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Analysis of Digital Science Literacy Competence to Build Students' Independent Learning Creativity in Learning Process

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Abstract

In the Industrial Era 4.0 which has entered the Society Era 5.0, mastery of Science and Technology is one of the key indicators of the success of the Indonesian nation in facing global competition. The purpose of this study is to analyze the digital literacy competency of science students using a questionnaire and digital literacy competency evaluation instrument for Chemistry Science related to independent learning within the scope of Heutagogy. This research method uses an applied mixed-method research approach conducted online and offline, using a simple random sample. The sample of this study is representative of FKIP UNJA students. The results of this study provide information that the digital literacy competency of Chemistry Education students is generally in the good category, and quite good when analyzed in terms of cognitive aspects, both in terms of attitude and also in terms of skills. Meanwhile, for general digital literacy skills, FKIP UNJA students are still low in terms of analyzing problems digitally. Policy options that can be implemented in the future are with various techniques and programs, including the use of PBL and Case Study models in the learning process, providing opportunities for students to take digital-based lectures in the Information Systems Study Program, and others through the Merdeka Belajar Kampus Merdeka program.

Keywords Digital-Based Lectures, Digital Literacy Competence, Science and Technology.

INTRODUCTION

Digital science literacy is a very significant aspect in the modern technological era because it allows students to understand, analyze, and utilize scientific information effectively in a digital environment. With increasing access to internet-based data and resources, students need to have critical skills in assessing the credibility of information, understanding complex scientific concepts, and using digital tools for academic exploration and innovation [1]. This literacy includes the ability to interpret data visualizations, process algorithm-based information, and apply evidence-based thinking in various fields of science. In addition, skills

in digital science literacy also contribute to students' readiness to face the challenges of technology-based industries, such as artificial intelligence, big data analysis, and the integration of the Internet of Things (IoT) in various sectors [2].

In relation to the concept of Merdeka Belajar, digital science literacy plays a central role in providing students with the freedom to learn independently and creatively. This concept emphasizes flexibility in choosing learning methods, sources, and approaches that suit their interests and academic needs [3]. With a strong understanding of digital literacy, students can more easily access scientific journals, take online courses, and participate in the global scientific community to broaden their horizons. Digital literacy also enables them to develop innovative projects based on data and technology that can have a direct impact on society. Thus, strengthening digital science literacy not only improves students' academic quality but also encourages intellectual independence and creativity in a more dynamic and adaptive learning environment [4].

One of the main problems in students' digital science literacy competencies is the gap in understanding how to manage and evaluate digital-based information. Many students have access to various scientific sources online, but often have difficulty assessing the credibility and validity of the data obtained. Lack of understanding of the principles of scientific data analysis, including statistical processing and interpretation of data visualization, makes them vulnerable to misinformation and errors in drawing academic conclusions [5]. In addition, limited technical skills in the use of data analysis software, scientific simulations, and big data exploration also hinder the optimal use of digital technology in science learning. This problem is further complicated by the low integration of digital literacy in the higher education curriculum, which causes students to have to independently find ways to improve their competencies without adequate structural support [6].

In addition to technical and evaluative aspects, another problem that often arises in digital science literacy is the limited creativity and innovation of students in utilizing digital technology for academic exploration. Students often only use digital technology for administrative purposes or simple information searches, without exploring the potential of utilizing digital devices in virtual experiments, scientific modeling, or data-based projects [7]. This challenge is exacerbated by the lack of critical thinking and technology-based problem-solving skills, so that students are less able to develop creative ideas in digital science-based learning. In addition, the lack of interdisciplinary training that combines digital literacy with traditional scientific methods makes it difficult for students to connect scientific knowledge with the use of the latest technology [8]. To overcome this problem, a more structured approach is needed in teaching digital science literacy, as well as support from educational institutions in providing facilities and training programs that are in accordance with modern technological developments [9].

