



Exploring the Level of AI (Artificial Intelligence) Digital Literacy and Creative Thinking Skills in High School Students

¹Nofamataro Zebua, ^{2*}Ibrohim, ³Sulisetijono

^{1,2,3}Program Studi Pendidikan Biologi, Fakultas Matematika dan Ilmu Pengetahuan Alam, Universitas Negeri Malang, Malang, Indonesia

*Corresponding Author e-mail: ibrohim.fmipa@um.ac.id

Received: February 2025; Revised: February 2025; Accepted: March 2025; Published: March 2025

Abstract: The development of Artificial Intelligence (AI) in education has opened up opportunities for strengthening AI digital literacy and creative thinking skills among students. AI digital literacy includes understanding how AI works, the ethics of use, and utilization in various contexts, while creative thinking refers to the ability to generate innovative and original ideas. This study aims to explore the level of AI digital literacy and creative thinking skills among Xth grade high school students, using a descriptive method with proficiency tests and self-assessment questionnaires. The results showed that students' AI digital literacy level was low, with an average score of 56.94%, where students had difficulty in critically digesting information, recognizing the social impact of AI, using AI technology, and considering the ethical aspects of its use. In addition, students' creative thinking skills were also low, with an average score of 55.14%, especially in the aspects of originality of ideas, flexibility of thinking, and conceptual mapping. These findings highlight the need for the integration of an AI curriculum in education, the use of interactive AI tools, and the implementation of project-based learning models to improve students' AI digital literacy and creativity. In addition, learning environments that support exploration and positive feedback from teachers play an important role in creating optimal synergy between these two skills. Further research is needed to explore the limitations of AI in supporting creativity as well as the risks of technology dependency in the innovative thinking process.

Keywords: AI digital literacy; creative thinking; education; AI technology; innovative learning

How to Cite: Zebua, N., Ibrohim, I., & Sulisetijono, S. (2025). Exploring the Level of AI (Artificial Intelligence) Digital Literacy and Creative Thinking Skills in High School Students. *Bioscientist: Jurnal Ilmiah Biologi*, 13(1), 510-520. doi:<https://doi.org/10.33394/bioscientist.v13i1.14782>



<https://doi.org/10.33394/bioscientist.v13i1.14782>

Copyright© 2025, Zebua et al

This is an open-access article under the [CC-BY-SA](https://creativecommons.org/licenses/by-sa/4.0/) License.



INTRODUCTION

Artificial Intelligence (AI) has developed rapidly in recent decades and is increasingly being integrated into various aspects of life, including education. The use of AI tools and methods enables the creation of complex digital learning environments that are individualized, flexible, inclusive, and engaging for students (Yuskovych-Zhukovska et al., 2022). The use of AI technologies by learners provides various benefits that can improve the quality and outcomes of learning, regardless of age, level of academic success, social status, or financial condition (Srinivasa et al., 2022).

The development of AI in education is also closely related to the vision of Society 5.0, a concept that places technology as a solution to sustainably improve the quality of human life. The basic scheme of Society 5.0 is the collection of data from the "real world," which is then processed by computers, with the results applied back to the real world (Deguchi et al., 2020). In the context of education, this concept requires individuals to have higher digital skills in order to optimally utilize technology (Smuts & Van der Merwe, 2022).

One of the key competencies in this era is AI digital literacy, which is the ability to understand, use, evaluate, and utilize AI ethically and responsibly. Ng et al. (2021a) conceptualized AI digital literacy as an effort to educate students in acquiring basic concepts, skills, knowledge, and attitudes that do not require prior understanding. AI

digital literacy can be defined as the ability to understand basic AI techniques and concepts in various products and services (Burgsteiner et al., 2016). AI digital literacy includes not only a technical understanding of how AI works but also an awareness of its impact on society, education, and the ethical aspects of its use.

