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Remap NHT learning model integrates scientific literacy and critical thinking to enhance students creative thinking

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ABSTRACT

Students' scientific literacy skills help them analyze and evaluate each scientific subject. It is predicted that scientific literacy skills will help students improve their communication abilities as well. This study evaluated the correlation between scientific literacy and Critical thinking skills in developing creative thinking skills using the Remap-NHT learning model. The study was quasi-experimental since it employed a non-equivalent pretest-post-test control group design and included 122 eleventh-grade students at SMAN 4 Soppeng during the 2023/2024 academic year. The participants were divided into three groups. An essay test assessed every variable. The findings indicated that (1) there was a significant correlation between scientific literacy skills and creative thinking skills; (2) there was a significant correlation between Critical thinking skills and creative thinking skills; and (3) there was a significant correlation between scientific literacy skills and Critical thinking skills. The regression equation showed $Y= 0{,}228*X_1+0.995*X_2+21{,}645$. Based on the findings, it can be concluded that Remap-NHT can be utilized to improve students' scientific literacy, communication, and creative thinking skills, all of which are demonstrated to be connected.

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INTRODUCTION

The 21st-century learning process is primarily concerned with enhancing students' ability to meet the twenty-first-century demands (Irawan et al., 2021). Several skills are mentioned, including scientific literacy, Critical thinking skills, and creative thinking. These are critical skills for students to possess in the competitive era of globalization (Kaczkó & Ostendorf, 2023) and will become

even more critical with the rapid advancement of technology, which will increase competitiveness ant to support deep learning processes (Zahra et al., 2021).

Learning in the twenty-first century is markedly different from learning in the previous century (Kokshagina et al., 2021), particularly in students developing higher-order thinking skills and self-actualization (Alt & Raichel, 2020). Self-actualization focuses on how students can leverage their scientific literacy, communication, and creative thinking skills to solve problems (Vannajak & Vannajak, 2023).

Data from PISA reveal that basic skills, including scientific literacy, remain very low due to the limited ability to process information from literature reviews. This, in turn, results in students' reasoning skills remaining very low and limited, preventing them from analyzing scientific ideas and phenomena. These constraints prevent students from becoming accustomed to problem-solving using an integrated scientific approach, particularly in biology (Hernández-Torrano & Ibrayeva, 2020).

In this regard, previous research revealed an interesting fact: scientific literacy skills significantly influence critical thinking skills and creative thinking skills. This is because, in scientific literacy skills, students are not only asked to understand each scientific phenomenon, but they must also be able to integrate more complex approaches and provide solutions to the events and scientific concepts they encounter. This is very evident in biology learning, where students are asked to think creatively to put forward original ideas that are adaptive and applicable in understanding the regularity of each scientific phenomenon in learning activities (Guo & Huang, 2023)

Students who possess scientific literacy skills are expected to describe any phenomenon they encounter using fundamental scientific concepts (Irawan, 2023). With scientific literacy, students are more actively involved in deriving information from various sources that increase students' reasoning power (Rio & Rodriguez, 2022). Scientific literacy skills will aid students in a problem-solving process using a scientific approach [8]. Those skills are consistent with an in-depth learning process, which encourages teachers to facilitate students' scientific literacy skills, enabling them to solve problems scientifically and use a scientific approach (Zhang et al., 2019).

Another set of skills that students should develop is Critical thinking skills. Students need to communicate each idea uniquely and diversely to accept the information conveyed (Kuzovlev et al., 2021) By focusing on the number of solutions that can be raised, Critical thinking skills enable students to get directly the diversity of solutions or answers based on existing facts (Kaffah et al., 2020) Additionally, students are expected to integrate any information communicated by analyzing various types of accurate information or data (Kokshagina et al., 2021) and identifying and proposing a solution or answer to a problem. Besides that, students can prioritize variations in responses or solutions to respond to a problem (Madhakomala et al., 2022).

