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Analysis of the Digital Literacy Skills of Grade XI Senior High School Students in Online Biology Learning

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Abstract The Covid-19 pandemic has made changes to several aspects of life such as education. Online learning is a new challenge for educators and students and mastery of using digital media is the key to successful education during a pandemic. This study aims to determine the digital literacy ability profile of class XI high school students in learning dare biology during the Covid-19 pandemic. The benefits of this research are providing knowledge and motivation for students, providing views and input for educators in developing learning strategies. This study used a descriptive quantitative method with instruments used in data collection in the form of validation sheets, questionnaire sheets and interview lists. The digital literacy component includes 8 digital literacy components. The results obtained on the functional skill component with an average of 86.91%, the creative component with an average of 77.79%, the average collaboration component is 71.07%, the ability to search for and select information with an average 77.10%, the critical thinking and evaluation component with an average of 76.20%, the socio-cultural understanding component with an average of 75.29%, the security component with an average of 84.82%. All of these components are known to mean that the average digital literacy ability of class XI students at SMA 3 Pekanbaru City gets a score of 78.81%. Based on these results, it can be interpreted that the Digital Literacy Ability of Class XI High School Students in Biology Online Learning during the Covid-19 Pandemic Period is in the Good category.

Keywords: Covid-19, Online learning, Digital literacy, Senior high school

INTRODUCTION

Education in the era of the Industrial Revolution 4.0 is closely connected to technology (Dewi & Septa, 2019; Puspaningtyas, 2019; Teknowijoyo, 2022), including in the field of education itself. Advancements in information technology have brought many positive impacts to education by offering various options and tools to support the learning process. The objectives of education as stated in Law No. 20 of 2003 require educators to develop graduates' competencies across life domains, namely cognitive, psychomotor, and affective components.

In 2020, the COVID-19 pandemic had a profound impact on various sectors, including education (Syah, 2020). This pandemic forced all stakeholders in education to shift to distance learning. As a result, learning activities began to be carried out using various digital platforms such as WhatsApp, Google Classroom, video conferencing, live chat, and Zoom Meetings, in accordance with the circular issued by the Ministry of Education and Culture of the Republic of Indonesia No. 4 of 2020. This circular provided a policy for the implementation of education during the COVID-19 emergency, regulating home-based learning.

The implementation of this policy led to the adoption of online or distance learning, where teaching and learning are no longer conducted face-to-face in classrooms but instead rely on internet-based information technology services. According to Bentley et al. (2012), a learning system that integrates internet connectivity with the learning process is known as online or digital learning. The interaction between students and these various applications reflects their level of digital literacy (Amini, 2020; Naufal, 2021). According to Restianty (2018), digital literacy is an individual's ability to analyze and search for information using various types of digital technologies.

Suhendi (2017) explains that students' digital literacy skills benefit the learning process, requiring deep understanding, focused attention, and critical selection of information. Learning becomes more process-oriented rather than content-driven, meaning that students do not need to rigidly follow scientific methods but instead gain skills in problem-solving and informal reasoning (Sujana & Rachmatin, 2019). Sukri (2021) concluded from his research that digital literacy holds significant potential in helping both teachers and students carry out the learning process effectively. Students with good digital literacy skills tend to actively seek and filter important information, as well as comprehend, communicate, and express ideas in digital spaces.

Therefore, according to Sujana & Rachmatin (2019), digital literacy provides opportunities for students to think critically, communicate effectively, and be creative, which ultimately leads to better learning outcomes. This is supported by Nasionalita & Nugroho (2020), who concluded that digital literacy components are closely linked to the learning process, particularly in exploring ideas, collaboration, communication, critical thinking, and creative thinking.

However, online learning is still often seen as a breakthrough or a new paradigm in teaching and learning activities. According to Syamsuddin (2021), one of the major concerns during the COVID-19 pandemic is the potential decline in student

learning outcomes, with the most alarming effect being the risk of student dropout at various educational levels. This learning system aims to ensure that students can continue their education from home by utilizing application- and internet-based systems.

