Digital Literacy Competence of Senior High School Science Students at the Sukoharjo Regency, Central Java, Indonesia

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Abstract

The 2018 PISA exam results indicate that Indonesia's scores were deficient in reading (371), mathematics (379), and science (396). The Department of Education is endeavoring to enhance students' information literacy skills as fundamental competencies to improve achievements in Mathematics and Science. The latest curriculum (2022) categorizes information literacy into three domains: locating, comprehending, assessing, and reflecting on information. This research assesses the capacity for information retrieval in the digital age or digital literacy. The research topic examines the digital literacy ability of tenth-grade science students in Sukoharjo Regency. The data was collected through a survey methodology. The sample comprises 425 tenth-grade science students from nine public and ten private high schools. Approximately 4% of pupils possess advanced digital literacy abilities, 64% have intermediate skills, and 32% are at the novice level. From this perspective, educators must diligently implement rigorous training and exercises to enhance students' digital literacy skills to an advanced level, enabling them to proficiently locate fundamental resources for high school science topics. Another research indicates that the average score of public school students (73.36) is inferior to that of private school students (75.79). The statistical study determined that the difference is substantial. The rationale is that most private high schools are situated in urban locales, resulting in a high intensity of digital device usage. Conversely, most public high schools are situated in rural regions and do not require extensive use of digital gadgets.

Keywords: Digital Literacy, Science High School Students, Sukoharjo, Tenth Grade

Introduction

The Indonesian government has declared that 2045 will be the golden year. Over that year, it is hoped that Indonesia will evolve into a more advanced and prosperous nation!

When it comes to the digital field, one of the advantages that must be achieved is necessary. Therefore, the Ministry of Communication and Information Technology has developed the 2021-2024 Digital Literacy Roadmap, encompassing digital infrastructure, governance, economy, and society (Setu, 2021). The people of Indonesia must possess a sufficient level of digital literacy for the roadmap and the different digital facilities and infrastructure to function at capacity.

The problems in the field bring to light the significance of literacy to the younger generation in Indonesia. Whenever the Program for International Students Assessment (PISA) is conducted, Indonesia is regularly ranked in the bottom positions. Indonesia was ranked 64th out of 65 countries in 2012, according to the OECD's 2014 report, with an average score of 375. According to the OECD (2018), it rose to 62 out of 70 nations from its previous average score of 403 in 2015. According to Avvisati, Echazarra, Givord, and Schwabe (2019a), Indonesia's average score dropped to 371 throughout 2018, placing it 74th out of the 79 participating countries.

A year of education was equivalent to the difference in thirty scores, according to the research that Aditomo and Felicia (2018) conducted. The Indonesian educational system is deemed to be significantly worse than the education systems of the Southeast Asian countries that took part in the PISA. According to Avvisati, Echazarra, Givord, and Schwabe (2019c), Indonesia follows Thailand by 22 points with an average literacy score of 393. According to Avvisati, Echazarra, Givord, and Schwabe (2019b), Indonesia's literacy level is further behind Malaysia's, which reached 415. According to Avvisati, Echazarra, Givord, and Schwabe (2019d), Vietnam has an average literacy score of 505, much higher than Indonesia's score of 371.

According to the findings of the World Bank's investigation, fifty-five percent of Indonesian pupils are considered to be functionally illiterate (UNICEF & UNESCO, 2021). It means that they can read but cannot comprehend the material they are reading. On the other hand, another research suggests that reading skills simultaneously affect workability and productivity. According to data provided by the World Bank, low-productivity industries were responsible for the creation of USD 3,600, which is equivalent to 65% of all new jobs that became available in Indonesia between 2011 and 2016. There are 1.5 times as many new employment in Thailand as in Indonesia, costing USD 5,300, while Malaysia has nearly four times as many, costing USD 15,800. Vietnam's literacy rate is well below average. According to the World Bank's Jakarta office (2018), Vietnam's gross domestic product (GDP) is still lower than that of Indonesia, even though Indonesia is voted higher.

As a result of their inability to absorb the stuff they read, younger people are more likely to express their feelings. Microsoft conducted the Digital Civility Index (DCI) survey to determine the level of civility exhibited by internet users, sometimes known as netizens. The poll had four criteria: upholding virtue, embracing differences, waiting before responding and voicing various deviations that create suffering for others. Out of the thirty-two countries that were assessed in the year 2020, Indonesia came in last place (Indrawan, 2020). Ikhsan (2021) asserts that Indonesian internet users are notoriously harsh since they routinely engage in dishonesty, spread hoaxes, make fun of, harass, discriminate against, and use hate speech. There is little difference between the realities of the digital world and those of the educational

sector. However, teachers and students are unaware that the narrative presented in textbooks regarding the history of the birth of Pancasila is intellectually problematic. The textbook narratives have been deceiving the Indonesian education community for decades (Purwanta, 2012). This behavior has been going on for decades.