Critical thinking skills enable students to comprehend multiple meanings of a concept, resolve divergent viewpoints, consider other students' perspectives, reflect on, and integrate multiple perspectives on the problem or theory being studied (Irawan et al., 2021). Students who possess strong Critical thinking skills will be able to integrate various concepts or ideas. Additionally, they will be able to develop the scientific literacy skills necessary to describe each scientific fact and the creative thinking skills necessary to incorporate each concept continuously (Goyal et al., 2022).

Scientific literacy and Critical thinking skills are both associated with creative thinking skills. Students develop creative thinking skills when they can generate diverse ideas through metaphorical thinking. Related research showed that those abilities are linked to developing students' courage to explore their curiosity, imagination ability, adaptability, and intuition (Zahra et al., 2021). Scientific literacy, communication, and creative thinking require students to

demonstrate personal understanding, including expressing any ideas or concepts they can arrange (Matsumoto-Royo & Ramírez-Montoya, 2021).

Unfortunately, students have not discovered the appropriate method for relating scientific phenomena or concepts to theory in general (Pujiati & Yulianto, 2021) because students have been unable to synthesize and connect all of the information they receive (Putri & Chairiyah, 2021). According to empirical data, only 31. 15% of students can synthesize the initial information they receive and create a detailed map of the concept (Mufida et al., 2017). Furthermore, school-based learning does not align with the primary educational instructional goal, which is to improve students' abilities to communicate ideas, make decisions, analyze, and solve problems (Lam & Tong, 2021).

Students are not taught scientific literacy and Critical thinking skills necessary for integrating scientific evidence when compiling information (Kim et al., 2021). Implementing sub-optimal and monotonous learning activities in schools makes students passive when accessing information or reading learning materials (Herniawati, 2019). As a result, students' ability to recognize, remember, and comprehend messages and information is severely limited. Therefore, an appropriate learning model is required to support the development of scientific literacy, Critical thinking skills, and creative thinking skills, all of which are interrelated and have a highly dynamic relationship (Suckale et al., 2018).

One of the learning models that can be a solution to this problem is the Remap-NHT learning model, because literacy skills and creative thinking skills can be trained through learning models that facilitate students to carry out scientific processes and literature reviews in finding the regularity of scientific concepts and facts that they encounter in everyday life.

This model of learning incorporates reading activities, concept mapping, and the NHT cooperative learning model. NHT cooperative learning emphasizes collaboration among students from diverse backgrounds to mitigate adverse learning outcomes (Winata et al., 2017). Reading activities in Remap-NHT assist students in identifying the central ideas of the learning topic and expanding on information to comprehend each concept studied. These concepts are then incorporated into a concept map that depicts the hierarchical relationship between each sub-component of the subject being studied [26]. The NHT learning model teaches students how to learn in an integrated fashion by compiling and communicating each concept learned. This process reflects students' performance in a learning activity (Abid et al., 2021).

According to the description above, this study used the Remap-NHT learning model to determine the correlation between scientific literacy skills, Critical thinking skills, and creative thinking skills. RemapHT can be used in place of this to help students develop these three skills dynamically.

RESEARCH METHODS

Research Design

This research was a correlation study utilizing the Cluster Sampling technique. The population contained seven classes of eleventh-grade students from the natural sciences department at SMAN 4 Soppeng. The research design used a non-equivalent pretest-posttest group design. The design was chosen based on the number of available classes to accommodate the selection of classes for each experimental and control class.

Population and Samples

The population in this study was students of class XI at SMA Negeri 4 Soppeng in the odd semester of the 2023/2024 academic year. The sample taken from the population was students of class XI SMAN 4 Malang, consisting of 7 science classes. The homogeneity test was used to select samples. The research samples consisted of 3 classes studying in the 2023/2024 academic year.

The materials covered in the study were the human movement system and the human circulatory system. The samples selected were class XI IPA 4 as the experimental class and class X IPA 1 as the positive control class, and class XI IPA 2 as the negative control, based on the results of the equivalence test. The sampling technique to determine the class to be given treatment was carried out by conducting an equivalence test to determine the character of every class.