According to a study by Adijaya & Santosa (2018), virtual learning is more practical and easier to implement, requiring only an internet connection and eliminating the need for face-to-face interaction. However, based on observations conducted in several schools in Pekanbaru, it was found that 70.69% of students felt that online learning did not provide significant benefits. Furthermore, 68.97% of students reported that the methods used in biology learning were not well-received or effective.

Despite this, online learning has had a positive impact in familiarizing students with the use of technology-based learning tools. Unfortunately, many students still lack understanding of digital safety when exploring technological platforms. Therefore, an analysis of digital literacy skills in biology learning during the pandemic is necessary to assess students' competencies in this area.

METHOD

This study employed a descriptive quantitative method. Data analysis was carried out using descriptive analysis, which functions to describe or provide a picture of the object being studied based on collected data or samples (Sholikhah, 2016). The population in this study consisted of all public high school students in Pekanbaru, totaling 17 public senior high schools in the city. The sample size was determined using the Slovin formula, resulting in a sample of 11th-grade science students (Grade XI IPA) from three selected public schools: SMAN 1 Pekanbaru, SMAN 8 Pekanbaru, and SMAN Plus Provinsi Riau.

Data collection was conducted using questionnaires and interviews. According to Hasan (2002), data needs to be collected systematically to facilitate the research process. The data collection involved validation sheets of the questionnaire to be used, students' questionnaire responses, field notes and observation of phenomena during research, and summaries of interview results.

The research questionnaire used was a closed-ended questionnaire (answers provided in multiple-choice format), measured using a 4-point Likert scale: Strongly Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (SD). The questionnaire results served as primary data, and the data was collected through 53 statements presented to the respondents.

The digital literacy questionnaire consisted of eight components, as follows: Functional skills and beyond, Creativity, Collaboration, Communication, Information searching and filtering skills, Critical thinking and evaluation, Socio-cultural understanding, and Digital safety and security.

Table 1. Blueprint of the digital literacy questionnaire instrument.

Component	Indicator	Item Numbers
Functional Skills	Ability to use computers	1, 2
	Internet utilization	3, 4, 5, 6, 7, 8
Creativity	Creative use of digital media in group presentations	9, 10
	Creative and imaginative thinking in planning and exploring ideas.	11, 12, 13, 14, 15
Collaboration	Participation in digital environments	16, 17, 18, 19, 21
	Ability to understand and explain ideas to others in digital space.	22, 23, 24, 25, 26
Communication	Communication through digital media	27, 28, 29
	Ability to understand and interpret others digitally.	30, 31, 32, 33, 34
Information Search and Selection	Ability to search and filter relevant information.	35, 36, 37, 38, 39, 40
Critical Thinking & Evaluation	Analyzing, evaluating, and contributing to information critically.	41, 42, 43, 44, 45
Socio-cultural Understanding	Understanding social and cultural contexts	46, 47, 48, 49
Digital Safety	Understanding safety in exploring, creating, and collaborating digitally	50, 51, 52, 53

The percentage scores from the questionnaire were categorized into assessment levels to determine students' digital literacy abilities in the context of online biology learning during the COVID-19 pandemic.

Table 2. Score interpretation criteria.

Percentage Interval	Category
0% – 24,99%	Poor
25% - 49,99%	Fair
50% - 74,99%	Good
75% - 100%	Excellent

(*Adapted from Sugiyono, 2016*)

In addition, interviews were conducted with both teachers and students via online platforms. A total of 20 interview questions were asked after the questionnaire distribution. The purpose of these interviews was to obtain complementary data from the research respondents or subjects.

FINDINGS AND DISCUSSION

The study analyzing the digital literacy skills of Grade XI high school students in online biology learning during the Covid-19 pandemic was conducted in three phases: the pre-research phase, the implementation phase, and the data analysis phase. The data was obtained through questionnaires containing a scoring system based on a 1–4 Likert scale, completed by students throughout the research activity. The results were then analyzed and are presented in the discussion and conclusion of this study. The discussion covers eight components of digital

literacy: Functional Skills, Creativity, Collaboration, Communication, Information Seeking and Evaluation, Critical Thinking and Evaluation, Socio-cultural Understanding, and Safety.

