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Abstract

Digital literacy promotes students' competitiveness and better opportunity in today's digital world and in the fourth industrial revolution (FIRe). This descriptive-survey research determined the digital literacy of science, technology, engineering & mathematics (STEM) senior high school students. A total of 130 respondents from two state-owned public high schools in Zambales, Philippines answered the digital literacy survey questionnaire. Results revealed that a typical STEM respondent came from school B, aged between 15-17, female and currently Grade 11. The STEM students are digitally literate to some extent in terms of access and evaluation of information; utilization and management of information; media analysis; creation of media products; effective application of technology; and interaction through technology. There is a significant difference in the extent of digital literacy of students when grouped according to sex and grade level. Moderate significant relationship exists across all domains digital literacy. The study recommends the implementation of the proposed digital literacy working group to enhance students' digital proficiency and to equip them with the challenges of the FIRe. Teachers may likewise utilize digital devices and information effectively and responsibly towards developing digitally literate citizens.

Introduction

Science and technology has a big impact in the society. Without science and technology, the world is a complete mess. People would become well-informed and allow them to make better decisions and choices by being scientifically and technologically literate (Ng, 2013). Through the advent of technology, science has become a very powerful tool in analyzing, exploring and discovering new concepts and ideas relevant in today's generation (Macanas & Rogayan, 2019). The ability to access, process, understand, and create information or media content in the digital environment is known as digital literacy (Hsieh, 2012). The ability to locate and consume, create, and communicate digital content, while simultaneously employing a process of critical evaluation are the practices involved in becoming digitally literate (Spires & Bartlett, 2012). However, despite of being part of the Generation Z, still many students have low digital literacy.

Digital literacy facilitates better learning for the students. Many students, entering in educational settings, make the learning process meaningful by using digital devices in digital environments (Yamada-Rice, 2011; Potter, 2012). Tamoria (2016) pointed out that above all, teachers and school administration have a significant role in preparing the future generation of a rapidly-changing global society. However, failure to handle and manage digital and technological tools may lead students to risks such as believing in fake and invalidated information, and their involvement in other cybercrimes.

At the onset of the fourth industrial revolution (FIRe), Education 4.0 is a model believed to respond to its demands (Hussin, 2018; Morales, 2019; Rogayan, 2019; Rogayan & Albino, 2019). According to Atkinson (2018), Education 4.0 promotes a new learning vision and novel ways of learning that emphasize collaboration of men and machines (also known as cyber-physical system). In addition, FIRe transforms the landscape of educational technology. The continuous changes of knowledge brought new model of education for the future.

With the inception of Education 4.0, students are expected fully by being digitally literate. This is supported by Ministry for Education and Employment (2015) which claimed that claimed that rapid development of technology results to increase of need of digital literate students. The skills to effectively and critically utilize digital technologies, evaluate reliable sources and create useful information are the characteristics of digitally literate citizen. The challenge now is how teachers can facilitate students to better enhance their digital literacy which is one of the core skills that they need to possess to brave the challenges of the current education landscape and the FIRe.

In Canada, a research revealed that Canadians have no definite understanding of how to be digitally literate. Moreover, the study determined the skills and competencies needed for the sustainability of digital economy (Media Awareness Network, 2011). The European Commission (2006), on the other hand, recognized digital competence as an essential foundation of life-long learning. They argued that digital literacy is not just about ICT skills, but they need to embrace the analytic, collaborative, artistic way of using new technologies for functional and societal inclusion. Japan is recognized as digitally-wired country; however, the Japanese youth level of digital literacy is left behind other countries. It was evident that the extent of Japanese utilization of ICT in schools has not been progressing compared to those similar industrialized nation (Ministry of Education, Culture, Sports, Science and Technology [MEXT], 2011). According to Spires, and Bartlett [2012], students must be digitally literate citizen. It enables them to select and utilize digital tools that are appropriate for their purposes in an increasingly digital environment. Being digital literate allow students to create, share, and understand meaning and knowledge in a digital environment (Spires & Bartlett, 2012).

In the Philippines, the primary objective of spiral curriculum is to develop the students to become scientifically, technologically, and environmentally literate and innovative members of the community who solves problem critically, environment-friendly, productive and creative citizens, oriented decision makers, and communicate effectively (K to 12 Science Curriculum Guide, 2016). In senior high school under the K to 12 curriculum, Media and Information Literary was included as a part of the core subject under the Communication Learning Area with one semester allocation to further develop students' digital literacy (Commission on Higher Education, 2016). Assessing the students' digital skills is important so that teachers, specifically those teaching in the science, technology, engineering and mathematics (STEM) strand, will be able to develop digitally literate students. Locally, there are only few researches conducted which described Filipino students' digital literacy. This prompted the researchers to conduct an investigation on the extent of digital literacy of STEM senior high school students in two national secondary schools in Zambales, Central Luzon, the Philippines.