Instruments

Data were collected using six essay questions arranged based on indicators of scientific literacy skills and creative thinking skills. Students' Critical thinking skills were tested using a questionnaire. To describe creative thinking skills as insights that have a dynamic process. These insights include three main processes: (a) selective selection, which is the separation of relevant and irrelevant information, (b) selective comparison, which is the ability to connect new information with previous knowledge, and (c) selective combination, which is the capacity to unite each piece of different information that is arranged in detail and logically. The rubric for creative thinking skills is and the indicators for creative thinking skills according to Treffinger include several specifications that include fluency, flexibility, originality, elaboration, and metaphorical thinking, as well as for measuring scientific literacy skills based on Gormally's measurement techniques which consist of several sub-indicators including Identifying valid scientific opinions, Conducting literature searches effectively and systematically, Evaluating the use and misuse of scientific opinions, Making inferences, predictions, and drawing conclusions based on quantitative data. The validity and reliability of the research instruments had been established before their use by the validator team. Each question was declared valid and reliable, as evidenced by a Pearson correlation coefficient of 0.05 and a Cronbach's Alpha coefficient of 0.903.

Procedures

The procedure of this research is divided into 4 stages: the planning stage, the pre-research stage, the research implementation stage, and the final research stage. The planning stage consisted of observations and interviews with biology teachers That have aim Observations and interviews were conducted to collect problems faced by teachers in measuring high-level thinking skills, obstacles found in the learning process, and to understand what learning models have been used or implemented by teachers in the learning process, so that from the results of interviews and observations, a comprehensive reflection can be carried out in training students' high-level skills. Furthermore, the pre-research stage is the preparation of a research proposal, the preparation of research instruments, and the validation of research instruments. Then, the research implementation stage is data collection at the school by distributing questionnaires and questions to students. The final stage of the research is the analysis of data obtained from the questionnaire scores.

Data Analysis

SPSS was used to analyze the data. Kolmogorov-Smirnov was used to determine the normality of the data. The homogeneity test was used to determine the data's equality, and the linearity test was used to determine the variables' linear/significant relationship, which includes normality test, linearity test, multicollinearity test, and heteroscedasticity test, then hypothesis testing, multiple regression analysis, and correlation analysis. The assumption tests showed that the data were distributed normally, homogeneously, and linearly. Following that, a Multiple Regression Analysis was conducted at the significance level of 5% or 0.05. I

RESULTS

Table 1 shows the result of multiple regression analysis on the simultaneous correlation between students' scientific literacy, communication, and creative thinking skills. Scientific literacy

and creative thinking skills both contribute significantly to creative thinking skills at a rate of 44% (R-square value in Table 1).

Table 1. The Result of Simultaneous Multiple Regression Analysis on the Correlation between Scientific Literacy, Communication, and Creative Thinking Skills

	R	R square	Adjusted R Square	Std. Error of the Estimate
1	0.788[a]	0.445	0.351	8.78577

Table 1 reports a correlation value of 0.788 and an R-square value of 0.445. These values indicate that 42.90% of the acquisition of creative thinking skills is influenced by scientific literacy skills, while other factors determine the remaining 57.10%.

Table 2 contains a regression analysis of the correlation between scientific literacy, Critical thinking skills, and creative thinking skills. According to Table 2, the significance level of scientific literacy skills is 0.000 < 0.05. Thus, there is a correlation between students' scientific literacy skills and their ability to think creatively. The correlation between students' communication and creative thinking skills shows a significance value of 0.001 < 0.05. This value indicates a relationship between students' communication and creative thinking skills. To some extent, scientific literacy and Critical thinking skills empower students' creative thinking skills.

Table 2. Multiple Regression Analysis on the Partial Correlation between Students' Scientific literacy and Critical thinking skills

Model		Non-standardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	21.645	.368		12.014	.000
2	Scientific Literacy	.995	.005	.502	193.664	.001
3	Critical thinking	.228	.055	.511	2.190	.001

The regression equation obtained by multiplying B-value with the independent variables is as follows:

$$Y= 0{,}228*X_1+0.995*X_2+21{,}645$$

Remarks:
Y = Creative Thinking Skills
X_1 = Scientific Literacy Skills
X_2 = Critical thinking skills

As the regression equation above indicates, both variables have a positive coefficient value, implying that scientific literacy and Critical thinking skills have a beneficial effect on the empowerment of creative thinking skills.

