pandemic
- Almeida, A. D., Santos, E. M. P., & Dias, H. A. (2016). The effect of learning styles on students' performance in online learning environments. *Computers & Education*, 94, 1–10.
- Armstrong, T. (2017). *The myth of the lazy learner: Why every child struggles and how we can help*. John Wiley & Sons.
- Bagon, S., & Vodopivec, J. L. (2016). Motivation for using ICT and pupils with learning difficulties. *International Journal of Emerging Technologies in Learning*, 11(10).
- Baterna, H. B., Mina, T. D. G., & Rogayan, D. V., Jr. (2020). Digital literacy of STEM senior high school students: Basis for enhancement program. *International Journal of Technology in Education*, 3(2), 105–117.
- Baylon. (2025). Digital literacy and self-efficacy of science, technology, engineering, and mathematics (STEM) strand students. *Asia Pacific Journal of Advanced Education and Technology*. <https://www.apjaet.com/wp-content/uploads/2025/08/Digital-Literacy-and-Self-Efficacy-of-Science-Technology-Engineering-and-Mathematics-STEM-Strand-Students.pdf>
- Binoya. (2020). Digital literacy profile of students: Basis for integration of information and communication technology in instructional adjustment plan. *International Journal of Novel Research in Education and Learning*. <https://www.noveltyjournals.com/upload/paper/paperpdf-1594728379.pdf>
- Cabero-Almenara, J., Gutiérrez-Castillo, J. J., Guillén-Gámez, F. D., & Gaete-Bravo, A. F. (2022). Digital competence of higher education students as a predictor of academic success. *Technology, Knowledge*

- and Learning, 28(2), 683–702.
<https://doi.org/10.1007/s10758-022-09624-8>
- Chuang, S. C., Lin, F. M., & Tsai, C. C. (2015). An exploration of the relationship between internet self-efficacy and sources of internet self-efficacy among Taiwanese university students. *Computers in Human Behavior*, 48, 147–155.
- Coccoli, M., Guercio, A., Maresca, P., & Stanganelli, L. (2014). Smarter universities: A vision for the fast changing digital era. *Journal of Visual Languages and Computing*, 25, 1003–1011.
- Coffin, C. M. (2017). *Learning styles: A comprehensive guide for teachers and learners*. Routledge.
- Commission on Higher Education. (2016). *Teaching guide for senior high school students in media and information literacy*.
http://www.deped.gov.ph/wp-content/uploads/2019/01/SHSCore_Media-and-Information-Literacy-CG.pdf
- Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed method approaches* (4th ed.). SAGE.
- Gobel, P., & Kano, M. (2014). Mobile natives, Japanese university students' use of digital technology. In J. B. Son (Ed.), *Computer-assisted language learning: Learners, teachers and tools* (pp. 21–46). Cambridge Scholars Publishing.
- Hatlevik, O. E., Throndsen, I., Loi, M., & Gudmundsdottir, G. B. (2018). Students' ICT self-efficacy and computer and information literacy: Determinants and relationships. *Computers & Education*, 118, 107–119.
<https://doi.org/10.1016/j.compedu.2017.11.011>
- Hero, J. L. (2022). Information and communications technology (ICT) literacy and self-efficacy of junior high school students: Basis for an ICT enhancement program. *International Journal of Multidisciplinary: Applied Business and Education Research*, 3(3), 393–403.
<https://doi.org/10.11594/ijmaber.03.03.10>
- Inskip, C. (2014). *Mapping resources to competencies: A quick guide to the JISC developing digital literacies resources*.
- Leeder. (2019). How college students evaluate and share “fake news” stories. *Library & Information Science Research*.
<https://www.sciencedirect.com/science/article/abs/pii/S0740818819300787>
- Manalao, A. (2022). Digital literacy and learning styles of selected Grade 11 students of Mindanao State University Senior High School.

- Mishra, P., & Mehta, R. (n.d.). What we educators get wrong about 21st-century learning: Results of a survey. ERIC. <https://eric.ed.gov/?id=EJ1123003>
- Pedarna, R., Jumadi, J., Yani, R., & Rosana, D. (2019). Assessing students' digital literacy skill in senior high school Yogyakarta. ResearchGate. https://www.researchgate.net/publication/335200021_Assessing_Students'_Digital_Literacy_Skill_in_Senior_High_School_Yogyakarta
- Permanasari, P., Panuntun, I., & Hayati, R. (2021). Improving literacy skills of students with different learning styles using e-6ts learning. *Jurnal Ilmiah Lingua Idea*, 12(2). https://www.researchgate.net/publication/357683056_Improving_Literacy_Skills_of_Students_with_Different_Learning_Styles_Using_E-6tslearning
- Rohatgi, A., Scherer, R., & Hatlevik, O. E. (2016). The role of ICT self-efficacy for students' ICT use and their achievement in a computer and information literacy test. *Computers & Education*, 102, 103–116.
- Senkbeil, M., & Ihme, J. M. (2017). Motivational factors predicting ICT literacy: First evidence on the structure of an ICT motivation inventory. *Computers & Education*, 108, 145–158. <https://doi.org/10.1016/j.compedu.2017.02.003>
- Siemens, G. (2008, January 27). Learning and knowing in networks: Changing roles for educators and designers. ITFORUM. <http://itforum.coe.uga.edu/Paper105/Siemens.pdf>
- Techataweewan, W., & Prasertsin, U. (2018). Development of digital literacy indicators for Thai undergraduate students using mixed method research. *Kasetsart Journal of Social Sciences*. <https://www.sciencedirect.com/science/article/pii/S2452315116301254>
- Yildiz, A., & Ozdemir, A. Y. (2016). The relationship between information and communication technology (ICT) self-efficacy and online learning achievement: The mediating role of online learning engagement. *Computers in Human Behavior*, 58, 256–262.
- Yip, B. (2022). Emotions as modulators of desire. *Philosophical Studies*, 179(3), 855–878. https://ink.library.smu.edu.sg/soass_research/4134