Previous studies have shown that digital science literacy plays an important role in enhancing students' creativity in Merdeka Belajar-based learning. A study conducted by [10] highlighted how the implementation of Merdeka Belajar can enhance students' creativity and

innovation in the digital era. This study used a case study approach with a qualitative method, involving teachers and students from several high schools in Jakarta. The results showed that freedom in designing learning allows students to be more creative, collaborate, and produce innovative projects. However, challenges such as the digital divide and limited technological resources are still obstacles to effective implementation. In addition, another study by [11] developed a digital module based on Project-Based Learning to enhance science creativity. This study used the ADDIE design and showed that the digital module had high validity and was effective in enhancing students' creativity. Another study by Balqis et al. (2025) tested the effect of the Project-Based Learning model assisted by Canva digital media on scientific literacy in science learning. The results showed that the use of this model significantly improved students' scientific literacy skills, with measurable improvements based on statistical tests. This study confirms that the integration of digital technology in project-based learning can strengthen digital science literacy competencies while encouraging students' creativity in the Merdeka Belajar ecosystem. Thus, previous research provides a strong foundation for the analysis of digital science literacy competencies in building student creativity, as well as highlighting the importance of technology support and adaptive education policies to optimize learning in the digital era.

The main objective of the research on Analysis of Digital Science Literacy Competence to Build Students' Independent Learning Creativity in Learning is to evaluate the level of understanding, skills, and application of digital literacy in the context of science possessed by students. With the increasing integration of technology in education, this study aims to understand the extent to which students can access, utilize, and criticize digital-based information to support their academic exploration and development of creativity. This study also seeks to identify factors that influence digital science literacy competence, such as the availability of technology access, understanding of digital concepts in science, and technology-based learning habits. The results of this study are expected to provide insight into the development of more interactive and technology-based learning strategies to improve students' digital science literacy in an academic environment [12].

Specifically, this study aims to (1) measure the level of digital science literacy of students through parameters such as understanding of digital-based scientific concepts, evaluation of information sources, and scientific data processing skills; (2) analyze the relationship between digital literacy and students' academic creativity abilities, especially in implementing innovative technology-based learning methods; (3) explore the challenges faced by students in developing their digital literacy, such as lack of technology training or limited access to digital devices that support academic exploration; and (4) design recommendations for educational institutions in integrating digital science literacy into the Merdeka Belajar curriculum. With this approach, the study is expected to be able to contribute to the development of an education system that is more adaptive to the digital era and supports students in building creativity and independence in their learning process.

METHODS

The mixed-method research approach in analyzing digital science literacy competencies to build students' Merdeka Belajar creativity combines quantitative and qualitative methods to gain a more comprehensive understanding. This approach allows researchers to measure digital science literacy competencies statistically through surveys or experiments, while exploring students' experiences and perceptions through in-depth interviews or case studies. In this study, quantitative methods are used to identify patterns of students' digital skills and creativity based on numerical data, while qualitative methods provide insight into how students develop their creativity in the Merdeka Belajar ecosystem. The combination of these two methods provides more holistic results, allowing for a deeper analysis of the factors that influence digital science literacy competencies and the effectiveness of technology-based learning strategies in enhancing academic creativity.