The description offered by the DCI survey is distinct from the one provided by UNESCO, the organization that carried out the research for the Digital Kids Asia Pacific (DKAP) project. Digital literacy, digital security and resilience, digital agency involvement, digital emotional intelligence, and digital creativity and innovation were the five characteristics investigated in this research (Widiputera, 2021). The pupils who participated in the research were 15 years old. The first four characteristics of the DKAP research are closely related to civility in the Microsoft survey, even though they use different phrases simultaneously. Digital literacy ratings of 3.17, digital security and resilience scores of 3.23, digital agency participation scores of 3.13, and digital emotional intelligence scores of 3.06 from the 2021 DKAP research demonstrate that students in Indonesia have high scores in all facets of digital civility (SEAMEO, 2021).

The contrasting outcomes of the Microsoft and DKAP questionnaires can be attributed to the wide range of individuals who participated in the surveys. Microsoft is conducting a poll open to all internet users, regardless of their age, educational level, or occupation. On the other hand, fifteen-year-old children were the primary focus of the DKAP survey." Therefore, respondents to the Microsoft survey are likely to differ from those who participated in the DKAP survey, which is why the results are very different.

Despite the findings, Microsoft and DKAP polls indicate an increasing focus on digital literacy abilities. It is also possible to observe the Ministry of Education and Culture demonstrating an increased focus on digital literacy. The Independent Learning Curriculum was formally implemented in 2022 after the Ministry of Education and Culture presented a new curriculum prototype in 2021 (Makarim, 2022). According to Makarim, 2022. (Widiasari, 2022) The curriculum must include information and numerical literacy as the minimal competencies students must possess. Students need to be able to locate, comprehend, analyze, and reflect on information to be considered information literacy skills. One of the most important aspects of digital literacy is the ability to locate information on the Internet.

A problem that arises as a consequence of this is the question of how to evaluate the core digital literacy skills of students in Indonesia. This inquiry is being conducted since no national norm has been established up until this point. The researchers Pratama et al. (2019) use four different criteria to measure digital literacy. A primary emphasis is placed on how educational activities incorporate and use digital literacy. The second component is the availability of electronic teaching resources and reading materials in quantity and variety. The third consideration is the number of times that books with digital themes are borrowed through the library. The fourth essential component is the periodicity with which instructional content is disseminated through digital media or websites. Digital literacy, on the other hand, is defined by Widiasari (2022) as the ability to utilize information and Communication Technology (ICT) in order to search, evaluate, utilize, develop, and communicate content or information by utilizing both cognitive and technical talents. The ability to transition between different forms of media, the understanding of acceptable language for specific information,

and the skill in communicating information through a medium or platform that improves audience comprehension are all examples of digital literacy, according to this point of view, can be proven.

Various survey results have been obtained due to the absence of a fundamental criterion for digital literacy. The majority of students in Grade X Science at Banjarmasin State High School 6 were classified as having low and severely poor digital literacy competencies, according to Pratama et al. (2019), who conducted the research. According to research on Generation Z in Medan using the Digital Literacy Global Framework (DLGF), their digital literacy competencies were weak (Tan, 2021). Information synthesis, content assessment, internet searching, and hypertextual navigation are all areas in which high school students in Yogyakarta have severe deficiencies, according to research that was carried out on these students (Perdana, Yani, Jumadi, & Rosana, 2019).

Several complex obstacles and challenges must be overcome to achieve the goal of a prosperous Indonesia by the year 2045. For this study, the research question will be as follows: What is the level of digital literacy competency among scientific high school students in the Sukoharjo Regency?

Methodology
Seventeen private senior high schools and ten public high schools in the Sukoharjo Regency are all senior high schools. This initiative proposes to involve students enrolled in the scientific curriculum in the tenth grade from twenty different senior high schools, ten of which are public and ten private. A single class was chosen randomly from each school as a representative sample. Compared to public senior high schools, private high schools typically only provide a single science program, whereas public schools offer a variety of possibilities. The instructor was responsible for selecting samples from senior high schools throughout the state, and the research team did not provide any recommendations or guidance.