The current trend in modern education is the individualization and personalization of learning. Individualization in the learning process refers to organizing a system of interaction between learners where the individual characteristics of each participant are maximally and effectively used (Osadcha et al., 2021). Individuals who have good AI digital literacy will be able to navigate the digital environment more critically, analyze AI-generated information, and utilize this technology productively in their daily lives (Naamati-Schneider & Alt, 2024). Therefore, AI digital literacy is not just a technical skill but also an important foundation for readiness to face changes in the Society 5.0 era.

In addition to AI digital literacy, creative thinking is also becoming an increasingly important skill in education. Creative thinking refers to the ability to generate new ideas, solve problems with innovative approaches, and see multiple possibilities in a situation (Runco & Jaeger, 2012). Utilizing AI in learning can support creativity by providing access to resources, interactive learning methods, and more exploratory learning experiences.

Despite the increasing relevance of AI digital literacy, the lack of integration of this concept in the secondary education curriculum has a direct impact on students' preparedness for the digital world. Currently, the focus of education is still limited to basic digital literacy, such as computer and internet usage, without explicitly including an understanding of AI as a core competency (Chiu et al., 2022). As a result, many students lack critical skills in assessing AI-based information, do not understand how these technologies work, and are ill-prepared for the ethical challenges that arise from using AI in everyday life (Ng et al., 2021b). In addition, the lack of training for teachers in understanding and utilizing AI ethically is also a major obstacle in the development of AI digital literacy in schools.

Teachers and schools have concerns that AI will reduce the level of students' creative thinking skills. In fact, AI digital literacy allows individuals to understand, explore, and utilize artificial intelligence as a tool in the creative thinking process (Long et al., 2021). AI not only helps in data analysis but also in stimulating new ideas, increasing the efficiency of concept exploration, and accelerating iterations in the creative process.

The 21st century is an era where technology and information are developing at a rapid pace. Individuals who have creative thinking skills are more adaptable to change, seek innovative solutions, and face new challenges (Avcı & Yildiz Durak, 2023). Students who are taught to think creatively will be more motivated to learn. Students not only memorize information but also look for new ways to understand and use it in everyday life.

The digital divide will widen further, causing an imbalance in students' readiness to enter an increasingly technology-driven workforce if not addressed immediately. Students who do not have an understanding of AI risk becoming mere passive users of technology without the creative ability to utilize it optimally. Furthermore, opportunities to generate solutions and creativity by utilizing technology cannot run optimally.

Based on these issues, this study aims to explore the level of AI digital literacy and creative thinking skills in grade X high school students. The results of this study

are expected to provide new insights for schools, teachers, stakeholders, and the development of education in Indonesia, especially in AI technology-based learning and creativity in learning.

METHOD

This type of research is descriptive research to describe the initial ability of AI digital literacy and creative thinking skills of grade X students. This research was conducted in November 2024 at SMAN 6 Malang. The research subjects were classes X6, X7, and X9 of SMAN 6 Malang, which totaled 107 students. AI digital literacy was measured using 8 test items, each of which tested the dimensions of AI digital literacy. In addition to the test, researchers also used a self-assessment questionnaire consisting of 20 statements. The measurement of AI digital literacy refers to four dimensions that have been developed by Hwang et al. (2023). Meanwhile, in creative thinking skills, researchers used a 5-item test question that referred to the indicators of creative thinking skills according to Treffinger et al. (2002).

The test questions that were tested focused on Biology subjects, especially the material of fungi and living things in the ecosystem. The results of the test questions and questionnaires done by students were triangulated with the results of the Biology teacher interview. The results of the interview were in the form of integration of AI digital literacy in learning to the level of students' creative thinking skills. The results of the study were analyzed in depth by the researcher to reveal the meaning in the form of data descriptions.

RESULTS AND DISCUSSION

Students' AI Digital Literacy

The measurement of AI digital literacy skill level was carried out using a test in the form of questions developed based on descriptors guided by the sub-dimensions of AI digital literacy. The questions are distributed to students by scanning the QR Code that leads to the test questions. The questions that are done are then processed and grouped based on the category of AI digital literacy test questions. The following summary of the AI digital literacy test results is presented in Table 1.