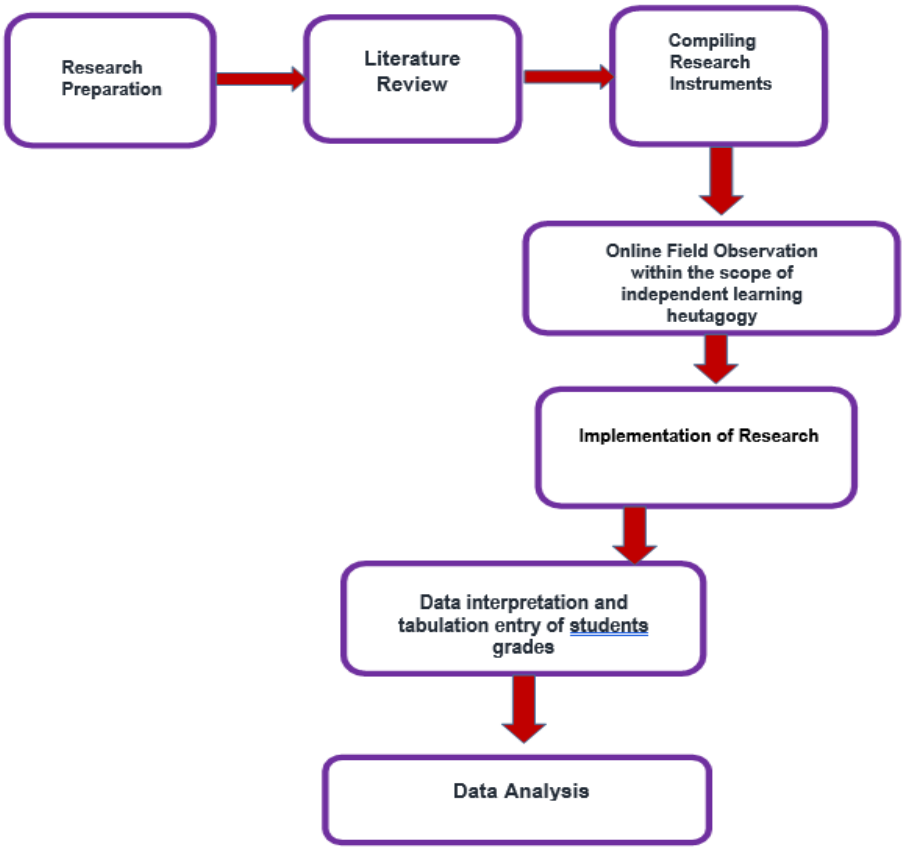

Figure 1. Research Procedure

This research was conducted at the Chemistry Education Study Program S1 FKIP Jambi University. The research schedule is from March 2021 to October 2021. Both online via Zoom Meeting and offline to strengthen the data obtained. This study is a mixed research conducted online, using random samples of two batches of Chemistry Education students. This study is to measure the digital science literacy competencies that students already have. The

population of this study was all active students of the S1 Chemistry Education Study Program, FKIP, Jambi University. The sample of this study was a purposive sample consisting of students from the 2018 and 2019 intakes who were active. The research instrument consists of an online questionnaire using the G-form application, to determine the application and mastery of students' digital literacy. Next, it is continued by testing digital science literacy competencies which are arranged based on the level of student literacy competency in chemistry material. The data obtained from all stages of this research were analyzed using inferential descriptive statistics using Ms Excel.

FINDINGS AND DISCUSSION

Findings

The results of this study provide information that the digital literacy competencies of students are vary. But in general our students are quite good. Although for some things, it is necessary to develop and improve students' mastery of Digital literacy related to Learning Materials. The following are the results of the analysis of scientific literacy competencies presented digitally and completed by Chemistry Education students with the following results:

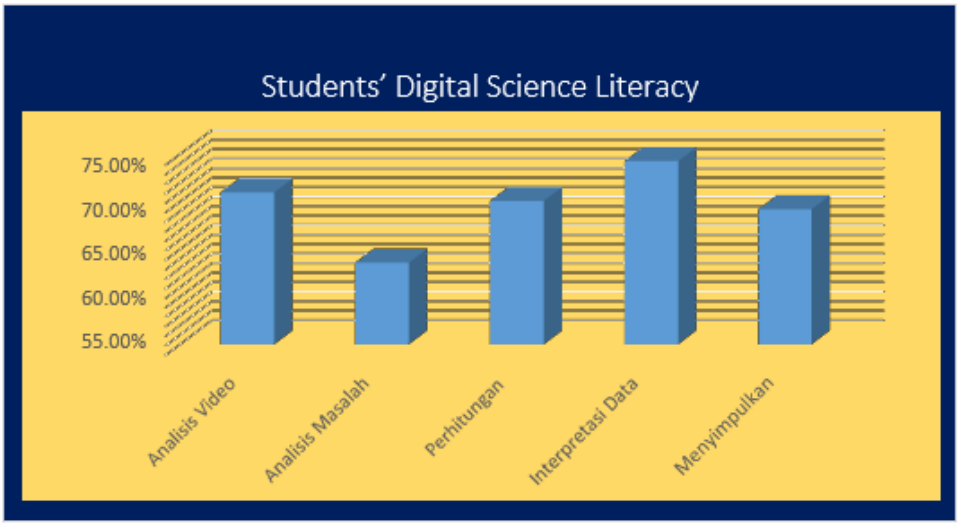

Figure 2. Students' Digital Science Literacy Skills in Learning

Based on the graph above, it can be seen that the average digital science literacy ability of students are 69.65%. This figure is still quite good, but it is approaching good. This data was obtained from the results of an assessment carried out on chemical science literacy questions presented digitally [13].