Functional Skill and Beyond

The functional skills and beyond component is the first and relates to the operational use of technology. It focuses on a person's ICT abilities and their relationship to content across various media. This component has two indicators: the ability to use a computer and the ability to utilize the internet.

Table 3. Indicators in the functional skills component

Indicator	Question	Average Per Item (%)
Ability to Use a Computer	Ability to Use a Computer Independently	85.02% (Very Good)
	Able to Operate a Computer	86.08% (Very Good)
Average per Indicator		**85.55% (Very Good)**
Utilizing the Internet	Connecting Learning Devices to the Internet	91.16% (Very Good)
	Utilizing the Internet to Participate in Virtual Face-to-Face Learning with Teachers and Classmates	87.62% (Very Good)
	Utilizing the Internet for Participating in Discussions by Expressing Opinions via Chat/Messages During Learning Activities	88.09% (Very Good)
	Utilizing the Internet to Search for Additional Information Provided	85.73% (Very Good)
	Utilizing the Internet to Submit Assigned Tasks	90.21% (Very Good)
	Accessing Previously Presented Grade XI Biology Learning Materials Anytime and Anywhere	86.79% (Very Good)
Average per Indicator		**88.27% (Very Good)**

In the Functional Skills component, both indicators scored very high, with only a 2.72% difference between them. All indicators fell into the Very Good category, showing that students are capable of using and operating a computer independently. This aligns with the availability of computer labs provided by the school, where students receive both theory and practice in computer use.

The second indicator, utilizing the internet, scored an average of 88.27%, also in the Very Good category. These results show that students are already able to identify the intended uses of the internet, including understanding its functions, processes, management, and benefits, especially within the biology subject. This aligns with Nur's (2019) theory of the four core competencies of digital literacy, particularly internet search competence, which refers to a person's ability to use the internet and engage in various activities within it.

Creativity

Creativity is a component related to thinking processes, knowledge construction, and the ability to share various ideas using digital technology. This component

consists of two indicators: creativity in presenting group materials using digital media and creative and imaginative thinking in planning and exploring ideas.

Table 4. Indicators in the creativity component

Indicator	Question	Average Per Item (%)
Creativity in Presenting Group Material Using Digital Media	Presenting Assigned Tasks as Written Work and Then Photographing It	80.07% (Good)
	Presenting Assigned Tasks in the Form of Papers, PPTs, and Learning Videos	79.36% (Good)
Average per Indicator		**79.72% (Good)**
Creative and Imaginative Thinking in Planning and Exploring Ideas	Elaborating Ideas or Solutions by Accessing Multiple Sources (e-books/blogs/articles/scientific journals)	78.77% (Good)
	Submitting Tasks Based on One's Original Thoughts Without Copying from Peers	79.01% (Good)
	Having Different Responses or Viewpoints Compared to Others	75.00% (Good)
	Imagining Steps for Problem-Solving Without Needing Directions from the Teacher	72.29% (Good)
	Explaining a Variety of Ideas Different from Classmates Regarding a Problem	74.29% (Good)
Average per Indicator		**75.87% (Good)**

In the Creativity in Presenting Group Material Using Digital Media indicator, there were two items with an average score of 79.72%. However, the item concerning submitting tasks by photographing written assignments scored slightly higher than submitting tasks in the form of papers, PowerPoint presentations, or learning videos. This suggests that Grade XI students prefer more practical methods, such as photographing assignments and sending them via WhatsApp or Google Classroom, over producing more elaborate digital formats. This supports the theory presented by Hague & Payton (Nasionalita & Nugroho, 2020), which defines creativity as the ability to think, construct, and share knowledge in a variety of ways using digital technology.

