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Analysis of the Use of LabXChange as a Virtual Laboratory Media to Improve Digital and Information Literacy for Biology Education Undergraduate Students

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abstract

Learning media is very important in order to facilitate learning or the income of information. In this 21st century, learning is not only focused on how to get but also how to find. 21st-century learning is also emphasized on digital literacy and also information literacy which is considered a fast door to learning. High digital literacy and information literacy, will facilitate the learning process carried out by students. This study aims to determine whether using LabXChange can improve or facilitate subjects in digital literacy and information literacy. The pre-Experimental design was used as a method in this study with a one-group pretest-posttest design. The research subjects were 15 subjects with a sampling technique purposive sampling. This study obtained the results with $H_0 = H_a \neq H_b = H_c$, which means, the 15 subjects can increase digital and information literacy with the use of LabXChange as a media for students.

1. Introduction

The development of science is growing rapidly in the 21st century, the presence of technology makes it easier for people to access information. Fast information makes it easier for someone to have information literacy. The development of science is growing rapidly in the 21st century, and the presence of technology makes it easier for people to access information. Fast information makes it easier for someone to have information literacy. Information literacy is not just about how to get information. However, in information literacy, a person should be able to process information, think critically and logically, and not easily believe in scattered information; in other words, sceptical. People who have literacy skills are those who can evaluate the information obtained. In the 21st century, the development of information and communication technology (ICT) such as the internet, computers, and gadgets that can be used as media that can help humans to develop literacy skills is not in the form of print-based texts. Digital information can be developed in e-books, e-modules, and websites as the role of digital information sources (Purnama et al., 2021; Rachmawati & Saepudin, 2017). For example, the use of e-modules can make digital information conveyed clearly visible, as in a study conducted by Sanova (Sanova et al., 2022) who found the result that learning when using e-modules, the subjects he studied could search for information digitally.

Digitization has many positive impacts, one of which is by making it easier for individuals to find information with the help of the internet (Nanto et al., 2022; Tanfiziyah et al., 2021). However, digitization cannot be done if individuals do not know how to use the internet, computers, or gadgets as a medium to obtain this information, therefore, it is very important to have digital literacy in individuals. Quoting from the book "Indonesian Digital Literacy Framework" (Syaripudin et al., 2018), Digital literacy is the ability to use information and communication technology (ICT) to utilize, create, discover, discover, and communicate content/information (Syaripudin et al., 2018). Digital literacy is the most important thing that must be mastered in the 21st Century, technological developments that continue to grow rapidly are a challenge for every individual to be able to understand it (Purnama et al., 2021). The challenges in the 21st century are not just on the 4C skills that are magnified by many studies, but the challenges in the 21st century must focus on qualified literacy such as digital literacy, and information literacy. Digital literacy is a major challenge for future generations, because in the future, the use of technology will be very rapid and very complex (Malik, 2018). In contrast to the future way of thinking, gathering information will be very difficult, because in the future you will be faced with a variety of confusing information sets due to freedom of opinion, therefore, information literacy skills are needed to know how someone processes information (Rahmatullah et al., 2022).

Having digital literacy skills and information literacy is considered a fast door to learning (Putra et al., 2022). Undergraduate students are required to have digital literacy skills and information literacy, because according to The enGauge 21st Century Skills, having information literacy and digital literacy are included in the skills needed in the 21st century to face the opportunities and challenges of the industrial revolution 4.0 (Burkhardt, G., Mosour, M., Valdez, G., Gunn, C., Dawson, M., Lemke, C., Coughlin, E., Thadani, V., & Martin, 2003). Quoted from Lai and Viering (Lai & Viering, 2012) in "Assessing 21st Century Skills: Integrating Research Findings" not only digital and information literacy skills, but also media literacy skills (AACTE and P21, 2010). In summary, literacy skills that are important for society in the 21st century include information literacy, digital literacy, and media literacy (Sujana & Rachmatin, 2019). As in the research conducted by Spires (Spires et al., 2019), shows that digital literacy is very necessary in the 21st century, especially in the field of education which requires the readiness of students' abilities in the 21st century to achieve super abilities that must be possessed in the future. In addition, Silber-Varod (Silber-Varod et al., 2019) argues that digital literacy is the main provision in understanding a technology later, coupled with the very rapid development of information requires a very high digital understanding as well. Digital literacy is not completely independent, as Silber-Varod reveals the rapid development of information, Moto (Moto et al., 2018) argues that planning information is very important, or it can also be called information literacy, which is where a person is able to digest information correctly and unbiased.