The results of the analysis of digital science learning literacy competencies in the cognitive aspect conducted on 45 FKIP undergraduate students are as follows:

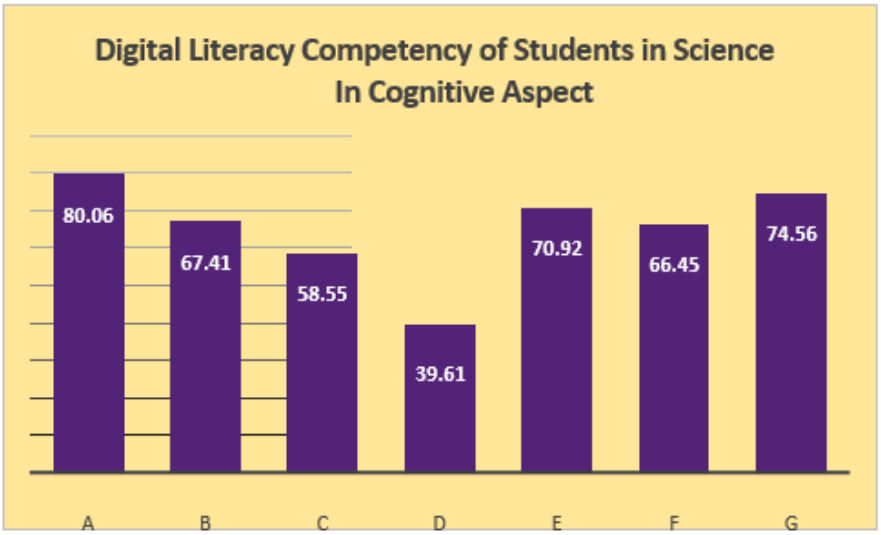

Figure 3. Digital Literacy Competency of Students in Science in Cognitive Aspect

Description:

A = Literacy competence understands religion, culture, environment and society

B = Literacy competence solves problems in learning techniques

C = Literacy competence analyzes digital systems for learning

D = Literacy competence designs digital products for learning

E = Literacy competence masters learning technology

F = Literacy competence knows and is proficient in operating and using Computers and computer applications that support learning

G = Literacy competence masters computer application techniques using learning technology

Based on the analysis data on the Digital Learning Competence of Science in the Knowledge Aspect, it was obtained that the average digital literacy competence of science undergraduate students of FKIP was 65.37%. Overall, this result is still quite good. The results of this analysis must be improved in the future.

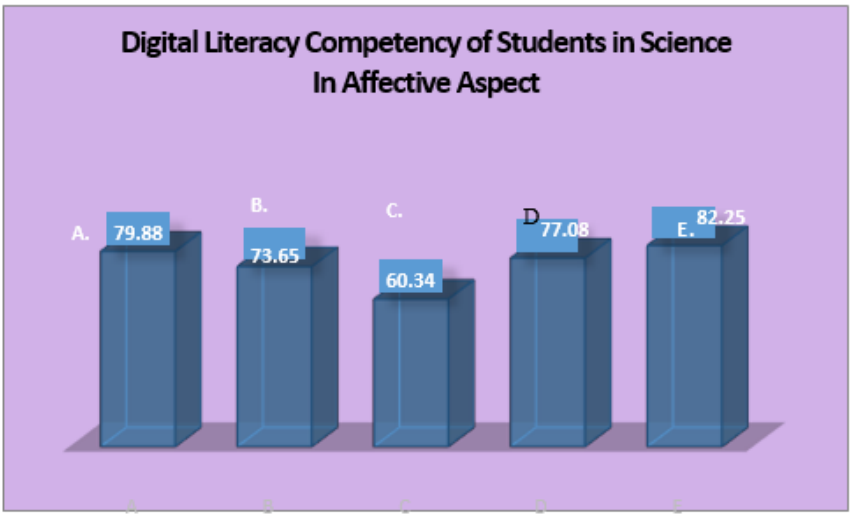

Figure 4. Digital Literacy Competency of Students in Science in Affective Aspect

Description:
A = Literacy competence to respect other people's opinions in learning digital
B = Literacy competence to behave honestly in learning digital
C = Literacy competence to be responsible in learning digital
D = Literacy competence of digital ethics in learning
E = Literacy competence of digital culture in learning