Table 1. Dimensions of students' AI digital literacy

Sub-Dimension	Descriptors	Value (%)	Description
Critical comprehension ability	Able to interpret and analyze the truth, objectivity, and information power of content presented by AI.	52,33	Low
The ability to recognize the social impact of artificial intelligence	Able to analyze the implications of AI on society and the role of AI in human development.	54,55	Low
The ability to use artificial intelligence technology	Able to effectively use and learn AI products and technologies.	58,52	Low

Sub-Dimension	Descriptors	Value (%)	Description
Ethical behaviour ability	Able to accept information produced by AI critically by considering ethical and moral aspects.	62,38	Low
Total		227,78	
Average		56,94	Low

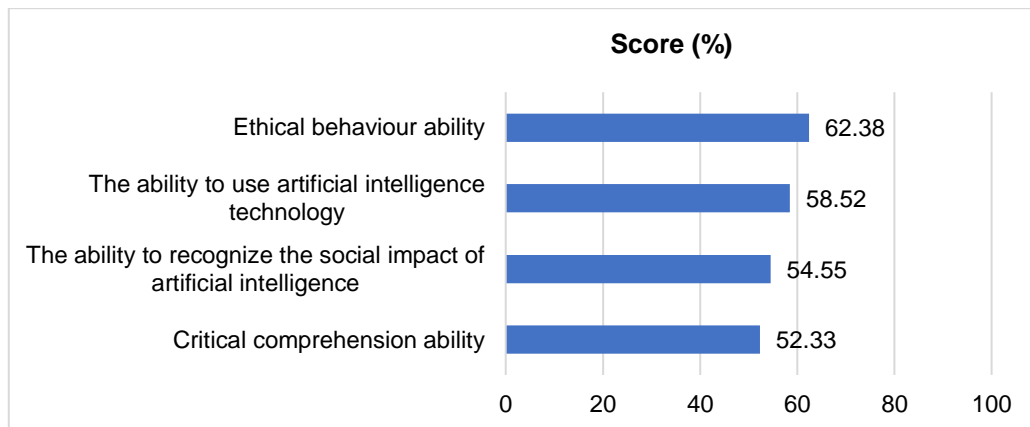


Figure 1. Bar graph of students' AI digital literacy knowledge results

Based on the results of the students' AI digital literacy knowledge test, it shows that overall, the students' AI digital literacy level is still in the low category, with an average score of 56.94%. In the sub-dimension of the ability to critically digest information, students obtained a percentage of 52.33%. This shows that students still have difficulty in critically evaluating the information provided by AI. Meanwhile, in the sub-dimension of the ability to recognize the social impact of AI, students obtained a percentage of 54.55%.

On the sub-dimension of the ability to use AI technology, students achieved a percentage of 58.52%. Although this value is slightly higher than the previous sub-dimensions, it is still relatively low, which indicates that students are still less skilled in using and learning AI technology products effectively. In the last sub-dimension, the ability to behave ethically, students obtained a percentage of 62.38%. This sub-dimension includes the ability to accept information generated by AI critically by considering ethical and moral aspects. Although this score is the highest among the other sub-dimensions, it is still in the low category.

In addition to measuring using tests, researchers also used questionnaires to measure AI digital literacy attitudes. The results of the AI digital literacy attitude test are presented in Table 2.

Table 2. Students' AI digital literacy attitude test results

No.	Statement	Statement Form	Value (%)	Criteria
1	If I have doubts about what the AI presents, I will look for more relevant information to learn more about it.	+	62,61	Good