The study's findings indicated a significant correlation between students' scientific literacy, communication, and creative thinking abilities when taught using the NHT REMAP learning model. The NHT REMAP learning model engages students in a meaningful learning process, allowing them to access the information necessary to develop a complete and unique concept (Maybee et al., 2015).

DISCUSSION

As the first activity in Remap-NHT, reading enables students to generate initial or major ideas about the material under study (Vannajak & Vannajak, 2023). Additionally, students organize these ideas into essential information and efficiently extract necessary information from the text (reading) (Lefringhausen et al., 2022). The factual information will be used to construct new knowledge based on the students' personal experiences. This process can help students develop their ability to think creatively.

Composing information selectively from the results of their thoughts teaches students to become fluent communicators. This result is supported by research conducted by Sewasew and Koester (Lee & Kwon, 2024), which indicates that the primary goal of developing students' communication and creative thinking skills should be to familiarize them with reading scientific sources to expose them to a variety of ideas (Anwar et al., 2019).

The next syntax in Remap-NHT is concept mapping. Students' initial ideas are used to create a concept map (Tikva & Tambouris, 2021). Concept maps assist students in identifying broad concepts prior to focusing on more specific concepts. In addition, concept mapping enables students to incorporate new meanings into the knowledge they acquire during the reading stage (Cui et al., 2018). When drawing a concept map, students are expected to memorize concept definitions, give propositional statements, and build relationships between sub-materials and interpret concepts holistically (Koes-H et al., 2019).

Concept mapping is an effective strategy for enhancing students' creative thinking skills. It enables students to visualize the specific relationship between concepts and the hierarchical structure of each learning material (topic) (Mashroofa et al., 2023). Concept mapping also aids in the enhancement of cognitive abilities and memory [38]. According to the assimilation process, memory is hierarchical; new information acquired and processed results in forming a more specific concept (Goodyear & Armour, 2021), where the relationship between each concept develops naturally. At this stage, students are encouraged to explain or communicate their concept maps to their peers. This activity assists students in developing their Critical thinking skills (Abid et al., 2021).

The use of concept maps enables students to connect each piece of information diversely and uniquely. The concept follows a specific pattern. As a result, concepts should not be drafted concurrently to ensure that the resulting ideas are unique (Apanovich et al., 2023). Additionally, concept mapping teaches students to recognize valid scientific opinions, provide accurate explanations, and draw appropriate conclusions based on the information gathered. This ability serves as the primary determinant of scientific literacy (Barnett & Jung, 2021).

