International Social Sciences and Humanities
UMJember Proceeding Series (2025) Vol. 4 No 2: 117-127

KOPI 2025

Enhancing Literacy In Elementary Educa-Tion: A Systematic Review Of Digital, Scien- Tific, And Basic Literacy Strategies

Suleha Ecca, Muhammad Hanafi, Nuraini Kasmanan, Syamsinar
Universitas Muhammadiyah Sidenreng Rappang; sulehasurapati@gmail.com

*Correspondence: Suleha Ecca
Email: sulehasurapati@gmail.com

Copyright:© 2025 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY) license (http://creativecommons.org/licenses/by/4.0/).

Abstract: This study aims to analyze various research studies on basic literacy, digital literacy, scientific literacy, and economic literacy in elementary education. A literature review method was employed by examining scholarly articles published in reputable journals. The study explores both internal and external factors influencing student literacy, as well as the effectiveness of various instructional strategies. The findings indicate that reading interest, motivation, and student engagement positively correlate with literacy skills, although the impact is not always significant. External factors such as digital technology integration, innovative teaching methods, and support from school leadership and learning environments also contribute to literacy development. Research highlights that interactive shared reading enhances students' communication skills, while project-based STEAM learning effectively improves scientific literacy. However, disparities in technological access in certain regions pose a risk of digital marginalization for students with limited connectivity. Additionally, prospective elementary school teachers exhibit low levels of digital literacy, potentially affecting the effectiveness of technology-based instruction. The findings also emphasize that integrating economic literacy into early education can help shape students' understanding of cooperative economic principles. Furthermore, school leadership support plays a crucial role in enhancing teacher efficacy and classroom emotional climate, ultimately influencing students' literacy development. Therefore, a holistic literacy strategy is required, encompassing teacher competency enhancement, optimized technology integration in education, and curriculum development that is responsive to the evolving digital era.

Keywords: basic literacy, digital literacy, elementary education, scientific literacy, and technology in learning.

INTRODUCTION

Literacy at the elementary school level has become a major focus in global educational research (Silitonga & Simanjuntak, 2022; Smith et al., 2023), as literacy forms the foundation for the development of students' academic abilities and life skills (Long & Bowles, 2024; Schluter et al., 2020). With the rapid advancement of technology (Ma'rufah Rohmanurmeta et al., 2024; Norman, 2023) and social change (Kucirkova & Cremin, 2024; Ngai et al., 2021), the challenges in developing literacy at the elementary school level have become increasingly complex. Literacy in the digi-

tal age now encompasses more than just reading and writing skills (Gibson et al., 2021; Sumarwati et al., 2021), but also includes the ability to understand digital information (Khasanah et al., 2021), scientific literacy, and economic literacy (Cunha et al., 2021; Levy & Mensah, 2021; Stolf et al., 2021). Recent studies (2021-2024) have shown that the integration of technology in education, such as the use of digital tools (Suleha et al., 2022) and online learning platforms, is increasingly being adopted to support students' literacy development. However, despite the advancements in technology showing positive impacts, the uneven quality and access remain significant challenges in its implementation in many areas, especially in rural and underdeveloped regions.

Previous studies have offered different solutions for improving literacy, such as problem-based learning (PBL) (Anggraini et al., 2022; Kristiantari et al., 2022), STEAM (Science, Technology, Engineering, Arts, and Mathematics) (Holmquist et al., 2024; Relmasira et al., 2023; Suryanti et al., 2023) approaches, and Universal Design for Learning (UDL) principles (Fitzgerald & Evans, 2024). Some studies focus on the use of technology to enhance students' digital literacy skills (Ma'rufah Rohmanurmeta et al., 2024; Moreno-Morilla et al., 2021), while others highlight the importance of experience-based teaching to improve scientific literacy (Annetta et al., 2024). However, earlier research tends to be limited to examining only one aspect of literacy or has not sufficiently addressed the social and cultural contexts that also influence students' literacy. Additionally, while the role of teachers and school leadership has a significant impact on the success of literacy programs, research on how these two factors can effectively support each other is still limited.

This study aims to fill this gap by examining the factors influencing literacy at the elementary school level, with a focus on digital, scientific, and economic literacy. In this context, the study also seeks to explore the role of technology and innovative approaches in addressing existing challenges. The purpose of this research is to analyze how various external and internal factors, such as technology, student motivation, and teaching quality, contribute to improving students' literacy at the elementary school level.

METHOD

This study employed a systematic literature review design to examine and analyze various research findings related to literacy in elementary schools. The population consisted of scientific articles published between 2021-2024, selected through purposive sampling based on the following inclusion criteria: empirical research articles, published in reputable journals, available in full-text format, and written in either Indonesian or English. Out of 85 identified articles, 57 were screened based on abstracts and manuscript completeness, and 28 articles were selected for in-depth analysis. The instrument used was an article review sheet that included elements such as research objectives, methods, findings, and implications. The analysis was conducted independently and verified through data triangulation to ensure the validity of the findings.