No.	Statement	Statement Form	Value (%)	Criteria
2	I do not believe the information presented by AI is always correct.	+	54,76	Good enough
3	When in doubt about the information provided by AI, I will check its veracity through other sources.	+	54,01	Good enough
4	I can evaluate whether the content suggested by the AI presents a balanced/unbiased point of view.	+	62,99	Good enough
5	I understand how to check the accuracy of the content provided by AI.	+	49,90	Low
6	I think AI technology is very important in my life.	+	47,47	Low
7	I know how fast AI can accomplish a task.	+	52,89	Low
8	Although AI is constantly evolving, I believe it cannot replace humans.	+	51,40	Low
9	I think everyone needs AI skills.	+	45,23	Low
10	I think about the good and bad impacts that AI can have.	+	54,01	Good enough
11	I can process the information or content I am looking for to produce something new.	+	45,23	Low
12	I can use AI services independently.	+	43,73	Low
13	I can choose the AI service (platform) that suits me, depending on the situation.	+	46,72	Low
14	I can use AI technology to solve learning and daily life problems.	+	42,99	Low
15	I can use AI technology to find the information or content I need.	+	44,48	Low
16	When using AI-based big data, I will ensure the legality and reliability of the information generated.	+	41,68	Low
17	Whether or not I follow AI's recommendations, I can consider who is responsible for the consequences of my choices.	+	49,90	Low
18	Whether or not I accept AI's recommendations, I take responsibility for the impact of my choices.	+	50,46	Low
19	I fully consider the viewpoints of others when sharing the information I have gathered.	+	42,61	Low
20	I have standards to distinguish between content that is good to share and content that is normal.	+	42,24	Low
Total			985,31	
Average			49,26	Low

The results of the student AI digital literacy attitude questionnaire show that, in general, students' attitudes towards AI digital literacy are still in the low category, with an average score of 49.26%. However, there are some aspects that show a positive attitude, including the ability of students to seek further information when in doubt about what is presented by AI at 62.61% and the ability to evaluate whether the content suggested by AI displays a balanced point of view with a percentage of 62.99%. However, other statements, such as understanding how to check the accuracy of AI content (49.90%), belief in the importance of AI in life (47.47%), and ability to use AI technology to solve problems (42.99%), are still in the low category. This indicates that students still lack confidence and skill in utilizing AI technology.

On the other hand, students' attitudes toward the impact and responsibility of AI use also need to be improved. Although some students think about the good and bad impacts of AI (54.01%) and take responsibility for the consequences of their choices (50.46%), most are still lacking in ensuring the legality and reliability of AI-generated information (41.68%) as well as considering others' viewpoints when sharing information (42.61%). Overall, these results indicate that students still need to improve their understanding, skills, and ethical awareness in interacting with AI technologies.

The low score of students in student digital literacy is evidenced by the test results of the question test and self-assessment questionnaire, which get a score of 56.94% (low) and 49.26% (low), respectively. These results indicate that AI digital literacy is a serious concern to immediately take wise solutions. Moreover, digital learning also requires teachers and students to be ready. One of them is the skill for students in using AI tools. The level of AI Digital Literacy in students refers to their skills in understanding, utilizing, assessing AI technology effectively and with critical thinking.

The results of interviews with subject teachers also mentioned that students are familiar with AI technologies, such as chatGPT and Gemini. However, they sometimes take results from AI chatbots without verifying them first. Subject teachers are also concerned if students rely too much on the results of AI technology. A study by Perrotta & Selwyn (2020) found that most students have a basic understanding of what AI is, but a deep understanding of how AI works is limited. Students tend to associate AI with robots and automation but lack an understanding of AI's role in data analysis, pattern recognition, and decision-making (Luckin & Holmes, 2016).

Students' ability to utilize AI tools for learning or productivity purposes is still low; this is because schools and teachers have not integrated AI into learning. Interviews with subject teachers also revealed that they are quite cautious in the application of AI for students because teachers are worried that students will become dependent on AI. Chiu & Chai's (2020) research also showed that teachers have concerns about the use of AI in education and have problems integrating it into lessons. Students tend to believe that AI is a neutral technology, without realizing that AI can produce bias and needs verification on credible sources by its users (Cukurova et al., 2020).