Data from the analysis of Digital Learning Competence in Science in the Attitude Aspect, it was obtained that the average digital literacy competence of Science of Chemistry FKIP UNJA undergraduate students was 74.64%. Overall, this result is classified as good. The results of this analysis must continue to be improved in the future to be very good. This is because the correct digital culture and attitude are in accordance with digital literacy methods [14].

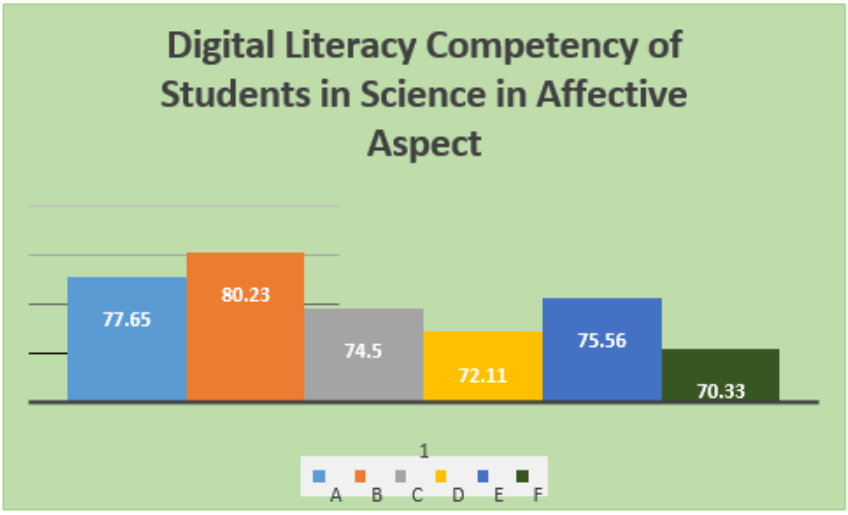

Figure 5. Digital Literacy Competency of Student

Description:
A = Digital literacy skills using computing technology equipment safely
B = Literacy skills storing data digitally
C = Literacy skills using digital learning applications
D = Literacy skills producing digital learning media
E = Literacy skills utilizing Google Workspace for learning

Data from the analysis of the Digital Learning Competence of Science in the Attitude Aspect, it was obtained that the average digital literacy competence of science of Chemistry Education undergraduate students was 75.06%. Overall, this result is classified as good. The results of this analysis must continue to be improved in the future to become very good. This is because FKIP students are classified as good and skilled in utilizing the Google Workspace application which is a digital literacy competence in the skills aspect.

Digital Science Literacy refers to an individual's ability to understand, evaluate, and use digital-based information to support the understanding and application of science concepts.

This definition includes skills in accessing digital resources, analyzing scientific data, and communicating effectively in a technology-based academic environment [15]. Key aspects of this literacy include an understanding of scientific methodology in the digital ecosystem, critical ability to assess the validity of information, and technical skills in using software and data analysis tools. In addition, digital science literacy also includes ethics in the use of technology, including awareness of copyright, data security, and the social impact of the dissemination of scientific information [16].

In the academic world, digital science literacy has great relevance, especially in supporting the Independent Learning-based learning approach. Students who have this competence can be more independent in exploring scientific resources, developing creativity in research, and contributing to academic innovation [17]. Digital science literacy also allows students to participate in global scientific discussions, access the latest journals and publications, and utilize technologies such as AI-based simulations and data analysis to deepen their understanding. With the increasing integration of technology in education, strengthening digital science literacy is key to building a more inclusive, adaptive, and innovative academic ecosystem [18].