Literature Review

According to Ba, Tally & Tsikalas (2002), a broad definition described digital literacy as routine through which students interact and share information using technologies for the betterment of their education, career, and life. As student make their way in the 21st century decade, society become expose to digital culture. New generation learners are entitled to be fit with this kind environment which is new to 20th century learners. It is both a necessity and privilege of citizens to become digital competent in order to be functional (Ferrari, 2012). Due to wide range access to technology, the 21st century learner has the privilege to be called as digitally literate. Every educator must know that digital literacy is important in today's modern world.

As provided by Martin (2008), a broad definition of digital literacy includes ICT, information, media and visual literacy which provide additional inquiry in the digital world. He defines digital literacy as "the ability to access and utilize the electronic infrastructures that make the twenty-first century world possible". In addition, mastery of using this electronic tools is necessary to become successful in digital world. The ability to acquire and use knowledge, strategies, and personal qualities are characteristics of being digitally literate person. It also comprises the personal ability to propose, perform and assess digital activities for the improvement of tasks in life. To become digitally literate, a person must know how to, access and evaluate, utilize and manage, analyze, create and interact using digital resources (Martin, 2008).

In today's society, technology literacy is described as the capability to produce original content, and evaluate technological information to positively affect the life of every person in the community (Hansen, 2005). Technology serves as the primary source of modernization that helps learners to become competence specifically in the pedagogical field. Weber (2005) stated that it is a necessity to be aware about the technological society in order to contribute in creating a better life on the assumption of technology literacy education.

Digital literacy involves the skills in creating and evaluating information wherein it uses technology that utilize the skills in technology literacy. Thus, it works together to enhance student's skills and literacy. In the field of media education, media literacy has been a critical notion of literacy. Media literacy involves reading and writing and presents some imperative challenges in digital technology (Jenkins & Deuze, 2008).

In relation with science, digital literacy brings knowledge of natural world through systematic observation and experiments. The scientists develop new technologies, improve scientific knowledge and use technology in all their experiments through science. For the era of information communication technology (ICT) the reform-based practices have become inevitable because of integrating technology and science pedagogy. All over the world, schools have committed to secure computers to improves student development (Windschitl & Sahl, 2002). Cox et al. (2003) argue that teachers use technology as a medium to teach the content of their subject in order for the students to understand it. The most effective way to achieve digital literacy is when in individual or in collaborative activity which apply program on a specific task. Osborne and Hennessy (2001) stated that presenting information with the use of ICT informed a good effect on the student's interest in biological science. This supports the study of Selinger (2004) which made mention of digital literacy as a tool towards better educational quality. Technology does not achieve the task to be supplied to preparation of the educators, but it gives unlimited access to information, which is accessible with less effort due to internet.

Purpose of the Study

The investigation determined the digital literacy of STEM students. Specifically, it sought answers to the following research questions:

RQ1: What is the profile of the respondents?
RQ2: What is the extent of students' digital literacy in terms of access and evaluation of information; utilization and management of information; media analysis; creation of media products; effective application of technology; and interaction through technologies?
RQ3: Is there a significant difference in the extent of digital literacy of the respondents when grouped according to profile variables?
RQ4: Is there a significant relationship among the digital literacy variables?
RQ5: What enhancement program could be proposed based from the results of the study?

Method

Research Design

The study used a descriptive-survey research design with survey questionnaires as the main instrument in gathering the required data. The present study surveyed the extent of digital literacy of STEM senior high school students. According to Koh and Owen (2000), the most common descriptive research method is the survey, which comprises questionnaires, normative surveys, open-ended surveys, and phone surveys. This implies that through the gathered data analysis, the quantifiable information can be utilized for statistical inference on the target audience. The use of survey design enables the researchers to easily collaborate with diverse respondents in comparatively minimal expenditure, numerous variables can be measured by a single instrument.

Research Respondents

The respondents of this study were the Grades 11 and 12 senior high school students of two government-owned national school in Zambales, Central Luzon, Philippines. The respondents were chosen through two-tier sampling, stratified and random sampling.