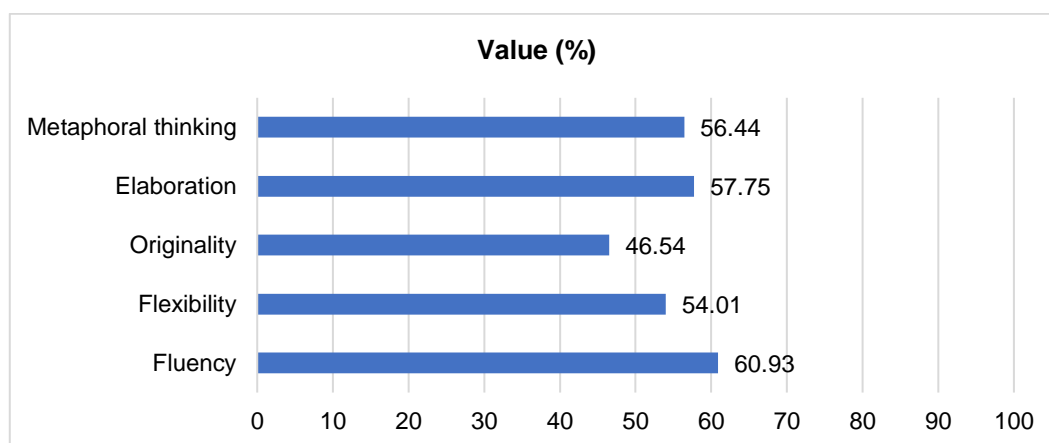
The low level of AI mastery among students emphasizes the importance of integrating AI curriculum in formal education to improve students' AI digital literacy. A well-designed educational program can help students understand AI concepts, develop practical skills, and increase ethical awareness.

Students' Creative Thinking Skills

As one of the important 21st-century skills possessed by students, researchers want to know the extent of students' thinking skills by using creative thinking skills test questions. The test question consists of 5 items, each of which measures the existing indicators by referring to the indicators of creative thinking skills.

Table 7. Student creative thinking skills test results

Indicators	Test Indicator	Value (%)	Category
Fluency	Able to create ideas to solve problems.	60,93	Simply Less
Flexibility	Able to create and apply several alternative ideas that vary from various points of view to solve problems.	54,01	
Originality	Able to think originally in creating new and unique ideas.	46,54	Very Poor
elaboration	Able to explain ideas in detail and specifically.	57,75	
metaphorical thinking	Able to use comparisons or analogies to make new connections.	56,44	Less Less
Total		275,70	
Average		55,14	Less

**Figure 2.** Bar diagram of student creative thinking skills results

The data results in Table 3 show that the average student's ability to think creatively is still in the insufficient category, with a percentage of 55.14%. Based on the indicators measured, fluency reached 60.93% with a sufficient category as well as being the highest indicator among other indicators. Meanwhile, the originality indicator obtained a percentage of 46.54% and became the lowest percentage in the skill indicators possessed by students.

The other three indicators, namely the flexibility indicator (54.01%), elaboration (57.75%), and metaphorical thinking, amounted to 56.44%. These three categories fall into the less category. Overall, these results show that students still face challenges in developing creative thinking skills, especially in terms of generating original ideas, being flexible, and being able to explain ideas in detail, so further efforts are needed to improve students' creative thinking skills, especially in aspects that are still weak.

Creative thinking is the cognitive ability of students to generate new, original, and useful ideas in solving problems or creating something innovative. This skill involves divergent (generating various solutions or ideas) and convergent (choosing the best solution) thinking processes. Creative thinking is not only limited to the arts, but is also very important in science, technology and other fields.

The results of the test questions, supported by in-depth interviews, show that the level of students' creative thinking skills is still in the "less" category. Low creative thinking skills are caused by several factors, such as an environment that is less

supportive of exploration and less space for students to develop their creativity. A learning environment that is open and does not pressure students tends to encourage the emergence of creative ideas. In addition, the application of learning models that emphasize problem-based learning (PBL) or project-based learning (PjBL) or a combination of models, such as problem-oriented project-based learning (POPBL), can stimulate students to think creatively (Francisco et al., 2024; Komalasari et al., 2024).

The role of the teacher in providing positive feedback and encouraging students to think freely is very important. Intrinsically motivated students tend to be more creative as they are more motivated to explore ideas. Skills such as attention, and problem solving also affect creativity.