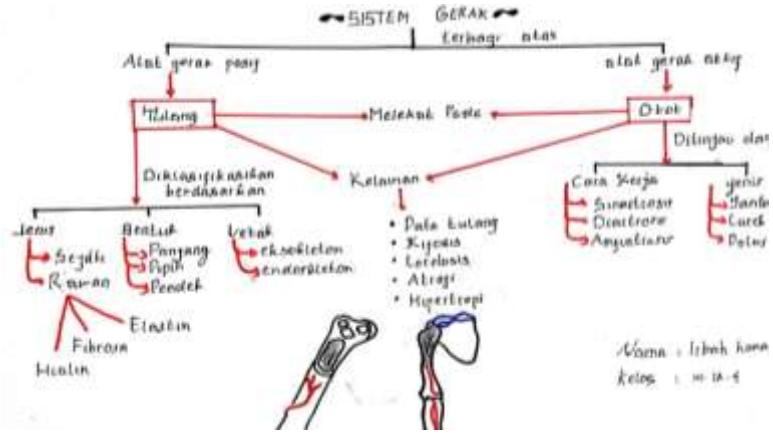

Figure 1. Concept Map of Human Movement System

English Translation For Figure 1

Alat Gerak aktif: Active Movement Tool
Alat Gerak pasif: Passive Movement Tool
Dikalsifikasikan:Classified
Letak: Location
Jenis: Kinds
Bentuk: Shape
Cara kerja :How it works
Amfiatrosisi: Amfiathrosis
Kelainan: Disease
Lordosis: Lordhosis
Hypertrophy: Hypertrophy
Otot jantung: Cardiac Muscle
Otot Polos: Smooth Muscle
Tulang Pipa: Long Bone
Eksoeskleton:Exoeskleton
Endoskleton:Endoskeleton
Tulang Rawan: Cartilage bone
Otot: Muscle
Tulang Hialin: Hyaline bone
Sinartrosis: Sinarthrosis
Diartrosis: Diarthrosis
Kifosis: Kifhosis
Artrofi:Arthrofi
Melekat pada:Attached to
Otot lurik: Skeletal muscle
Terbagi Atas:Divided into

Figure 1 illustrates an example of a student concept map. As illustrated in Figure 1, the student was engaged in several primary processes when creating concept maps. First, the student examined the consistency of each concept sequence and then classified them hierarchically from lowest to highest. These processes required the student to be precise in reconciling the horizontal and vertical connections between each concept. The interactive reconciliation process was demonstrated through the student's concept of creative thinking, which is connected to the reciprocal relationship of each sub-section via arrows or connecting lines that demonstrate the sub-materials' unity and cohesiveness.

The development of students' scientific literacy skills is inextricably linked to the development of their creative thinking skills (Smith et al., 2020). Students' scientific literacy skills can be enhanced by developing competent attitudes. Students are invited to convert and describe relevant information from articles or other results of literature reviews (Panjaitan et al., 2020). Additionally, students should be taught how to support their arguments with relevant evidence and explicit explanations in accordance with pertinent references. Enhancing scientific literacy skills, which can dynamically improve creative thinking abilities, requires an elaboration process, which refers to the capacity to add details and expand ideas (Suciari et al., 2021).

According to research, students' scientific literacy skills can improve due to their ability to master categorizing data from information sources [49],[50]. The ability of students to review information holistically at the same time can enhance their capacity for creative thinking [51]. Scientific literacy and communication abilities have a strong correlation with students' ability to think creatively. Each scientific idea or concept compiled by students due to their scientific literacy activity must be communicated/delivered by students [52]. Before communicating the result, students must collaborate to solve problems, collect scientific evidence, conduct practicum activities, and organize the delivery of information resulting from each team member's thinking (Ching Leen et al., 2014).

According to research (Peña-Ayala, 2021), collecting scientific evidence that students engage in during the learning process helps students unite ideas to observe, classify, and draw conclusions [55]. Additionally, exploration of scientific activities resulting from investigation and interpretation with scientific understanding, a product of scientific literacy, contributes to developing students' creative thinking skills [56].

Remap-NHT learning is practical and contributes to the assessment of students' scientific processes. Remap-NHT enables students to communicate learning materials or science facts with

others effectively. Along with enhancing students' scientific literacy skills, Remap-NHT contributes significantly to developing their communication and creative thinking skills.

CONCLUSION

This study's findings indicated a strong correlation between scientific literacy and communication thinking skills, which together accounted for 48% of students' creative thinking skills. It was also found that the syntax of Remap-NHT contributed to students' development of scientific literacy, communication, and creative thinking skills. The direct implication is to provide innovative solutions through learning models that provide meaningful learning experiences, especially in science lessons, to train students' high-level skills.