Research Instrument

The Digital Literacy Survey Questionnaire (DLSQ) developed by the researchers served as the main instrument in gathering data. It is composed of two parts. The first part consists of the demographic profile of the respondents. The profile of the students includes age, sex, school, and grade level. The second part assessed the extent of digital literacy of the students with six domains with five items each, access and evaluation of information (α=0.602), utilization and management of information (α=0.618), media analysis (α=0.735), creation of media products (α=0.578), effective application of technology (α=0.690), and interaction through technology (α=0.807). The DLSQ had an excellent internal consistency having obtained an overall Cronbach's alpha coefficient of 0.904. The research tool was based from the P21 Partnership for 21st Century Learning (2015) and Digital Competence Framework (Ferrari, 2013). The survey questionnaire was subjected for content and construct validation. Three experts checked the consistency of the items in each variable. A total of 26 non-respondent STEM students were asked to answer the survey questionnaire for pilot testing. The responses were processed and subjected to reliability test.

Ibanez as cited in Rondaris, Ibañez & Varela (2014) contends that an instrument's score is only interpretable when it possesses a substantial internal consistency and when each item in the instrument measures the same construct as the rest of the items. Therefore, internal consistency correlations are essentially measures of homogeneity, with Cronbach's Alpha, being the most widely used measure. The generally agreed upon lower limit for this type of diagnostic measure to assess the internal consistency of an instrument is 0.70, although it may decrease to 0.60 in exploratory research.

Data Gathering Procedure

The researchers underwent several phases in order to gather the necessary data for the analysis and interpretation. The researchers initially developed the research instrument. The tool was checked by three experts. They evaluated the content of the Digital Literacy Survey questionnaire and reviewed how items were constructed based on the level of the respondents' understanding. Next in the process, the researchers secured the approval for the conduct of the study. Prior to the day of the conduct of the survey, the researchers secured necessary approval from concerned offices. Thereafter, the researchers underwent the research survey to 130 students.

During the survey process, the researchers guided the students in answering the survey questionnaire. Eventually, the researchers collected and encoded the result of the survey questionnaire given to the respondents. Data retrieval converts the information into electronic format and assigns a numerical value to a response. It helps to analyze the data for the summarization of findings. Lastly, the researchers conducted a random interview to support the data gathered and summarized the key findings, linked with the significance of the study and recommended what actions must be taken as a result of the findings.

Data Analysis and Ethical Considerations

The study used frequency and percent distribution, weighted mean, standard deviation, analysis of variance (ANOVA) and Pearson r for statistical analysis. Items in the survey instrument followed a four-point Likert scale format. Rating scales were analyzed using the following ranges: 1.00-1.49 = not at all, 1.50-2.49 = little extent, 2.50-3.49 = some extent, and 3.50-4.00 = great extent.

To establish and safeguard ethics in conducting this research, the researchers firmly observed the following considerations: The students' names were not mentioned in any part of the research. The students were not emotionally or physically harmed just to be a respondent of the study. The respondent was allowed not to be part of the study if he/she opted to. The respondents' identities were coded using numerical values. Proper citation and referencing of literature were done to ensure and promote copyright laws. A communication letter was presented to the principal and teachers to ask approval to gather the needed data on the extent of students' digital literacy. An informed consent and respondents' assent were secured first before they responded to the survey questionnaire.

Results and Discussion

Profile of STEM Senior High School Students

Table 1 shows the frequency and percent distribution of the respondents' demographics in terms of school, age, sex, and grade level. As shown in the table, most of the respondents were from School B with a total of 80 students (61.54%) while School A comprised a total of 50 students (38.46%). The students aged 15-17 dominated the distribution with a total of 94 (72.31%). Students aged 18-19 had a total number of 34 (26.15%) while aged 20 and above had only 2 (1.15%) students. As shown, there were more females (79 or 60.77%) compared to males (51 39.23%). Out of 130 student-respondents, 81 (62.32%) were Grade 11 while 49 (37.69%) were grade 12.

Table 1. Demographic Profile of the Respondents

Profile	Categories	Frequency	Percent
School	A	50	38.46
	B	80	61.54
Age	15-17	94	72.31
	18-19	34	26.15
	20- above	2	1.54
Sex	Male	51	39.23
	Female	79	60.77
Grade level	11	81	62.31
	12	49	37.69

Digital Literacy of STEM Students

Table 2 presents the extent of digital literacy of the STEM students in terms of six domains.