Following the criteria established by UNESCO (Laanpere, 2019), this survey aims to assess the baseline proficiency in digital literacy. Some of the questions in the poll were derived from a study conducted by Helsper and colleagues (2020) on indicators of digital capabilities among younger people. Components of the digital skills possessed by the younger generation, more specifically:
1. Information literacy includes the ability to locate sources, analyze and synthesize materials, evaluate the authenticity of sources, utilize and cite sources ethically and legally, focus on themes, and articulate research queries with accuracy and efficiency.
2. The second component of computer literacy is a proficient understanding of using computers and application software for practical purposes.
3. Communication skills include the ability to collect, analyze, evaluate, and present information across various formats, including printed and non-printed messages. This is what we mean when we talk about media literacy.
4. Communication Literacy: Learners are required to be able to communicate effectively as individuals and work together effectively in groups, using publishing technologies (including word processing, databases, spreadsheets, and drawing tools), the Internet, and a variety of electronic and communication tools.

5. Visual literacy is defined as the ability to "read," interpret, and comprehend information that is communicated through pictorial images or graphics; the skill of transforming different kinds of information into visual representations that facilitate Communication; a collection of skills that enable individuals to recognize and interpret observable actions, objects, and symbols, whether they are natural or artificial, that they come across in their surroundings.

6. Technology Literacy: The ability to use computers and other forms of technology to improve learning, productivity, and performance (Bradic-Martinovic, 2018; Covello, 2010). This includes having a proficient level of computer abilities.

Data collection was carried out through an online survey, in which students were provided with a link to questions concerning their level of digital literacy. This method is utilized because it can access a significant number of samples in a short time. According to Panadero and Alonso-Tapia (2013), the questions included in this survey on digital literacy are self-assessment questions that evaluate each student's capabilities from their point of view.

Students are allowed to select the response that most appropriately reflects their level of digital literacy skills by providing them with six different answer options for each question during this survey. Seven different responses are available for each question:

a. I can comprehend the methods if I am given direction.
b. I am aware of the capabilities.
c. I am aware of the competency and can describe it.
d. I am aware of the skills and can describe them, demonstrating my understanding of them by providing pertinent examples.
e. I am able to assist others in recognizing the skills that they possess.
f. I have the ability to teach others and assist them in realizing their abilities.
g. None of these are relevant to my life.

Findings

On 17 May 2022, information was gathered through a survey regarding digital literacy. One of the 10 state high schools sampled, specifically Tawangsari 1 state high school, had the cause to not apply the Independent Learning Curriculum in 2022/2023. This school was the only one of the ten schools considered. Because of this, the data were only collected from nine senior high schools in the state. On the other hand, according to the study sample, four of the ten private senior high schools intended to be included did not supply any data. Al-Amin Palur, Assalam Sukoharjo, Muhammadiyah 1 Sukoharjo, and Muhammadiyah 4 Kartasura are the names of the four private high schools in the area. In the absence of any explanation, their involvement was not present.

The digital literacy survey has yielded results from 425 students, comprising data from 351 students across 9 state senior high schools and 7 students from private senior high schools. The incoming data indicates that the average proficiency level of Grade X high school students in Sukoharjo is classified as pre-intermediate, scoring 73.78. Table 1 shows the digital literacy scores of students in the tenth grade of the science curriculum.

Table 1
Results of the digital literacy survey for science program students in grade X senior high schools at the Sukoharjo Regency.

Score	Letter	Description	Frequency	Percentage
90 - 100	A	Advantage	16	3.8%
80 - <90	B	Intermediate	96	22.6%
70 - <80	C	Pre-Intermediate	173	40.7%
60 - <70	D	Beginner	115	27.1%
50 - <60	E	Pre-Beginner	23	5.4%
<50	F	File	2	0.4%
Total			425	100%

According to Oktavia and Hardinata (2021), the level of digital literacy competency among students in the Science Program at senior high schools in Sukoharjo Regency, Central Java Province, is higher than that of their peers who attend senior high schools in Kuala 1 and Kuala 3 state for senior high school students in Nagan Raya Regency, Aceh Province. Students in the Sukoharjo Regency who are enrolled in high school science classes have demonstrated digital literacy, which shows that students feel the importance of using the Internet to help their studies. Several studies demonstrate that students have a positive experience with online learning (Jumila, Paristiowati, Zulhipri, & Allanas, 2018). They are encouraged to develop their knowledge, discuss and analyze material, seek online learning resources, employ advanced linkages in hypertext, and construct their knowledge. Even the research conducted by Muyasaroh (2021) discovered that students attending Grobogan State Madrasah achieved a high average score on each of the investigated aspects. According to this point of view, students will be more likely to improve their digital literacy abilities and attain higher levels of peak learning accomplishment if they participate in science learning activities that encourage fun (Akhyar et al., 2021).