REFERENCES

Abid, G., Arya, B., Arshad, A., Ahmed, S., & Farooqi, S. (2021). Positive personality traits and self-leadership in sustainable organizations: Mediating influence of thriving and moderating role of proactive personality. *Sustainable Production and Consumption*, *25*, 299–311. https://doi.org/10.1016/j.spc.2020.09.005

Alt, D., & Raichel, N. (2020). Enhancing perceived digital literacy skills and creative self-concept through gamified learning environments: Insights from a longitudinal study. *International Journal of Educational Research*, *101*(July 2019), 101561. https://doi.org/10.1016/j.ijer.2020.101561

Anwar, C., Saregar, A., Yuberti, Y., Zellia, N., Widayanti, W., Diani, R., & Wekke, I. S. (2019). Effect size test of learning model arias and PBL: Concept mastery of temperature and heat on senior high school students. *Eurasia Journal of Mathematics, Science and Technology Education*, *15*(3). https://doi.org/10.29333/ejmste/103032

Apanovich, N., Okyere, S. A., Mensah, S. L., & Frimpong, L. K. (2023). Education for sustainable development: Societal benefits of a community garden project in Tucson, Arizona. *Societal Impacts*, *1*(1–2), 100011. https://doi.org/10.1016/j.socimp.2023.100011

Barnett, W. S., & Jung, K. (2021). Effects of New Jersey's Abbott preschool program on children's achievement, grade retention, and special education through tenth grade. *Early Childhood Research Quarterly*, *56*, 248–259. https://doi.org/10.1016/j.ecresq.2021.04.001

Ching Leen, C., Hong, H., Ning Hoi Kwan, F., & Wan Ying, T. (2014). Teaching Creative and Critical Thinking in Singapore Schools. In *NIE Working Paper Series* (Vol. 2, Issue January 2016). https://books.google.com/books?hl=en&lr=&id=DnB6DwAAQBAJ&oi=fnd&pg=PP1&dq=threat+(%22smart+home+assistant%22+OR+%22smart+speaker%22+OR+%22amazon+echo%22+OR+%22google+home%22+OR+%22amazon+tap%22+OR+%22apple+homepod%22+OR+%22jbl+link%22+OR+%22polk+command+b

Cui, C., Shen, J., Chen, Z., Wang, S., & Ma, J. (2018). Learning to rank images for complex queries in concept-based search. *Neurocomputing*, *274*, 19–28. https://doi.org/10.1016/j.neucom.2016.05.118

Goodyear, V. A., & Armour, K. M. (2021). Young People's health-related learning through social media: What do teachers need to know? *Teaching and Teacher Education*, *102*, 103340. https://doi.org/10.1016/j.tate.2021.103340

Goyal, M., Gupta, C., & Gupta, V. (2022). A meta-analysis approach to measure the impact of project-based learning outcome with program attainment on student learning using fuzzy inference systems. *Heliyon*, *8*(8), e10248. https://doi.org/10.1016/j.heliyon.2022.e10248

Guo, J., & Huang, J. (2019). Information literacy education in WeChat environment at academic libraries in China. *The Journal of Academic Librarianship*, *August*, 102073.

https://doi.org/10.1016/J.ACALIB.2019.102073

Hernández-Torrano, D., & Ibrayeva, L. (2020). Creativity and education: A bibliometric mapping of the research literature (1975–2019). *Thinking Skills and Creativity*, *35*(December 2019), 100625. https://doi.org/10.1016/j.tsc.2019.100625

Herniawati, A. (2019). Game Edukasi Dalam Pembelajaran Anak Usia Dini (Aud). *Kementerian Pendidikan Dan Kebudayaan*, *I*(63), 1–7.

Irawan, F. (2023). Media pembeljaran Vertiminaponik. In *Indonesia*, *11*(1).

Irawan, F., Zubaidah, S., Sulisetijono, & Astriani, M. (2021). Does Remap-STAD have the potential to promote students' creative thinking skills. *AIP Conference Proceedings*, *2330*(March). https://doi.org/10.1063/5.0043179

Kaczkó, É., & Ostendorf, A. (2023). Critical thinking in the community of inquiry framework: An analysis of the theoretical model and cognitive presence coding schemes. *Computers and Education*, *193*(August 2022). https://doi.org/10.1016/j.compedu.2022.104662