Table 2. STEM Students' Extent of Digital Literacy

Domains	M	SD	VD	Rank
Access and Evaluation of Information	3.23	0.44	SE	4
Utilization and Management of Information	3.15	0.53	SE	5.5
Media Analysis	3.24	0.51	SE	3
Creation of Media Product	3.15	0.50	SE	5.5
Effective Application of Technology	3.48	0.44	SE	1
Interaction through Technology	3.36	0.48	SE	2
Overall	**3.27**	**0.48**	**SE**	

**M=Mean; SD-Standard Deviation; VD-Verbal Description; SE-Some Extent*

Access and Evaluation of Information

STEM students are literate to some extent in terms of access and evaluation of information with an overall mean of 3.21 (SD=0.44). They understand to some extent about protecting their own devices (cellular phone, laptop, etc.) and understanding online risks and threats. This implies that students could moderately identify the unnecessary things that may cause malware to their digital devices. Meanwhile, the student-respondents gained the lowest mean in the indicator, access science information in credible website sources. This means that students could spread science related information minimally. Based from the interview among the selected respondents, they indicated access and evaluation of information as one of their practices as a responsible digital citizen. One respondent shared that he is alert and active at all times especially when encountering suspicious messages, links, pop-up windows, and other sites to prevent computer from being infected from malicious software. Another respondent mentioned that as a responsible digital citizen, if there is malware during computer laboratory, he always informs the teacher so that any problems can be addressed right away.

In addition, one of the respondents shared that he practices responsible digital citizen through the access of science information in credible website sources. Furthermore, one of the respondents mentioned that he has always been responsible in evaluating scientific information critically and competently. These signify that they can verify if the given information was useful. This supports the study conducted by Ministry for Education and Employment (2015) which stated that digitally literate person can utilize digital devices strategically to evaluate information and use the internet to accomplish academic, professional and personal goal.

Utilization and Management of Information

STEM students are digitally literate to some extent in terms of utilization and management of information as shown in an overall mean of 3.15 (SD= 0.53). The respondents use to some extent information accurately and creatively for the current issues and problems in science. This connotes that students can fairly use the given information accurately and creatively with the understanding of the ethical and legal issues. On the other hand, the respondents are literate to some extent in manipulating and storing scientific information and content for easier retrieval. This implies that students have moderate manipulation and retrieval of science related information.

Response from the interview indicated that students utilize and manage the information. Two among the respondents said that they practice responsible digital citizenship by searching for information with reliable sources which shows that they manage the flow of scientific information from a wide variety of sources. Another respondent mention that he practices being responsible digital citizen in terms of science through comparing things which are scientifically proven by other scientists.

This denotes that he can use and store scientific information. It supports the study of Spires & Bartlett (2012) which they stated that, digital literacy enables them to select and utilize digital tools that are appropriate for their purposes in an increasingly digital environment. Digital literacy enables students to create, share, and understand meaning and knowledge" in a digital environment as a wide-range set of practices.

Media Analysis

The STEM students are literate to some extent in the domain of media analysis with an overall mean of 3.24 (SD=0.51). They have moderate literacy in terms of examining how media can influence beliefs and behaviors regarding issues in science and technology. This suggests that students can be highly influenced by the media in terms of how they think and how they behave in relation in science and technology. They also have literacy to some extent on applying a fundamental understanding of the ethical and legal issues surrounding media analysis. This indicates that students have moderate level of content analysis and cannot address the intellectual property of the information.

Data from the interview revealed that media analysis is being practiced by the respondents. One of the respondents quoted "think before you click". This is parallel with the response of other respondents stated that "be responsible in what you say" which supports the statement of the two respondents. This signify that they analyze, examine and apply a fundamental understanding of the ethical and legal issues surrounding media analysis. In the same vein, the European Commission (2006) recognized digital competence as an essential foundation of life-long learning. They averred that digital literacy is not just about ICT skills, but they need to embrace the analytic, collaborative, artistic use of new technologies for functional and societal inclusion.

Creation of Media Products

As gleaned on the table, STEM students possess to some extent literacy in terms of creation of media products with an overall mean of 3.15 (SD= 0.50). Specifically, the students have digital literacy to some extent in creative expression of digital media and technologies. This signifies that students can create and utilize the most appropriate digital tools for scientific reports and projects. They can modify, refine and mash-up to some extent existing resources to create new, original and relevant content and knowledge in science. This connotes that students have a moderate level in terms of utilization and creation of science related content.

Based from the interview, some of the respondents indicated creation of media products as one of their practices as responsible digital citizens. One respondent stated that he practices responsible digital citizenship by utilizing digital devices as a means in conducting a research. This implies that he can modify, refine and mash-up existing resources to create new, original and relevant content and knowledge in science. This supports the study of Hsieh (2012) which stated that the ability to access, process, understands, and creates information or media content in the digital environment was called digital literacy.