Relationship between AI Digital Literacy and Creative Thinking Skills

AI digital literacy refers to an individual's ability to understand, use, and evaluate AI technologies effectively and critically. These skills include an understanding of how AI works, the ethics of its use, and the ability to utilize AI-based technologies in various contexts (Hwang et al., 2023). On the other hand, creative thinking skills involve the ability to generate new, original, and useful ideas. These two variables are interrelated as AI digital literacy can be a supporting tool to enhance creativity, while creative thinking skills can help individuals utilize AI more innovatively. Runco & Jaeger (2012) argue that creativity is not only innate but can also be enhanced with the right skills and tools. AI as a creative tool can provide a new stimulus in the creative thinking process, in line with research findings showing that AI helps individuals explore new perspectives.

Proficiency in AI digital literacy can expand creative thinking capacity by providing tools and platforms that enable the exploration of new ideas. For example, AI tools such as ChatGPT, Gemini, QuickChat, and Microsoft Copilot can be used to generate creative content, design innovative solutions, or even solve complex problems in the form of generative text. An understanding of AI allows individuals to think critically about the limits and potential of this technology, which in turn encourages innovation (Markauskaite et al., 2022).

The relationship between AI digital literacy and creative thinking skills can also be dynamic. High AI digital literacy does not necessarily guarantee increased creativity if individuals lack divergent thinking skills or cognitive flexibility. Conversely, individuals with strong creative thinking skills but who lack AI digital literacy may struggle to utilize the full potential of these technologies (Junaedi et al., 2024). Therefore, integration between these two skills is important to create optimal synergy.

AI digital literacy can also be a catalyst for improving creative thinking skills. For example, in a study conducted by students who used AI tools to design science projects showed significant improvements in their ability to generate original ideas and develop innovative solutions. These students reported that AI tools helped them look at problems from different perspectives and explore possibilities that were previously unthinkable. Giuggioli & Pellegrini (2022) found that the use of AI-based technologies in learning and project design can improve cognitive flexibility and divergent thinking skills. This supports the finding that AI enables students to generate original and innovative ideas.

However, the findings revealed that a lack of understanding about the ethics and limitations of AI can hinder individual creativity. For example, some participants admitted to feeling apprehensive about using AI tools for fear of producing unoriginal

work or violating copyright. This suggests that comprehensive AI digital literacy, including an understanding of ethical aspects, is essential to support creativity.

Research by Marrone et al. (2022) found that most students reported that while AI can never match human creativity, it can certainly help them develop their creativity. Learning environments that support experimentation with AI can enhance creativity. Students who have better AI digital literacy tend to be more creative in completing tasks, and it is possible to explore new ideas and increase efficiency in the creative process. The use of AI in education found that the utilization of AI in the exploration of ideas can encourage student creativity, especially in project-based tasks.

Implications

Students' low scores in digital literacy, especially AI digital literacy, is a serious concern that demands a wise solution, considering that digital learning requires teacher and student readiness. The results of this study show that while students have a basic understanding of AI, there is limited in-depth understanding of how AI works, its ethical implications, and its utilization for productivity. AI digital literacy and creative thinking skills are essential 21st-century skills that every student needs to have in the face of technological development. These two skills are interrelated, where AI digital literacy can be a supporting tool to enhance creativity, while creative thinking skills enable innovative utilization of AI. The integration of a well-designed AI curriculum, the use of interactive AI tools, and the implementation of project-based learning models can be solutions to improve students' AI digital literacy and creative thinking skills. A learning environment that supports exploration, positive feedback from teachers, and students' intrinsic motivation also plays an important role in creating optimal synergy between these two skills.

This study opens up a range of opportunities for further research, particularly in understanding how the level of AI digital literacy at beginner, intermediate, and advanced levels can influence individual creativity. In addition, it is important to explore the extent to which AI can contribute to enhancing creativity in professional contexts compared to education, given the different needs and dynamics in the two domains. Furthermore, research on the same topic also needs to examine the limitations of AI in enhancing human creativity as well as the potential risks of stunting creativity, especially due to over-reliance on this technology in the innovative thinking process.