It is clear that in the 21st Century, learning is not only focused on how to get digital literacy knowledge but also how to find it. Mastery of these two literacy skills will make it easier for students in the learning process, such as finding their own learning media so that undergraduate students can more easily achieve the goals that have been set. Introduction of various abilities and skills such as; Observing experiments and conducting tests in the laboratory is very important to use real and virtual laboratories to simplify and make laboratory activities more effective. Learning activities using practicum can be divided into two, namely practicum activities with real laboratories and virtual laboratories (Cesariyanti et al., 2022; Putra et al., 2021), with one example of virtual laboratory learning media developed by Harvard University with support from the Amgen Foundation, believe LabXChange (labXchange, 2021). The LabXChange virtual laboratory is an example of the integration of computer technology as digital learning. In the LabXChange platform, users can use it as a means or media to learn, teach, and practice science

using technology. One of the features of this digital platform is the existence of a virtual laboratory simulation that can be used as a medium in learning, especially to explain various events that are impossible to observe directly or conduct research that is constrained by laboratory equipment or others. In addition to virtual laboratories, LabXChange also has innovations in integration such as the Learning Management System (LMS) where educators can assemble all laboratory activities such as providing theoretical steps, work steps, and also tests that must be done by students. The whole series, assembled into a systematic series that must complete the previous task before continuing the next task. Therefore, this study aims to explore the use of LabXChange in increasing literacy and digital information for undergraduate biology education students.

The systematic use of LMS certainly does not only require the readiness of devices that can support laboratory activities, but also digital literacy skills. As research conducted by Oh (Oh et al., 2021), in her research Oh found that the systematic use of LMS can make adult learners find it difficult but will get used to it if it is done in a structured manner. Oh's statement is supported by research conducted by Tohara (Tohara, 2021), which in his research states that digital literacy should be improved by using systematic digital integration such as; (1) Use of LMS; (2) digital-based learning; (3) Use of virtual laboratories; and (4) the habit of using digital technology in life. Therefore, this study aims to explore the use of LabXChange in increasing literacy and digital information for undergraduate biology education students.

2. Method

Research on the subject of Biology Education students in semester 6, totaling 15 subjects, was carried out in the even semester 2020/2021 academic year, using the research method used, namely pre-experimental with one group pretest-posttest design, the sampling technique used was purposive sampling. Schematically, it can be seen in table 1, and in a flow chart, the flow of research carried out can be seen in Figure 1.

Table 1. One group pretest-posttest design scheme

Sampling	Pretest	Treatment	Posttest
Purposive	O_1	X	O_2

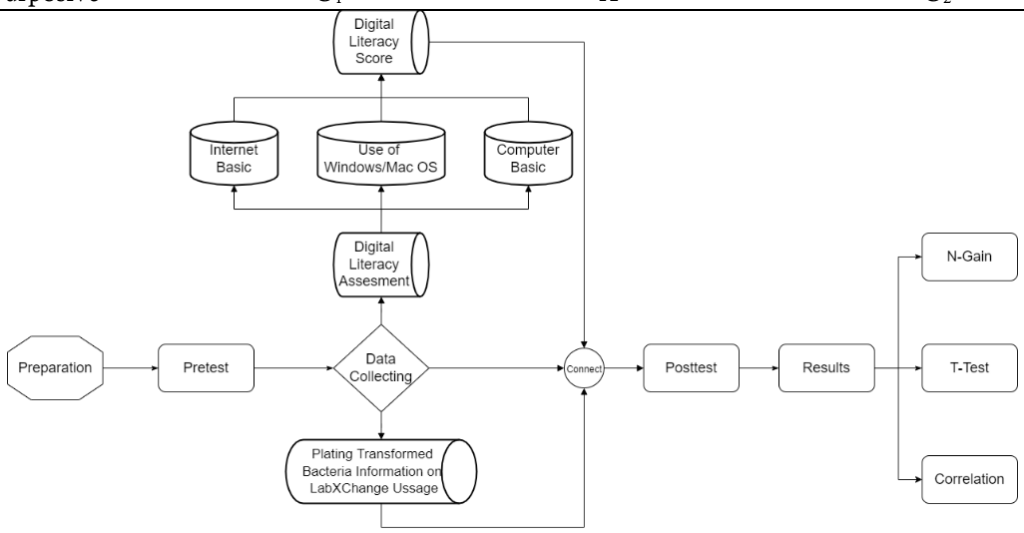

Figure 1. Research flowchart

Data collection for early and late digital literacy uses an assessment provided by Northstar at the link https://www.digitalliteracyassessment.org/. The assessments assessed are; (1) Use of Windows/Mac OS; (2) Internet Basics; (3) Basic Computer. The initial and final information

literacy data collection was by using a similar assessment but by adding an initial understanding of Plating Transformed Bacteria by searching through some of the information available on the internet. In the treatment, the subject was given the use of LabXChange with the domain www.labxchange.org, then selected Platting Transformed Bacteria. The display of LabXChange interactively simulated Plating Transformed Bacteria can be seen in Figure 2.