Creativity in learning is an individual's ability to generate new ideas, innovative solutions, and flexible approaches in understanding and applying academic concepts. In the context of education, creativity is not only limited to art or free expression, but also includes critical thinking skills, problem solving, and adaptation to complex challenges. The concept of creativity in education is rooted in constructivism theory, which emphasizes that learning must be active and exploration-based [19]. Learning models such as Project-Based Learning and Problem-Based Learning have been shown to be effective in encouraging student creativity by giving them the freedom to explore, collaborate, and find solutions independently. In addition, creativity is also closely related to divergent thinking skills, namely the ability to generate various alternative solutions to a problem[20].

Supporting factors for creativity in learning include a conducive academic environment, innovative teaching methods, and the use of digital technology. An environment that supports creativity must provide freedom of thought, opportunities for experimentation, and access to rich and diverse resources. In addition, the role of lecturers as facilitators is very important in guiding students to develop creative ideas through open discussions and interdisciplinary approaches. Digital technology, including digital science literacy, also plays a major role in building student creativity, especially in the Merdeka Belajar ecosystem [21]. With access to various sources of information, data analysis tools, and interactive learning platforms, students can be more independent in developing creative thinking and contributing to academic and professional innovation. Therefore, the integration of creativity in learning is key to forming students who are adaptive, innovative, and ready to face global challenges [22].

Merdeka Belajar (Independent Learning) is an educational concept that aims to provide freedom for students and educators in determining learning methods and materials that are appropriate to their needs and potential. The basic principles include curriculum flexibility,

project-based learning, and strengthening character and competencies that are relevant to the world of work [23]. In the context of higher education, Independent Learning allows students to choose cross-disciplinary courses, participate in internship programs, and engage in more applicable research and community service. This approach aims to create an academic ecosystem that is more adaptive, innovative, and oriented towards developing 21st-century skills, including digital science literacy which is key to utilizing technology for learning and research [24].

The implementation of Merdeka Belajar faces various challenges, including the readiness of educational institutions, limited resources, and resistance to change from various stakeholders. One of the main obstacles is the gap in access to technology and digital literacy, which can affect the effectiveness of digital-based learning. In addition, the paradigm shift from conventional learning to a more independent approach requires strong policy support and training for educators to be able to optimally adapt new methods. However, with the right strategy, Merdeka Belajar can be a catalyst in building student creativity, increasing their involvement in learning, and strengthening connections between the academic world and industry. Therefore, strengthening digital science literacy in the Merdeka Belajar ecosystem is a strategic step in creating a more innovative generation that is ready to face global challenges [25].

The results of the study on the Analysis of Digital Science Literacy Competence to Build Students' Independent Learning Creativity in Learning provide significant benefits for students, lecturers, and educational institutions. For students, this study can help them understand the level of digital science literacy needed to improve creativity and independence in learning. With better digital literacy, students can access scientific information sources more critically, process data effectively, and develop innovative technology-based projects. In addition, this study also provides insight into the challenges faced by students in developing digital skills, so that they can design more adaptive and technology-based learning strategies. With increased understanding and application of digital literacy in science, students will be better prepared to face the demands of the world of work that increasingly relies on the use of technology and data.

For lecturers and educational institutions, this research contributes to designing curricula and teaching methods that are more relevant to the development of digital technology. Lecturers can use the results of this study to understand how digital literacy affects students' creativity and develop learning strategies that encourage more active digital exploration. Educational institutions can also identify the need for better digital infrastructure, including access to technological resources, training for teaching staff, and integration of digital literacy in various disciplines. In addition, the findings of this study can help universities in formulating academic policies that support flexible and independent learning, in line with the principles of Merdeka Belajar. Thus, this research not only contributes to improving the quality of education but also building an academic ecosystem that is more innovative and responsive to changes in the digital era.