The Creative and Imaginative Thinking indicator contains five items that reflect students' creativity and imagination. The average score of 75.87% falls into the Good category, indicating that students' creative abilities are not yet fully developed. Many students still find it difficult to think creatively and present group materials in a structured and engaging manner using various approaches. This is unfortunate, considering that creativity plays a vital role in the learning success of students.

Colaboration

Collaboration is a component based on the nature of digital technology itself. For example, the ability to participate in digital spaces, explain and negotiate ideas with others in a group. This component consists of two indicators: the ability to participate in digital spaces, and the ability to understand and explain ideas to others in digital spaces.

Table 5. Indicators of the collaboration component

Indicator	Question	Average Per Item (%)
Ability to Participate in Digital Spaces	Enthusiastic when engaging in online learning	72.76% (Good)
	Turns on the camera during online learning	62.62% (Fair)
	Actively answers questions during learning sessions	67.81% (Fair)
	Actively asks questions when they do not understand the material	66.39% (Fair)
	Able to prioritize, plan, and manage group tasks to achieve group goals and obtain maximum scores	78.42% (Good)
	Demonstrates integrity and ethical behavior within the group to inspire others in achieving learning goals	77.48% (Good)
Average Indicator Score		**70.91% (Good)**
Understanding and Explaining Ideas to Others in Digital Spaces	Understands the material delivered by the teacher during online learning	69.58% (Good)
	Verbally responds to questions asked by the teacher or peers during online discussions	67.81% (Fair)
	Provides written responses to questions from teachers and peers during online learning	74.76% (Good)
	Actively helps explain materials to peers who do not understand during discussions	68.87% (Fair)
	Utilizes social and cultural differences to generate new ideas and improve innovation and task quality	75.12% (Good)
Average Indicator Score		**71.23% (Good)**

The Collaboration component includes two indicators. The highest score is in the second indicator, understanding and explaining ideas to others in digital spaces, with a percentage of 71.23% (Good). The lowest is the first indicator ability to participate in digital spaces at 70.91% (Good). The overall average score for the Collaboration component is 71.07%, categorized as Good.

For the first indicator, the highest response rate was for the statement: Students are always able to prioritize, plan, and manage group tasks to achieve group goals and obtain the highest score using platforms such as WhatsApp/Google Classroom at 78.42% (Good). This suggests that Grade XI high school students sampled have good time management and problem-solving skills in group settings. Therefore, one strategy to improve students' collaboration skills is through the application of the Problem-Based Learning (PBL) model.

According to Arends (Abbas, 2020), the Problem-Based Learning model is a teaching approach that presents students with authentic problems, allowing them to construct their own knowledge, develop higher-order thinking and inquiry skills, foster independence, and build self-confidence.

Communication

Communication is an essential aspect of digital literacy, representing the ability to communicate through digital technology media. Effective communication in digital literacy involves the ability to share thoughts, ideas, and understanding. This component has two indicators: The ability to communicate through digital technology media, and the ability to understand and empathize with others in digital spaces.

Table 6. Indicators of the communication component

Indicator	Question	Average Per Item (%)
Ability to Communicate via Digital Technology Media	Uses proper and effective language when speaking during learning activities	83.49% (Good)
	Uses proper and effective language when writing opinions in the comment section during learning activities	84.55% (Good)
	Offers clear and accurate solutions during debates in discussion forums using reliable sources and proper language	75.94% (Good)
Average Indicator Score		**81.31% (Good)**
Ability to Understand and Empathize with Others in Digital Spaces	Understands the teacher's language	76.53% (Good)
	Understands the language used by peers	78.66% (Good)
	Accepts differing opinions in discussion forums and seeks additional information for verification	82.43% (Good)
	Listens attentively and respectfully to others, remains focused, and provides feedback during discussions	81.25% (Good)
	Displays appropriate body language such as proper posture and controlled movements when the camera is on	78.30% (Good)
Average Indicator Score		**79.43% (Good)**

There are two indicators within the Communication component. The first, the ability to communicate via digital technology, received an average score of 81.31% (Good), indicating students use appropriate language when expressing opinions. The second, the ability to understand and empathize with others in digital spaces, scored 79.43% (Good).