Not only do students in high school discover the benefits of utilizing the Internet to acquire scientific knowledge, but students at all educational levels also find this an appealing option. According to A'yun's research (2021), seventh-grade students at Semesta 2 Junior High School in Semarang have a high category in digital literacy and student collaboration skills. This is because they are learning science at the junior high school level. On the other hand, Wijaya and Supadmini's 2020 research suggests that children can develop abilities relevant to the 21st century if they can learn science in primary schools through the Internet. This will make the subject more appealing to pupils. In a study conducted by Utami and Hardini (2021), it was discovered that implementing Educational Game-Based Digital Literacy led to an increase in the degree of interest that primary school pupils had in learning and reading.

As shown in Table 2, a more comprehensive picture can be obtained by isolating pupils attending senior high schools from those attending private schools.

Table 2

Comparison of digital literacy proficiency between grade X science students of state and private senior high schools at Sukoharjo Regency

Score	Letter	Description	State Frequency	%	Private Frequency	%
90 - 100	A	Advantage	10	2.8%	6	8.1%
80 - <90	B	Intermediate	78	22.2%	18	24.3%
70 - <80	C	Pre-Intermediate	145	41.3%	28	37.8%
60 - <70	D	Beginner	96	27.4%	19	25.7%
50 - <60	E	Pre-Beginner	20	5.7%	3	4.1%
<50	F	File	2	0.6%	0	0.0%
Total			351	100%	74	100%

According to the data presented in Table 2, the average student attending a state high school performs worse than their peers attending private high schools in virtually every aspect of digital literacy. The results obtained from the t-test on digital literacy, which was administered to pupils attending state and private high schools, revealed a noteworthy distinction ($p < 0.05$, with $p = 0.001$) between the two groups. It is clear from the findings that there are significant differences in the level of digital literacy among students attending senior high schools that are either public or private, as shown in Table 3.

Table 3

The Digital literacy proficiency difference between state and private high schools at the Sukoharjo Regency

		Levene's Test for Equality of Variances		t-test for Equality of Means							
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Nilai	Equal variances assumed	,020	,888	-3,379	836	,001	-2,64473	,78259	-4,18079	-1,10866
	Equal variances not assumed			-3,372	226,533	,001	-2,64473	,78430	-4,19018	-1,09927

The discrepancy in digital literacy abilities between senior high schools run by the state and private organizations is entrenched in a diverse context; therefore, it cannot be attributed only to the institutional type. The findings of the research conducted by Aini and Syarifuddin (2016) revealed a significant gap between the statuses of state and private senior high schools. According to Aini and Syarifuddin (2016), school status is not the only element that plays a role in determining a student's educational trajectory. Other factors that play a role

include the availability of sufficient school facilities and infrastructure, the support of extracurricular groups and activities, and the development of educational goals beyond high school graduation. Considering these different variables, it is reasonable to expect that state senior high schools should have higher literacy skills than private high schools. This is because the provincial government provides funding for private high schools.

One further significant component that plays a role in determining the level of digital literacy competency in a region is the geographical characteristics of that region. The level of digital literacy skills among those living in rural areas is typically lower than that of people living in metropolitan areas. In North Sumatra, research has shown that the majority of the locals do not have access to the Internet. According to Ginting (2015) and Sumolang (2013), most people who utilize the Internet are members of the younger generation, specifically students, business owners, employees, and employees. An identical discovery was made in research conducted in East Java, where it was discovered that 85 percent of internet users were rural dwellers between the ages of 15 and 44 (Subiakto, 2013). Instead of searching for academic knowledge, most people with access to the Internet use it to access social networking platforms, particularly Facebook. According to Sari (2019), the skill level of students who live in rural areas in internet searching, hypertextual navigation, content evaluation, and knowledge synthesis ranges from poor to moderate.