Figure 2. Platting transformed bacteria LabXChange (https://www.labxchange.org/library/items/lb:LabXchange:d92f7509:lx_simulation:1)

After carrying out virtual laboratory activities as shown in Figure 2 and finding out about plating transformed bacteria on the internet, the subject then did a posttest that had been prepared previously in LabXChange by researchers to find out whether there was an increase from the pretest or not. The increase in digital and information literacy is calculated based on the value of Normal Gain (N-Gain) which is normalized appropriately to avoid misinterpretation of the total N-Gain gain. Paired sample t-test was conducted to determine the significance of differences for samples with the same subject but receiving two different treatments (Riduwan & Akon, 2009). Selain itu, penelitian ini mencari tahu juga apakah adanya korelasi antara domain digital literacy, dan information literacy pada penggunaan virtual laboratory dengan menggunakan pedoman derajat hubungan yang dapat dilihat pada tabel 2 (Hidayati, 2020).

Table 2. Pearson correlation degree guide

Pearson Correlation Value	Description
0.00 – 0.20	No Correlation
0.21 – 0.40	Weak Correlation
0.41 – 0.60	Moderate Correlation
0.61 – 0.80	Strong Correlation
0.81 – 1.00	Perfect Correlation

3. Result and Discussion

The pretest-posttest analysis of literacy and digital information can be seen in Figure 3, the graph shows the average N-Gain value to determine the results of the pretest-posttest analysis.

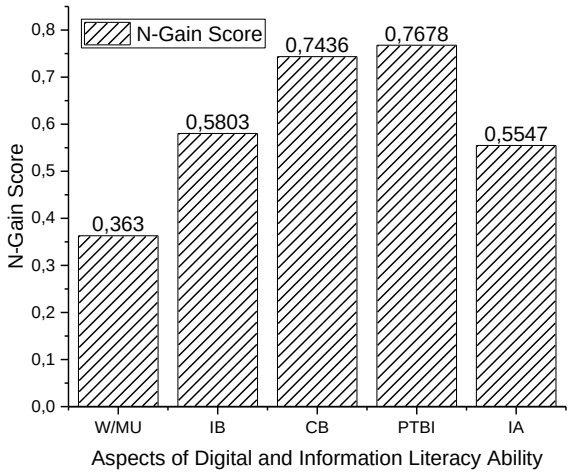

Figure 3. N-Gain recapitulation of all aspects of digital and information literacy
*Note: W/MU = Windows/Mac Usage, IB = Internet Basic, CB = Computer Basic, PTBI = Platting Transformed Bacteria Information, IA = Information Assessment.

The literacy aspect assessment is then averaged so that the results of the N-Gain Score for these two aspects can be seen in Figure 4.

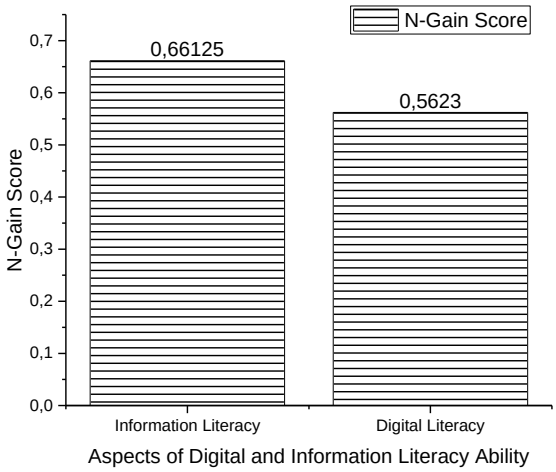

Figure 4. Average N-gain score on digital literacy and information literacy

Paired sample t-test was conducted to find out the results of hypothesis testing and make a decision whether there was an increase or not in the digital literacy domain which can be seen in table 3, and information literacy can be seen in table 4.