Kaffah, S. A., Arafah, R. N., Rahimsyah, M. L., Nurfauziah, A., Alpiansah, A. B., Ziaul, D., Iskandar, H., Isada, G. J., Firmansyah, R., Informatika, T., Informasi, F. T., Ars, U., Indonesia, B., & Kunci, K. (2020). *Media Pembelajaran Multimedia Interaktif Mengenai Pengenalan Nama Buah dalam Tiga Bahasa untuk Anak Usia Dini Informasi Artikel Abstrak Riwayat Artikel : Keywords : modern saat ini terlebih dahulu seperti mencoba mengenal nama - nama hewan , sayuran atau . 2*. https://doi.org/10.35473/ijec.v2i2.542

Kim, H. J., Kim, Y. T., Kim, H. B., Choi, S. H., & Lee, J. H. (2021). Characterization of bacteriophage VVP001 and its application for the inhibition of Vibrio vulnificus causing seafood-borne diseases. *Food Microbiology*, *94*(March 2020), 103630. https://doi.org/10.1016/j.fm.2020.103630

Koes-H, S., Suwasono, P., & Pramono, N. A. (2019). Efforts to improve problem solving abilities in physics through e-scaffolding in hybrid learning. *AIP Conference Proceedings*, *2081*(March). https://doi.org/10.1063/1.5094004

Kokshagina, O., Rickards, L., Steele, W., & Moraes, O. (2021). Futures literacy for research impact in universities. *Futures*, *132*(February), 102803. https://doi.org/10.1016/j.futures.2021.102803

Kuzovlev, A., Monsieurs, K. G., Gilfoyle, E., Finn, J., Greif, R., Bigham, B. L., Breckwoldt, J., Cheng, A., Duff, J. P., Hsieh, M. J., Iwami, T., Lockey, A., Ma, M. H. M., Yeung, J., & Morley, P. (2021). The effect of team and leadership training of advanced life support providers on patient outcomes: A systematic review. *Resuscitation*, *160*(January 2021), 126–139. https://doi.org/10.1016/j.resuscitation.2021.01.020

Lam, J. H. Y., & Tong, S. X. (2021). Drawing a New Picture: Children with Developmental Dyslexia Exhibit Superior Nonverbal Creativity. *Research in Developmental Disabilities*, *116*(April), 104036. https://doi.org/10.1016/j.ridd.2021.104036

Lee, S. J., & Kwon, K. (2024). A systematic review of AI education in K-12 classrooms from 2018 to 2023: Topics, strategies, and learning outcomes. *Computers and Education: Artificial Intelligence*, *6*(February), 100211. https://doi.org/10.1016/j.caeai.2024.100211

Lefringhausen, K., Moftizadeh, N., Zagefka, H., Bilgen, E., & Barn, R. (2022). Testing the theory of cultural inertia: How majority members' perceptions of culture change relate to prejudice. *International Journal of Intercultural Relations*, *91*(October), 229–241. https://doi.org/10.1016/j.ijintrel.2022.10.009

Madhakomala, Aisyah, L., Rizqiqa, F. N. R., Putri, F. D., & Nulhaq, S. (2022). Kurikulum Merdeka dalam Perspektif Pemikiran Pendidikan Paulo Freire. *At- Ta'lim : Jurnal Pendidikan*, *8*(2), 162–172. https://doi.org/10.55210/attalim.v8i2.819

Mashroofa, M. M., Haleem, A., Nawaz, N., & Saldeen, M. A. (2023). E-learning adoption for

sustainable higher education. *Heliyon*, *9*(6), e17505. https://doi.org/10.1016/j.heliyon.2023.e17505

Matsumoto-Royo, K., & Ramírez-Montoya, M. S. (2021). Core practices in practice-based teacher education: A systematic literature review of its teaching and assessment process. *Studies in Educational Evaluation*, *70*, 101047. https://doi.org/10.1016/j.stueduc.2021.101047

Maybee, C., Carlson, J., Slebodnik, M., & Chapman, B. (2015). "It's in the Syllabus": Identifying Information Literacy and Data Information Literacy Opportunities Using a Grounded Theory Approach. *Journal of Academic Librarianship*, *41*(4), 369–376. https://doi.org/10.1016/j.acalib.2015.05.009

Mufida, R. H., Mahanal, S., Zubaidah, S., Biologi, J., & Malang, U. N. (2017). Pengaruh Model Pembelajaran Biologi Reading-Concept-Map-Student Team Achievement Division pada Kemampuan Akademik Berbeda terhadap Keterampilan Berpikir Kreatif Siswa Kelas X MIPA SMA. *Pros. Seminar Pend. IPA Pascasarjana UM*, *2*, 539–547.