CONCLUSION

The low AI digital literacy and creative thinking skills of high school students pose a serious challenge in the digital learning era. This study shows that students have a basic understanding of AI, but there is limited in-depth understanding of how AI works, ethical implications, and utilization for productivity. Students' creative thinking skills are also still low, especially in generating original and flexible ideas. These two skills are interrelated, where AI digital literacy can support creativity, while creative thinking skills enable innovative utilization of AI. AI curriculum integration, the use of interactive AI tools, and project-based learning models can be solutions to improve both of these skills. Learning environments that support exploration and positive feedback from teachers are also important to create optimal synergy.

REFERENCES

- Avci, Ü., & Yildiz Durak, H. (2023). Innovative thinking skills and creative thinking dispositions in learning environments: Antecedents and consequences. *Thinking Skills and Creativity*, 47, 101225. <https://doi.org/10.1016/j.tsc.2022.101225>

- Burgsteiner, H., Kandlhofer, M., & Steinbauer, G. (2016). IRobot: Teaching the Basics of Artificial Intelligence in High Schools. *Proceedings of the AAAI Conference on Artificial Intelligence*, 30(1). <https://doi.org/10.1609/aaai.v30i1.9864>
- Chiu, T. K. F., & Chai, C. (2020). Sustainable Curriculum Planning for Artificial Intelligence Education: A Self-Determination Theory Perspective. *Sustainability*, 12(14), 5568. <https://doi.org/10.3390/su12145568>
- Chiu, T. K. F., Meng, H., Chai, C.-S., King, I., Wong, S., & Yam, Y. (2022). Creation and Evaluation of a Pretertiary Artificial Intelligence (AI) Curriculum. *IEEE Transactions on Education*, 65(1), 30–39. <https://doi.org/10.1109/TE.2021.3085878>
- Cukurova, M., Luckin, R., & Kent, C. (2020). Impact of an Artificial Intelligence Research Frame on the Perceived Credibility of Educational Research Evidence. *International Journal of Artificial Intelligence in Education*, 30(2), 205–235. <https://doi.org/10.1007/s40593-019-00188-w>
- Deguchi, A., Hirai, C., Matsuoka, H., Nakano, T., Oshima, K., Tai, M., & Tani, S. (2020). What Is Society 5.0? In *Society 5.0* (pp. 1–23). Springer Singapore. https://doi.org/10.1007/978-981-15-2989-4_1
- Francisco, R., Ibrohim, I., & Susilo, H. (2024). The Influence of Problem-Oriented Project-Based Learning (POPBL) on Students' Creative Thinking Skills. *BIOEDUKASI*, 22(1), 146–151. <https://doi.org/10.19184/bioedu.v22i1.44648>
- Giuggioli, G., & Pellegrini, M. M. (2022). Artificial intelligence as an enabler for entrepreneurs: a systematic literature review and an agenda for future research. *International Journal of Entrepreneurial Behavior & Research*, 29(4), 816–837. <https://doi.org/10.1080/IJEBR-05-2021-0426>
- Hwang, H. S., Zhu, L. C., & Cui, Q. (2023). Development and Validation of a Digital Literacy Scale in the Artificial Intelligence Era for College Students. *KSII Transactions on Internet and Information Systems*, 17(8). <https://doi.org/10.3837/tiis.2023.08.016>
- Junaedi, A. T., Panjaitan, H. P., Yovita, I., Veronica, K., Renaldo, N., & Jahrizal, J. (2024). Advancing Digital and Technology Literacy through Qualitative Studies to Bridging the Skills Gap in the Digital Age. *Journal of Applied Business and Technology*, 5(2), 123–133. <https://doi.org/10.35145/jabt.v5i2.170>
- Komalasari, R. N. A., Ibrohim, I., & Listyorini, D. (2024). Creativity in Biology: The Impact of Problem-Oriented Project Based Learning on High School Students. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, 10(2), 555–562. <https://doi.org/10.22219/jpbi.v10i2.32497>
- Long, D., Blunt, T., & Magerko, B. (2021). Co-Designing AI Literacy Exhibits for Informal Learning Spaces. *Proceedings of the ACM on Human-Computer Interaction*, 5(CSCW2), 1–35. <https://doi.org/10.1145/3476034>
- Luckin, R., & Holmes, W. (2016). Intelligence Unleashed: An Argument for AI in Education. In *UCL Knowledge Lab: London, UK*. UCL Knowledge Lab. <https://discovery.ucl.ac.uk/id/eprint/1475756>
- Markauskaite, L., Marrone, R., Poquet, O., Knight, S., Martinez-Maldonado, R., Howard, S., Tondeur, J., De Laat, M., Buckingham Shum, S., Gašević, D., & Siemens, G. (2022). Rethinking The Entwinement Between Artificial Intelligence and Human Learning: What Capabilities Do Learners Need for A World With AI? *Computers and Education: Artificial Intelligence*, 3, 100056. <https://doi.org/10.1016/j.caeai.2022.100056>
- Marrone, R., Taddeo, V., & Hill, G. (2022). Creativity and Artificial Intelligence—A Student Perspective. *Journal of Intelligence*, 10(3), 65. <https://doi.org/10.3390/jintelligence10030065>
- Naamati-Schneider, L., & Alt, D. (2024). Beyond digital literacy: The era of AI-powered assistants and evolving user skills. *Education and Information Technologies*, 29(16), 21263–21293. <https://doi.org/10.1007/s10639-024-12694-z>
- Ng, D. T. K., Leung, J. K. L., Chu, K. W. S., & Qiao, M. S. (2021a). AI Literacy: Definition, Teaching, Evaluation and Ethical Issues. *Proceedings of the Association for Information Science and Technology*, 58(1), 504–509. <https://doi.org/10.1002/pra2.487>