Table 3. Paired sample t-test on digital literacy

Paired Differences					t	df	sig (2-tailed)
Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
			Lower	Upper			
-25.87778	16.73228	2.49430	-30.90471	-20.85085	-10.375	44	.000

Table 4. Paired sample t-test on information literacy

Paired Differences					t	df	sig (2-tailed)
Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
			Lower	Upper			
-39.09333	21.64873	3.95250	-47.17710	-31.00956	-9.891	29	.000

Figure 2 shows that the average value of N-Gain at W/MU gets a result of 0.363 which indicates the medium category, IB gets a result of 0.5803 which indicates the high category, CB gets a result of 0.7436 which indicates the high category, PTBI gets the result of 0.7678 which indicates the high category, IA gets the result of 0.5547 which indicates the medium category. There are no results that get the low category which indicates an increase in aspects of digital and information literacy. These results are in line with research conducted by Shopova (Shopova, 2014) in her research showed an increase in the use of ICT stimuli provided to conduct virtual trials. The findings in tables 3 and 4 are in linear with the findings made by Rizal (Rizal et al., 2019), in his research revealed that some science teachers have a view that tends to support the existence of virtual digital activities/trainings that can increase proficiency in using technology. Besides that, Rizal (Rizal et al., 2019) in his findings also reveal that the use of technology in education is believed to be able to increase digital literacy and also make it easier to find information, however, Emmett (Emmett & Emde, 2007) revealed that information literacy must be done with guidance and guidance to find out how to get the expected information. Bruehl (Bruehl et al., 2015) conducted research on several subjects to find out how to improve information literacy and in his research showed that virtual activities can increase directed and interactive information literacy.

Increasing digital literacy as well as information literacy is closely related to the use of virtual laboratories, as found by Susilawati (Susilawati et al., 2021) In her findings, he found that in addition to digital literacy and information can be improved using a virtual laboratory, in fact there is a perfect correlation between increasing digital literacy and using a virtual laboratory. Besides, Manalu (Manalu et al., 2021) revealed that there is a relationship between digital literacy which is supported by the ability to find information on the use of virtual laboratories because the use of virtual laboratories is not only oriented to how someone is skilled in carrying out laboratory activities, but also how that person knows and also understands what he is doing in real time. digital, coupled with the use of an all-digital virtual laboratory, makes one have to understand more deeply the use of a technology including existing features. As according to Susilawati's and Manalu findings, this study found a correlation between increasing digital literacy and information literacy on the use of virtual laboratories which can be seen in tables 5 and 6.

Table 5. Correlation results between digital literacy and use of VLab

		Digital Literacy	Virtual Laboratory
Digital Literacy	Pearson Correlation	1	.807**
	Sig. (2-tailed)		.000
	N	15	15
Virtual Laboratory	Pearson Correlation	.807**	1
	Sig. (2-tailed)	.000	
	N	15	15

Table 6. Correlation results between information literacy and use of VLab

		Information Literacy	Virtual Laboratory
Information Literacy	Pearson Correlation	1	.744**
	Sig. (2-tailed)		.000
	N	15	15
Virtual Laboratory	Pearson Correlation	.744**	1
	Sig. (2-tailed)	.000	
	N	15	15

The correlation results in tables 5 and 6 show that in the digital literacy and information literacy domains there is a correlation with each shown in the Sig value. (2-tailed) which is worth .000, but the difference is seen in the degree of relationship, namely in digital literacy there is a perfect degree of relationship shown in the Pearson correlation which is valued .807, and in information literacy there is a strong degree of relationship as indicated in the Pearson correlation. which is valued .744. Increasing digital literacy and also information literacy is closely related to the use of virtual laboratories, especially LabXChange because of its clear and structured integration. The findings in table 4 are in linear with Susilawati's findings (Susilawati et al., 2021) which gets a perfect correlation on digital literacy, and is in line with the findings of Maki Haffa (Maki Haffa et al., 2021) who found a strong to perfect correlation in information literacy on the use of virtual laboratory. LabXChange can facilitate students in providing information about the latest issues or biological materials which may be difficult to do independently because of the hard to find tools and materials and the associated unaffordable prices as many virtual laboratory does (Wilkinson et al., 2021). LabXChange is very instrumental in the use and development of technology in Remote Virtual Labs, or Virtual Labs of biology, physics, and chemistry. The role of LabXChange in increasing digital literacy as well as information literacy is important, knowing that LabXChange is a technology development to address real laboratory activities and facilitate students in using Virtual Labs (Pan, 2018).

4. Conclusion

The findings of this study indicate that the use of LabXChange can increase digital literacy as well as information literacy as indicated by N-Gain in the domain of digital literacy and information literacy on a medium scale. In addition, the hypothesis test shows that there is an increase in both domains using LabXChange, and also in the digital literacy and information literacy domains, indicating a perfect correlation in digital literacy and a strong correlation in information literacy.

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