This is consistent with interview findings with teachers who stated that they provide language-use stimuli during online learning, helping students maintain etiquette and politeness in digital communication. These results support a prior study (Perwita, 2021), which explained that good communication skills among respondents are influenced by their habitual use of smartphones for communication, making them more confident in expressing their ideas and listening to others through digital media.

The Ability to Find and Select Information

This component emphasizes students' ability to search for and filter relevant information.

Table 7. Indicators of the ability to find and select information

Indicator	Question	Average Per Item (%)
Ability to Search for and Select Information	Searches for relevant information using only teacher-provided books/e-modules	76.77% (Good)
	Searches for relevant information using blogs/quiz answers from other users' websites	78.54% (Good)
	Searches for relevant information using multiple articles and scholarly journals as primary sources	80.90% (Good)
	Reads source material before summarizing to meet assignment requirements	81.96% (Good)
	Provides clear, concise, and accurate answers based on relevant information sources	80.07% (Good)
	Includes source links and references from e-books/blogs/articles/journals	64.39% (Fair)
Average Indicator Score		**77.10% (Good)**

The average score for the ability to search for and select information is 77.10% (Good). This indicates that students generally have good information literacy skills in digital spaces. However, they often neglect to include source links and references, making their work less efficient in terms of information traceability. This aligns with Hague & Payton as cited in Nasionalita & Nugroho (2020), who found that most students tend to take information without including the primary source links, which are crucial for providing further reference.

Critical Thinking and Evaluation

The critical thinking and evaluation component emphasizes that individuals should not passively accept and interpret information, but rather actively contribute, analyze, and sharpen their critical thinking when engaging with information.

Table 8. Indicators of the critical thinking and evaluation component

Indicator	Question	Average Per Item (%)
Ability to contribute, analyze, and think critically when encountering information	Analyze discussion topics and actively participate in discussion forums by asking relevant questions related to the subject matter	73.82% (Good)
	Analyze discussion topics and actively express opinions based on relevant information obtained	74.41% (Good)
	Able to explain information obtained from sources such as e-books, blogs, articles, or scientific journals	72.88% (Good)
	Seek information from more than one source (books/modules, e-books, blogs, articles, journals) and summarize using own words (Google Classroom)	79.72% (Good)
	Find accurate sources relevant to the discussion material and assess the relevance of sources (e-books, blogs, articles, journals)	80.19% (Good)
Average Score		**76.20% (Good)**

This component consists of a single indicator: the ability to contribute, analyze, and think critically when engaging with information, with an average score of 76.20%. This indicates that respondents demonstrate good abilities in analyzing and critically evaluating information, as well as assessing the usefulness, content reliability, and source credibility during the information search process.
These findings are consistent with the digital literacy theory proposed by Hague & Payton (Nasionalita & Nugroho, 2020), which states that critical thinking and evaluation are essential components that require individuals to not only receive and interpret information passively, but also contribute, analyze, and refine critical thinking in the face of information.

Cultural and Social Understanding
The cultural and social understanding component includes only one indicator: understanding the social and cultural context. This indicator is measured using four questions as shown in Table 9.

Table 9. Indicators of the cultural and social understanding component

Indicator	Question	Average Per Item (%)
Understanding of social and cultural context	Raise hand using the application feature before asking a question	65.45% (Fair)
	Turn on the microphone when speaking and turn it off when not speaking	83.96% (Good)
	I find it easier to understand the material delivered by the teacher because it is contextual and related to daily life	76.30% (Good)
	Use cultural values as a filter to align digital information with social and cultural understanding	75.47% (Good)
Average Score		**75.29% (Good)**

The average score for understanding the social and cultural context is 75.29%, categorized as Good. This indicates that respondents are capable of aligning digital information with their social and cultural understanding. These findings are in line with Heriyanto (2018), who stated that cultural values act as a filter in harmonizing digital information with the social and cultural context.