Panjaitan, N. Q., Yetti, E., & Nurani, Y. (2020). Pengaruh Media Pembelajaran Digital Animasi dan Kepercayaan Diri terhadap Hasil Belajar Pendidikan Agama Islam Anak. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, *4*(2), 588. https://doi.org/10.31004/obsesi.v4i2.404

Peña-Ayala, A. (2021). A learning design cooperative framework to instill 21st century education. *Telematics and Informatics*, *62*(May), 1–16. https://doi.org/10.1016/j.tele.2021.101632

Pujiati, D., & Yulianto, D. (2021). Analisis Media Pembelajaran Anak Usia Dini Berbasis Teknologi Masa Pandemi Covid-19. *Efektor*, *8*(1), 45–52. https://doi.org/10.29407/e.v8i1.15857

Putri, M. S., & Chairiyah. (2021). Transformasi Lingkungan Pembelajaran Berbasis Literasi Digital Pada Anak Usia Dini. *Jurnal Pendidikan Anak Usia Dini Undiksha*, *9*(3), 408. https://doi.org/10.23887/paud.v9i3.38491

Rio, T. G., & Rodriguez, J. (2022). Education for Chemical Engineers Design and assessment of a project-based learning in a laboratory for integrating knowledge and improving engineering design skills. *Education for Chemical Engineers*, *40*(April), 17–28. https://doi.org/10.1016/j.ece.2022.04.002

Smith, S. A., Foster, M. E., Baffoe-Djan, J. B., Li, Z., & Yu, S. (2020). Unifying the current self, ideal self, attributions, self-authenticity, and intended effort: A partial replication study among Chinese university English learners. *System*, *95*, 102377. https://doi.org/10.1016/j.system.2020.102377

Suciari, N. K. D., Lbrohim, L., & Suwono, H. (2021). The impact of PjBL integrated STEAM on students' communication skills and concept mastery in high school biology learning. *AIP Conference Proceedings*, *2330*(March). https://doi.org/10.1063/5.0043395

Suckale, J., Saiyed, Z., Hilley, G., Alvisyahrin, T., Muhari, A., Zoback, M. Lou, & Truebe, S. (2018). Adding a community partner to service learning may elevate learning but not necessarily service. *International Journal of Disaster Risk Reduction*, *28*(January), 80–87. https://doi.org/10.1016/j.ijdrr.2018.02.011

Tikva, C., & Tambouris, E. (2021). A systematic mapping study on teaching and learning Computational Thinking through programming in higher education. *Thinking Skills and Creativity*, *41*, 100849. https://doi.org/10.1016/j.tsc.2021.100849

Vannajak, P. T., & Vannajak, K. (2023). Effect of tablet tilt positioning on ergonomic risks and respiratory function. *Heliyon*, *9*(5), e15654. https://doi.org/10.1016/j.heliyon.2023.e15654

Winata, A., Cacik, S., & R. W., I. S. (2017). Analisis Kemampuan Awal Literasi Sains Mahasiswa Pada Konsep Ipa. *Education and Human Development Journal*, *1*(1), 40–47. https://doi.org/10.33086/ehdj.v1i1.291

Zahra, F., Zubaidah, S., Mahanal, S., & Astriani, M. (2021). The improvement of students' argumentation skills through Remap-NHT learning model. *AIP Conference Proceedings*, *2330*(March). https://doi.org/10.1063/5.0043291

Zhang, J., Sun, Y., Gao, Y., & Fang, X. (2019). Event-centric Machine Strategic Reading Approach for Scientific Literature. *Procedia Computer Science*, *147*, 44–48. https://doi.org/10.1016/j.procs.2019.01.182