CONCLUSION

The Digital Science Literacy Competencies needed to develop students' independent learning creativity are multimedia competencies, problem analysis, calculation, data interpretation, and conclusion. The technical analysis of the Digital Science Literacy Competencies needed to develop students' independent learning creativity is through evaluating students' competencies in mastering digital science literacy in the aspects of knowledge, attitude, and skills. The achievement of students' Digital Science Literacy Competencies in general is still in the fairly good category (69.65%), while for the knowledge aspect it is quite good (65.37%), the attitude aspect is good (74.64%) and for the skills aspect it is good (75.06%). Digital Science Literacy Competencies that can develop students' independent learning creativity are combined competencies between general digital literacy competencies by combining and integrating them with digital science competencies in the aspects of knowledge, attitude and skills.

Furthermore, it is suggested to the study program management at FKIP UNJA to choose various policy options that can be developed in the future, namely with various techniques and programs, including the use of PBL and Case Study models in the learning process, providing opportunities for students to take digital-based lectures in relevant study programs such as information systems, and others through the Merdeka Belajar Kampus Merdeka program. Other options can also be the best solution.

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REFERENCES

[1] W. Matli and M. Ngoepe, "Capitalizing on digital literacy skills for capacity development of people who are not in education, employment or training in South Africa," *African J. Sci. Technol. Innov. Dev.*, vol. 12, no. 2, pp. 129–139, 2020.

[2] K. C. Rath, A. Khang, and D. Roy, "The Role of Internet of Things (IoT) Technology in Industry 4.0 Economy," in *Advanced IoT Technologies and Applications in the Industry 4.0 Digital Economy*, CRC Press, 2024, pp. 1–28.

[3] Z. Zurweni, D. A. Kurniawan, P. A. Rivani, and R. Perdana, "Gender Analysis From a Review of Middle School Students' Attitudes and Self-efficacy," *JPI (Jurnal Pendidik. Indones.*, vol. 11, no. 2, pp. 252–264, 2022.

[4] B. Mardhotillah, Z. Zurweni, E. Elisa, and K. Alim, "Relation Visualization of Environmental Quality Index with Environmental Resource Indicators Using Multiple Indicators Multiple Causes Model," *Multi Prox. J. Stat.*, vol. 2, no. 2, pp. 83–87, 2023.

[5] Z. Zurweni and A. Malik, "Development of Performance Technology Competency Training Model for Students of Chemical Education," *Form. J. Ilm. Pendidik. MIPA*, vol.

12, no. 1, 2022.

[6] A. Sanova and A. Malik, "The influence of ethnoscience approach through problem based learning model on science literacy ability in buffer solution material," *J. Penelit. Pendidik. IPA*, vol. 9, no. 7, pp. 5498–5508, 2023.

[7] A. R. Haniah, A. Aman, and R. Setiawan, "Integration of strengthening of character education and higher order thinking skills in history learning," *J. Educ. Learn.*, vol. 14, no. 2, pp. 183–190, May 2020, doi: 10.11591/edulearn.v14i2.15010.

[8] G. Falloon, "From digital literacy to digital competence: the teacher digital competency (TDC) framework," *Educ. Technol. Res. Dev.*, vol. 68, pp. 2449–2472, 2020.

[9] D. Pratama, N. Nurwani, and Y. S. J. Nasution, "The Effect of Understanding of Financial Literacy and Ease of Digital Payment on the Continuity of Msmes in the Digitalization Era," *Indones. Interdiscip. J. Sharia Econ.*, vol. 6, no. 2, pp. 618–638, 2023.

[10] A. Hadi, M. Marniati, R. Ngindana, M. S. Kurdi, M. S. Kurdi, and F. Fauziah, "New Paradigm of Merdeka Belajar Curriculum in Schools," *AL-ISHLAH J. Pendidik.*, vol. 15, no. 2, pp. 1497–1510, 2023.

[11] D. Sinaga and N. Y. S. Siahaan, "Student Perceptions of Economic Education Through the Implementation of Merdeka Belajar Kampus Merdeka," *AL-ISHLAH J. Pendidik.*, vol. 15, no. 2, pp. 1904–1912, 2023.

[12] M. J. Lascano Pérez and S. P. Altamirano Carvajal, "Think-Pair-Share strategy in speaking skill development," *ConcienciaDigital*, vol. 6, no. 1.4, 2023, doi: 10.33262/concienciadigital.v6i1.4.2039.