Effective Application of Technology

The STEM students possess literacy to some extent in terms of effective application of technology with an overall mean of 3.48 (SD=0.44). The respondents attained the highest literacy in the use technology as a tool to research, organize, evaluate and communicate information in science. This suggests that students can highly use technology to process science information for the benefits of diverse society. The respondents are literate to some extent in terms of using technologies and media for teamwork, collaborative processes and co-construction and co-creation of resources, knowledge and content in science This connotes that students can moderately interact when it comes with the collaborative process involving technology.

Several respondents shared that they practice responsible digital citizenship by applying what they have learned. This implies that students can apply a fundamental understanding of the ethical and legal issues. Another respondent stated "a citizen must know how to protect its privacy" which connotes that he is aware of cultural diversity aspects he can protect self and others from possible online dangers (e.g. cyber bullying, cybersex, etc.). This supports the study of Hansen (2005) which described that technology literacy is the abilities to evaluate technological information to positively affect the life of every person in the community (Hansen, 2005). Technology serves as the primary source of modernization that helps learners to become competence specifically in the pedagogical field (Weber, 2005).

Interaction through Technologies

The STEM students are digitally literate to some extent in terms of effective application of technology with an overall mean of 3.36 (SD=0.48). Students apply to some extent a fundamental understanding of the ethical and legal issues surrounding the effective application of technologies. This shows that students can use technology as a means to create new scientific information to be utilized by the digital society. They are also aware of cultural diversity aspects and are able to protect self and others from possible online dangers (e.g. cyber bullying, cybersex, etc.). Thus connotes that students are quite aware in the diverse culture and they cannot use digital technologies effectively.

Furthermore, several respondents shared in an interview that the interaction through technology is a means of being digitally literate citizen. One respondent stated that she always cites the source of information as a responsible scholar by giving credits to the author. This implies that she knows about proper citation of articles and to connect new ideas into a current scientific body of information. Another respondent mentioned that media devices like computer, laptops, cellphone, tablets are useful in educating and learning. This suggests that she can utilize various digital devices and applications. This is aligned with the study of Xie (2008) which stated that information retrieval is a collaborative process, consisting of dynamic interplay between IR systems and users.

Difference in the Respondents' Extent of Digital Literacy as to Profile Variables

Table 3 shows the difference in the respondents' extent of digital literacy based on the domains when grouped according to school.

Table 3. Independent Samples t-test for the Extent of Digital Literacy of STEM Senior High School by School

Domain	School	M	SD	t-value	df	p-value	Decision
Access of Information	A	3.20	0.45	0.576	128	0.566	Accept H_o
	B	3.25	0.44				
Utilization of Information	A	3.04	0.62	1.817	128	0.072	Accept H_o
	B	3.22	0.45				
Media Analysis	A	3.17	0.46	1.282	128	0.202	Accept H_o
	B	3.29	0.54				
Creation of Product	A	3.07	0.51	1.498	128	0.137	Accept H_o
	B	3.20	0.49				
Application of Technology	A	3.42	0.52	1.294	128	0.198	Accept H_o
	B	3.52	0.38				
Interaction through Technology	A	3.26	0.52	1.828	128	0.070	Accept H_o
	B	3.42	0.45				

Note: $N_{School\ A=50\ School\ B=80}$ ** Significant at* $p < 0.050$ **equal variances assumed*

As shown on the table, there are no significant differences in the extent of digital literacy across all domains when grouped according to school. However, it is evident that School B gained higher means scores compared to School A. Both of the schools are government-owned secondary schools in Zambales, Philippines.

Table 4 shows the difference in the respondents' extent of digital literacy based on the domains when grouped according to age. A one-way analysis of variance between groups was conducted to explore the extent of digital literacy of STEM senior high school students. There are no significant differences in the extent of digital literacy across all domains when grouped according to age.

Table 4. One-Way Analysis of Variance of the Respondents' Extent of Digital Literacy by Age

Domain	SS	df	MS	F	p-value	Decision
Access of Information						
Between Groups	0.309	2	0.155	0.790	0.456	Accept H_o
Within Groups	24.875	127	0.196			
Total	25.184	129				
Utilization of Information						
Between Groups	0.150	2	0.075	0.266	0.767	Accept H_o
Within Groups	35.635	127	0.281			
Total	35.785	129				
Media Analysis						
Between Groups	1.131	2	0.565	2.199	0.115	Accept H_o
Within Groups	32.651	127	0.257			
Total	33.781	129				
Creation of Product						
Between Groups	0.257	2	0.128	0.509	0.603	Accept H_o
Within Groups	32.068	127	0.253			
Total	32.325	129				
Application of Technology						
Between Groups	0.390	2	0.195	1.004	0.369	Accept H_o
Within Groups	24.633	127	0.194			
Total	25.023	129				
Interaction through Technology						
Between Groups	0.177	2	0.089	0.377	0.687	Accept H_o
Within Groups	29.822	127	0.235			
Total	29.999	129				