From a geographical perspective, the Sukoharjo district comprises twelve sub-districts, most of which are rural areas. When it comes to urban centers, the fringes of the Surakarta Municipality are only considered to be a selected few regions. Rural areas are home to most of the 10 senior high schools the state provides. Some sub-districts do not have state senior high schools. These sub-districts include Baki, Bendosari, Gatak, and Grogol. Compared to public senior high schools, private senior high schools are more prevalent, and most are situated in suburban areas. The population density and the availability of students are considered when selecting the locations of private senior high schools in suburban areas. This is because these schools' financial stability dramatically depends on students' tuition. Private schools have more digital facilities than state schools do, according to Sinaga (2017). This is a factor that affects digital literacy.

Discussion
It should come as no surprise that the digital literacy abilities of students in Grade X Science who attend state senior high schools are lower than those of private senior high schools. This is especially true when considering rural areas' geographical location and characteristics. Higher education students attending private high schools in Pakistan also demonstrate a high level of proficiency. The vast majority of children have a higher level of digital literacy when compared to their peers who were enrolled in state-run schools. They are proficient in fundamental digital literacy and fully grasp the subject. They are able to access, interpret, and communicate through the use of essential information and Communication technology tools and applications. It is January of 2018.

The discrepancies between kids attending schools in urban regions and those attending schools in rural areas have been the subject of much research and analysis. Students in the Tumkuru (urban) and Chitradurga (rural) Districts of India were the subjects of research conducted by Kumar and Kumara (2018). They discovered that there are significant

discrepancies between the two districts. Familiarity with the operation of digital gadgets is the most important factor. The percentage of high school pupils in rural areas who utilize computers is only 20.66 percent. The vast majority of them use computers at school (92.67 percent), at home (22.34%), and at the Computer Coaching Center (19.41 percent). However, according to Kumar and Kumara (2018), out of the 69.70 urban high school students who use computers, the location distribution is as follows: 63.43% of them use computers in school, 48.42 percent use them at home, and 60.49% use them at the Computer Coaching Center. The quantitative disparities indicate that students attending high schools in remote areas are incredibly reliant on the computers provided by their schools and that less than twenty-five percent of them have access to a computer at home. In Nigeria, everything follows the same pattern. For example, according to Akuoma (2012), just 33 percent of schools in rural areas have computer facilities, but every school in urban areas has access to computers. In Taiwan, there are also significant discrepancies in the technological facilities available to rural schools compared to those located in urban regions (Pei-Yu, 2013). According to this point of view, there is a disparity in the culture of assisting in learning through the use of technology between students in metropolitan regions and those in rural areas.

Conclusion

There is a need for a large number of advocates in order to facilitate the development of digital literacy skills. When we talk about support, we are not just referring to the technology resources that are accessible but also to the cultural readiness of the community. This cultural readiness comprises the academic institutions and the broader social milieu. The average degree of digital literacy among high school pupils in Sukoharjo Regency suggests significant progress in utilizing digital devices to increase academic capabilities. This advancement has been witnessed by both educators and the community that surrounds the school.

One of the most important challenges that requires immediate attention is the difference in digital literacy competencies between rural and urban areas. When it comes to the learning processes, it is necessary for science teachers and students attending senior high schools in rural areas of the state to engage with information technology more proactively. The identification of challenges, the gathering of information, the evaluation of data, and the synthesis of knowledge are all included in this.

Certain drawbacks are present in this study, the most notable of which is that the analysis continues to be relatively generic. Therefore, in the future, it will be possible to conduct a more comprehensive comparative analysis between senior high schools in rural and urban areas by examining the six dimensions of digital literacy. These dimensions include information literacy, computer literacy, media literacy, Communication literacy, visual literacy, and technological literacy.

Theoretical and Contextual Contributions
This research contributes both theoretically and contextually to the field of digital literacy and education in developing regions. Theoretically, the study supports and extends existing frameworks of digital literacy by applying them to a specific socio-educational context—senior high school science students in Sukoharjo Regency. It offers empirical validation of

existing digital competence models (e.g., UNESCO and DLGF indicators) within a regional Indonesian setting, thereby enhancing the cross-contextual applicability of these models.

Contextually, the findings highlight the disparity in digital literacy competencies between public and private institutions and between rural and urban regions. This emphasizes the critical need for policy interventions that address infrastructural and pedagogical inequalities. By identifying specific weaknesses in digital proficiency dimensions such as technological, media, and information literacy, the research serves as a roadmap for educational stakeholders aiming to tailor digital skills development programs for high school learners. Ultimately, the study advances our understanding of how digital divides manifest in educational environments and how they can be strategically reduced to achieve national goals such as "Indonesia Emas 2045."

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