[13] I. Blau, T. Shamir-Inbal, and O. Avdiel, "How does the pedagogical design of a technology-enhanced collaborative academic course promote digital literacies, self-regulation, and perceived learning of students?," *internet High. Educ.*, vol. 45, p. 100722, 2020.

[14] A. S. Rahmatullah, E. Mulyasa, S. Syahrani, F. Pongpalilu, and R. E. Putri, "Digital era 4.0: The contribution to education and student psychology," *Linguist. Cult. Rev.*, vol. 6, no. S3, pp. 89–107, 2022.

[15] I. Adhicandra, A. Asfahani, T. Tanwir, J. W. Sitopu, and F. Irawan, "Latest Innovations in Internet of Things (IoT): Digital Transformation Across Industries," *Innov. J. Soc. Sci. Res.*, vol. 4, no. 3, pp. 1027–1037, 2024.

[16] M. Jannah, L. D. Prasojo, and M. A. Jerusalem, "Elementary school teachers' perceptions of digital technology based learning in the 21st century: promoting digital technology as the proponent learning tools," *Al Ibtida J. Pendidik. Guru MI*, vol. 7, no. 1, pp. 1–18, 2020.

[17] T. S. Qodr, A. Efendi, and A. A. Musadad, "Opportunities for Using Smartphones in the Digital Era to Facilitate Students in Learning Sociology in High Schools," *J. Educ. Technol.*, vol. 5, no. 2, pp. 263–271, 2021.

[18] E. S. Sahabuddin, L. Liskawati, and S. Syamsiah, "Teaching Science Through Demonstrations: an Innovative Approach To Improve Students' Environmental Science Literacy," *Klasikal J. Educ. Lang. Teach. Sci.*, vol. 5, no. 1, pp. 138–147, 2023, doi: 10.52208/klasikal.v5i1.624.

[19] A. Syamsul, Basyaruddin, and A. Yuhdi, "Integration of High Order Thinking Skills in Research Method Subject in University," *Britain Int. Linguist. Arts Educ. J.*, vol. 2, no. 1, pp. 378–383, 2020, doi: 10.33258/biolae.v2i1.207.

[20] M. L. Mogale and K. S. Malatji, "Progressed Learners' Participation in Developing Curriculum Support Programmes: A Critical Pedagogy Approach," *E-Journal Humanit. Arts Soc. Sci.*, no. October, pp. 475–487, 2022, doi: 10.38159/ehass.20223105.

[21] R. Lee, K. Hoe Looi, M. Faulkner, and L. Neale, "The moderating influence of environment factors in an extended community of inquiry model of e-learning," *Asia Pacific J. Educ.*, vol. 41, no. 1, 2021, doi: 10.1080/02188791.2020.1758032.

[22] C.-H. Chen, C.-C. Shih, and V. Law, "The effects of competition in digital game-based learning (DGBL): a meta-analysis," *Educ. Technol. Res. Dev.*, vol. 68, pp. 1855–1873, 2020.

[23] F. A. Hidajat, L. D. Haeruman, E. D. Wiraningsih, and D. S. Pambudi, "The Effect of Digital Technology Learning Based on Guided Discovery and Self-regulated Learning Strategy on Mathematical Creativity," *Int. J. Inf. Educ. Technol.*, vol. 13, no. 3, pp. 535–543, 2023, doi: 10.18178/ijiet.2023.13.3.1836.

[24] N. Nurfadillah, E. S. Sahabuddin, and W. K. Sari, "The Effect Of The Form Of Parental Participation On Students Motivation To Learn Science In Bayang Elementary School Makassar City," *Int. J. Elem. Sch. Teach.*, vol. 1, no. 2, p. 98, 2022, doi: 10.26858/ijest.v1i2.23923.

[25] H. Harmanto, B. Yulianto, M. Sholeh, H. Subekti, and S. Sueb, "Strategies to Implement Independent Learning Programs: A Reflective Study on Ministerial Programs," in *Eighth Southeast Asia Design Research (SEA-DR) & the Second Science, Technology, Education, Arts, Culture, and Humanity (STEACH) International Conference (SEADR-STEACH 2021)*, Atlantis Press, 2022, pp. 346–352.