**Significant at p <0.050* **equal variances assumed*

The computed p-value for access (0.456); utilization (0.767); analysis (0.115); creation (0.603); application (0.369) and interaction (0.687) are higher than (>) 0.05 level of significance, thus the null hypothesis is accepted. Hence, there were no statistically significant differences at the 0.05 level of significance in the digital literacy mean scores of the respondents. There is no sufficient evidence to show statistically significant differences in the respondents' digital literacy rating in the program relevance by age.

Table 5 shows the difference in the respondents' extent of digital literacy based on the domains when grouped according to sex.

Table 5. Independent Samples t-test for the Extent of Digital Literacy of STEM Senior High School by Sex

Domain	Sex	M	SD	t-value	df	p-value	Decision/ Interpretation
Access of Information	Male	3.38	0.33	3.268	128	0.001*	Reject H_o
	Female	3.13	0.48				
Utilization of Information	Male	3.25	0.45	1.785	128	0.077	Accept H_o
	Female	3.08	0.57				
Media Analysis	Male	3.28	0.48	0.674	128	0.501	Accept H_o
	Female	3.22	0.53				
Creation of Product	Male	3.29	0.45	2.531	128	0.013*	Reject H_o
	Female	3.06	0.51				
Application of Technology	Male	3.56	0.38	1.711	128	0.090	Accept H_o
	Female	3.43	0.47				
Interaction through Technology	Male	3.39	0.44	0.593	128	0.554	Accept H_o
	Female	3.34	0.51				

Note: $N_{Male=51\ Female=79}$ **equal variances assumed* **Significant at p <0.05*

As seen on the table, there are statistically significant differences between the mean scores in access of information according to sex (t=3.268, p<0.05) which implies that male students (M=3.38; SD=0.33) have higher digital literacy in this domain than the females (M=3.13; SD=0.48). On the other hand, digital literacy in terms of creation of product (t=2.531, p<0.05) also registered significant difference which implies that male students (M=3.29; SD=0.45) are more digitally literate than the females (M=3.06; SD=0.51). Meanwhile, there are no significant differences in the extent of digital literacy in terms of utilization of information, media analysis, application of technology, and interaction through technology according to sex. However, it can be noted that males registered higher digital literacy mean scores than their female counterparts.

Table 6 shows the difference in the respondents' extent of digital literacy based on the domains when grouped according to grade level.

Table 6. Independent Samples t-test for the Extent of Digital Literacy of STEM Senior High School by Grade Level

Domain	Grade Level	M	SD	t-value	df	p-value	Decision
Access of Information	Grade11	3.19	0.43	1.572	128	0.118	Accept H_o
	Grade12	3.31	0.46				
Utilization of Information	Grade11	3.06	0.56	2.631	128	0.010*	Reject H_o
	Grade12	3.30	0.44				
Media Analysis	Grade11	3.18	0.47	1.861	128	0.065	Accept H_o
	Grade12	3.35	0.56				
Creation of Product	Grade11	3.06	0.49	2.591	128	0.011*	Reject H_o
	Grade12	3.29	0.49				
Application of Technology	Grade11	3.43	0.48	1.625	128	0.107	Accept H_o
	Grade12	3.56	0.36				
Interaction through Technology	Grade11	3.29	0.50	2.095	128	0.038*	Reject H_o
	Grade12	3.47	0.43				

Note: $N_{Grade\ 11=81\ Grade\ 12=49}$ **equal variances assumed* **Significant at p <0.050*

There is a statistically significant difference between the mean scores in the digital literacy domain in terms of utilization of information (t=2.631, p<0.05), creation of product (t=2.591, p<0.05), and interaction through technology (t=2.096, p<0.05). This implies that grade 12 students (M=3.30, SD=0.44) are digital literate than grade 11 (M=3.06, SD=0.56) in terms of utilization of information. In addition, grade 12 students (M=3.29, SD=0.49) rated themselves digitally literate than grade 11 (M=3.06, SD=0.49) in terms of creation of product. In interaction through technology, grade 12 (M=3.47, SD=0.43) also got a higher mean compared to grade 11 (M=3.29, SD=0.50). Specifically, there are no significant differences in the extent of digital literacy among the following domains; access of information, media analysis, and application of technology when grouped according to grade level. However, it can be noted that Grade 12 registered higher mean scores than Grade 11.