E-Safety
The e-safety component emphasizes the importance of making choices that ensure safety while exploring, creating, and collaborating using digital technology.

Table 10. Indicators of the e-safety component

Indicator	Question	Average Per Item (%)
Understanding safety while exploring, creating, and collaborating with digital technology	Protect personal account security	86.56% (Excellent)
	Use official websites to find information for completing assignments	84.43% (Good)
	Focus on searching for information online without accessing non-beneficial websites	85.97% (Good)
	Use technology and digital media as a	82.31% (Good)

	means of creativity and positive self-expression to enhance skills	
Average Score		**84.82% (Good)**

This component consists of one indicator: understanding safety when exploring, creating, and collaborating using digital technology, with an average score of 84.82%, categorized as Good. This demonstrates that respondents are highly capable of using digital technology safely while also showing concern for personal data security.

This is supported by interviews with teachers who stated that they consistently provide guidance on the proper and responsible use of technology for exploring and presenting information. The students actively respond to assignments and participate in online discussions while maintaining the security of their accounts. This finding aligns with the digital literacy framework by Hague & Payton (Nasionalita & Nugroho, 2020), which emphasizes that *e-safety* is a component that focuses on choices that ensure user safety in digital exploration, creation, and collaboration.

Digital Literacy Analysis

The implementation of digital literacy in schools requires teachers to go beyond simply utilizing traditional learning resources such as textbooks. They are encouraged to explore various learning sources such as magazines, newspapers, the internet, and digital media. According to Mulyasa (2009), this is essential to ensure that what students learn is relevant to current conditions and global developments.

Table 11. Digital literacy analysis of students

Aspect	Indicator	% (Category)	% (Average)
Functional Skills (and Beyond)	Ability to use a computer	85.55% (Excellent)	86.91% (Excellent)
	Use of the internet.	88.27% (Excellent)	
Creativity	Creative in presenting group material using digital media	79.72% (Good)	77.79% (Good)
	Ability to think creatively and imaginatively in planning and exploring ideas.	75.87% (Good)	
Collaboration	Ability to participate in digital spaces	70.91% (Good)	71.07% (Good)
	Ability to understand and explain ideas to others in digital spaces	71.23% (Good)	
Communication	Ability to communicate using digital technology	81.33% (Good)	76.28% (Good)
	Ability to understand and empathize with others in digital spaces.	79.43% (Good)	
Information Literacy	Ability to search and select information.	77.10% (Good)	77.10% (Good)
Critical Thinking and Evaluation	Ability to contribute, analyze, and think critically when engaging with information.	76.20% (Good)	76.20% (Good)
Cultural and Social	Understanding of social and cultural context.	75.29% (Good)	75.29% (Good)

Understanding E-Safety	Understanding safety when exploring, creating, and collaborating digitally.	84.82% (Good)	84.82% (Good)
Overall Average			**78.81% (Good)**

Based on the overall analysis, the average digital literacy score of 11th-grade high school students in online biology learning during the COVID-19 pandemic is 78.81%, which falls into the Good category.

The highest-performing component is Functional Skills (and Beyond) with a score of 86.91% (Excellent), indicating that students in the sample are highly capable in using computers and leveraging the internet. Conversely, the lowest-performing component is Collaboration with a score of 71.07% (Good), suggesting that while students demonstrate adequate digital collaboration skills, including explaining ideas and participating in digital spaces, there is still room for improvement to reach the Excellent category.

CONCLUSION

Based on the research results, it was found that the digital literacy skills of 11th-grade high school students in online biology learning during the COVID-19 pandemic, based on eight components, had an overall average percentage of 78.81%. From these results, it can be concluded that the digital literacy skills of 11th-grade high school students in online biology learning during the COVID-19 pandemic fall into the "Good" category. For future research, a comparative analysis between schools is recommended to examine students' digital literacy skills more broadly. It is also suggested to use specific subject topics to obtain more detailed findings and to implement particular learning strategies aimed at enhancing students' digital literacy skills.

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