- Ng, D. T. K., Leung, J. K. L., Chu, S. K. W., & Qiao, M. S. (2021b). Conceptualizing AI literacy: An Exploratory Review. *Computers and Education: Artificial Intelligence*, 2, 100041. <https://doi.org/10.1016/j.caeai.2021.100041>
- Osadcha, K., Osadchyi, V., Kruglyk, V., & Spirin, O. (2021). Modeling of the adaptive system of individualization and personalization of future specialists' professional training in the conditions of blended learning. *Educational Dimension*, 5, 109–125. <https://doi.org/10.31812/educdim.4721>
- Perrotta, C., & Selwyn, N. (2020). Deep learning goes to school: toward a relational understanding of AI in education. *Learning, Media and Technology*, 45(3), 251–269. <https://doi.org/10.1080/17439884.2020.1686017>
- Runco, M. A., & Jaeger, G. J. (2012). The Standard Definition of Creativity. *Creativity Research Journal*, 24(1), 92–96. <https://doi.org/10.1080/10400419.2012.650092>
- Smuts, H., & Van der Merwe, A. (2022). Knowledge Management in Society 5.0: A Sustainability Perspective. *Sustainability*, 14(11), 6878. <https://doi.org/10.3390/su14116878>
- Srinivasa, K. G., Kurni, M., & Saritha, K. (2022). *Harnessing the Power of AI to Education* (pp. 311–342). https://doi.org/10.1007/978-981-19-6734-4_13
- Treffinger, D. J., Young, G. C., Selby, E. C., & Shepardson, C. (2002). *Assessing Creativity: A Guide for Educators*. National Research Center on the Gifted and Talented.
- Yuskovych-Zhukovska, V., Poplavska, T., Diachenko, O., Mishenina, T., Topolnyk, Y., & Gurevych, R. (2022). Application of Artificial Intelligence in Education. Problems and Opportunities for Sustainable Development. *BRAIN. Broad Research in Artificial Intelligence and Neuroscience*, 13(1Sup1), 339–356. <https://doi.org/10.18662/brain/13.1Sup1/322>