Difference in the Respondents' Extent of Digital Literacy as to Profile Variables

Table 7 shows the inter-correlations among the digital literacy domains.

Table 7. Correlation among the Domains of Digital Literacy of STEM Senior High School Students

Domain	1	2	3	4	5	6
1. Access and Evaluation of Information	–					
2. Utilization and Management of Information	.685**	–				
3. Media Analysis	.504**	.492**	–			
4. Creation of Media Products	.541**	.570**	.510**	–		
5. Effective Application of Technology	.506**	.509**	.497**	.584**	–	
6. Interaction through Technology	.561**	.560**	.472**	.563**	.652**	–

***Correlation is significant at the 0.01 level (2-tailed)*
**Correlation is significant at the 0.05 level (2-tailed)*

As presented in the table, inter-correlations among all domains of digital literacy of the students are moderately significant. In particular, there is a higher moderately significant correlation between utilization and management of information; and access and evaluation of information (r=0.685; p<0.01) this implies that the students with moderate utilization and management of information, likely have moderate access and evaluation of information. Additionally, it can also be noted that there is a higher moderate correlation between interaction through technology and effective application (r=0.652; p<0.01) implying that students with moderate interaction through technology, likely have an effective application of technology. Moreover, effective application of technology and creation of media product have higher moderately significant correlation (r=0.584; p<0.01) which suggest that if the students can effectively apply technology, likewise they can create a media product. Furthermore, the extent of digital literacy of the students in terms of creation of media products; and utilization and management of information have higher moderately significant correlation (r=0.570; p<0.01) this infer that students who create a media product, hence can utilize and manage the information. Although moderately significant, the following domains have lower correlation values; media analysis and utilization and management of information ($r=0.492$; $p<0.01$); and interaction through technology and media analysis ($r=0.472$; $p<0.01$).

Proposed Enhancement Program to Increase STEM Students' Digital Literacy

The proposed enhancement program was crafted based from the results of the survey conducted among STEM Senior High School students (see Table 8).

Table 8. Digital Literacy Working Group: A Propose Enhancement Program

Objectives	Activities	Persons Involved	Duration	Expected Output
1. Disseminate information about the relevance of digital literacy.	***Feed your mind now!*** Putting up of tarpaulin, distribution of pamphlets and brochure announcing the launching of the	(DepEd); School Administration; Principal; Faculty; Students; Parents; and other Stakeholders.	June (2nd week)	At least 95% of the students will attend the intervention program.
2. Enhance students' awareness with regards to digital literacy.	***Let's go STEM!*** Orientation Program; Forum on the scope of the program	Sangguniang Kabataan, Researchers, Faculty, and students	June (3rd week)	STEM Students are expected to give 85 % of their commitment to join.
3. Use a variety of digital devices and various means to get reliable information.	***Choose the best!*** Conduct a brain storming about the qualities of being digitally literate.	Researchers, Faculty and students	July- August (Every Friday of the month)	85% of the participants will actively participate in the program
4. Assess the students' ability to access and evaluate information.	***Think before you click!*** Collaboration of students on proper accessing and evaluating of information.	Researchers, Faculty and students	September (Every Friday of the month)	100% of the participants are expected to improve their level accessing and evaluating of information.
5. Monitor the students' level of utilization and management of information.	***Focus on me!*** Provide students with reliable sources and monitor their utilization.	Researchers, Faculty and students	October (Every Friday of the month)	90% of the participants will utilize the given source
6. Share ways to analyze media content.	***Pick the right!*** Choose current issues and let the students make a reflection journal.	Researchers, Faculty and students	November (Every Friday of the month)	Monthly report of reflection journal
7. Facilitate the students in the creation of media products.	***Create a good one!*** Spearhead content creation workshop	Researchers, Faculty and students	December (Every Friday of the month)	95% of the participants are expected to create media product.
8. Describe the effective application of technology.	***Use it wisely!*** Apply technology in demonstration and communication.	Researchers, Faculty and students	January (Every Friday of the month)	90% of the participants are expected to effectively apply technology.
9. Increase the level of interaction through technology.	***Inter-ethics!*** Interact using digital folder as a means in education	Researchers, Faculty and students	February (Every Friday of the month)	STEM participants are expected to improve their level of interaction through technology
10. Evaluate the effectiveness of the program.	***Digitally meant to be!*** Result and effectiveness of the program.	Researchers, Faculty and students	March (Every Friday of the month)	Evaluation report

The proposed program can support the students to enhance their level of digital literacy. The different activities included are geared toward developing digital competent STEM students that will serves as their edge among other strand. Also, it will help them to have better opportunities in finding a profession align with their chosen career.

Conclusions

The study determined the extent of digital literacy of STEM senior high school students as basis for a proposed enhancement program. The study concludes that a typical STEM respondent is from school B, aged between 15-17, female and currently grade 11. The degree of digital literacy of STEM Senior High School students in all domains is rated to some extent. There is a significant difference in the extent of digital literacy of students when grouped according to sex and grade level. Moderate significant relationship exists across all domains of the digital Literacy. The proposed enhancement program was crafted based from the survey results and is proposed to facilitate the improvement of the students' extent of digital literacy.

Recommendations

The study recommends that the proposed working group about digital literacy may be established to help the students to achieve higher digital literacy. Being digitally literate will eventually become the students' advantage in the workplace and in the new industrial era. Teachers may likewise utilize digital devices and information effectively and responsibly towards developing digitally literate citizens. The digital interests of the students may be considered by the teachers in designing the learning tasks. Teachers may also craft digital literacy rubrics to gauge students' performances in a digital classroom. Students should be willing to participate and apply what they learn to enhance their digital literacy skills. Since the study only involved STEM students, further studies may be conducted in other students from different disciplines and to a larger population to validate the results of this study.

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Appendix. Digital Literacy Survey Questionnaire

Part I. DEMOGRAPHIC PROFILE
Direction: Please fill in the following information and check the appropriate boxes.

Age: □ 15 - below □ 16 – 17 □ 18 – 19 □ 20 – 21 □ 22 – above
Sex: □ Male □ Female
Grade Level: □ 11 □12

Part II. DIGITAL LITERACY OF STEM STUDENTS
Direction: Please rate the extent of your digital literacy. Put a check mark (√) to the corresponding rating as follows:
4 – Great Extent 3 –Some Extent 2 – Little Extent 1 – Not at all

Indicators	4	3	2	1
A. Access and Evaluation of Information				
1. Access science information efficiently (time) and effectively (sources).				
2. Evaluate scientific information critically and competently.				
3. Access science information in credible website sources.				
4. Protect own devices (cellular phone, laptop, etc.) and understand online risks and threats.				
5. Spread science-related news, content and resources proactively.				
B. Utilization and Management of Information				
1. Use information accurately and creatively for the current issues and problems in science.				
2. Manage the flow of scientific information from a wide variety of sources.				
3. Apply a fundamental understanding of the ethical and legal issues surrounding the access and use of information.				
4. Manipulate and store scientific information and content for easier retrieval.				
5. Share with others the location and content of information found regarding science and development.				
C. Media Analysis				
1. Understand both how and why media messages are constructed for scientific research purposes.				
2. Examine how individuals interpret messages differently.				
3. Examine how values and points of view are included or excluded.				
4. Examine how media can influence beliefs and behaviors regarding issues in science and technology.				
5. Apply a fundamental understanding of the ethical and legal issues surrounding media analysis.				
D. Creation of Media Products				
1. Utilize the most appropriate media creation tools, characteristics and conventions for science reports and projects.				
2. Utilize effectively the most appropriate expressions and interpretations in diverse, multi-cultural environments.				
3. Create science-related content in different formats including multimedia.				
4. Express creatively through digital media and technologies.				
5. Modify, refine and mash-up existing resources to create new, original and relevant content and knowledge in science.				
E. Effective Application of Technology				
1. Use technology as a tool to research, organize, evaluate and communicate information in science.				
2. Use digital technologies (computers, media players, GPS, etc.), communication tools and social network appropriately to process science information for the benefits of society.				
3. Apply a fundamental understanding of the ethical and legal issues surrounding the effective application of technologies.				
4. Use technologies and media for teamwork, collaborative processes and co-construction and co-creation of resources, knowledge and content in science.				
5. Become aware of cultural diversity aspects and to be able to protect self and others from possible online dangers (e.g. cyber bullying, cybersex, etc.).				
F. Interaction through Technologies				
1. Interact through a variety of digital devices and applications.				
2. Understand how digital communication is distributed, displayed and managed for scientific purposes.				
3. Understand appropriate ways of communicating through digital means.				
4. Adapt scientific communication modes and strategies to the specific audience.				
5. Know about citation practices and to integrate new information into an existing scientific body of knowledge.				