RESULTS AND DISCUSSION

Based on a systematic review of 28 selected articles published between 2021-2024, various approaches, findings, and implications related to literacy in elementary education were identified. These studies were analyzed in depth using a structured article review instrument and are presented in thematic tables to facilitate the mapping of research topics, methodologies, and scholarly contri-

butions. The following section presents a synthesis of the key findings and discusses them in relation to current theoretical perspectives and practical developments in the field of literacy education.

Table 1 Research in 2021

No.	Researcher	Research Title	Journal
1.	Maria Cockerill, Allen Thurston, Andy Taylor, Joanne O'Keeffe, and Tien-Hui Chiang	A Phase 2 Exploratory Trial of a Vocabulary Intervention in High Poverty Elementary Education Settings	Social Inclusion
2.	Amanda R. Levy, Felicia Moore Mensah	Learning through the Experience of Water in Elementary School Science	MDPI-AG
3.	James Kim, Joshua Gilbert, Qun Yu, Charles Gale	Measures Matter: A Meta-Analysis of the Effects of Educational Apps on Preschool to Grade 3 Children's Literacy and Math Skills	AERA Open
4.	Jennifer Cunha, Cátia Silva, Ana Guimarães, Patrícia Sousa, Clara Vieira, Dulce Lopes, Pedro Rosário	No Children Should Be Left Behind During COVID-19 Pandemic: Description, Potential Reach, and Participants' Perspectives of a Project Through Radio and Letters to Promote Self-Regulatory Competences in Elementary School	Frontiers in Psychology
5.	Mariana Taborda Stolf, Natália Lemes dos Santos, Ilaria D'Angelo, Noemi Del Bianco, Catia Giaconi, Simone Aparecida Capellini	Performance of Early Literacy Students in Cognitive-Linguistic Skills During the Pandemic	Journal of Human Growth and Development
6.	Sumarwati, Sukarno, Atikah Anindyarini	The Effect of Folktale-Based Comics on Traditional Ecological Knowledge Literacy about Non-Rice Food Security	International Journal of Instruction

The findings of this literature review indicate that literacy development in primary schools is significantly influenced by various intervention approaches, the utilization of technology, and the strengthening of contextual aspects in learning. The primary focus of this research is on how these strategies can holistically enhance students' literacy skills, particularly in varying social, economic, and educational access conditions.

First, vocabulary-based interventions have been shown to contribute significantly to improvements in reading and comprehension skills, as reported by (Cockerill et al., 2021). The effectiveness of this intervention suggests that structured vocabulary development can serve as a crucial foundation for enhancing literacy, especially for students from disadvantaged educational backgrounds. These findings emphasize the importance of reinforcing cognitive linguistic aspects to support foundational literacy. This is further corroborated by (Stolf et al., 2021), whose research highlights that early-grade students face difficulties with tasks such as dictation, sequential visual memory, and word repetition, which are indicators of weak mastery in basic literacy skills.

Furthermore, educational technology also plays a significant role in improving student literacy. (Kim et al., 2021) found that educational applications have a considerable impact on students' literacy and mathematics achievements. These findings support the theory of digital interactivity in learning, which posits that student engagement through digital media can accelerate knowledge acquisition through multisensory learning experiences. However, limited digital access remains a significant challenge, especially for students in underserved areas. In this context, (Cunha et al., 2021) demonstrated that alternative media such as radio broadcasts and letters are effective in reaching

students without access to online learning. This highlights the importance of flexible learning strategies in addressing limitations in educational infrastructure.

Meanwhile, hands-on approaches and the reinforcement of local values have also proven effective in developing literacy (Levy & Mensah, 2021) showed that involving students in concrete experiences, such as water experiments, enhances their understanding of scientific concepts and fosters a more dynamic thinking system. This indicates that literacy extends beyond reading and writing skills, encompassing systematic and conceptual thinking abilities. A similar approach is evident in (Sumarwati et al., 2021), where the use of comics based on folklore significantly improved students' ecological literacy regarding food security. This shows that contextual learning, which incorporates local wisdom, can bridge students' understanding of global issues through narratives relevant to their environment.

In summary, the findings from these various studies strengthen the argument that primary school literacy development cannot rely on a single approach. A combination of strategies is required, including linguistic interventions, the integration of technology, and contextual and participatory learning. The implications of these findings are significant for the advancement of primary education research, particularly in designing curricula and learning media that are responsive to students' needs and their socio-cultural contexts. Literacy, in this sense, should not only be viewed as a technical skill but as a reflective competence that encourages students to think critically, understand their environment, and develop their potential holistically.

Table 2 Research in 2022

No.	Researcher	Research Title	Journal
1.	Junhyeok Jang, Jaecheon Jeon, and Soon Ki Jung	Development of STEM-Based AI Education Program for Sustainable Improvement of Elementary Learners	Sustainability
2.	Maria Goreti Rini Kristiantari, I Wayan Widiana, Ni Ketut Desia Tristiantari, and Ni Nyoman Rediani	Impact of Prezi Media-Assisted Problem-Based Learning on Scientific Literacy and Independence of Elementary School Students	Journal of Education and e-Learning Research
3.	Vina Iasha, Muhammad Japar, Arifin Maksum, Yulia Elfrida Yanty Siregar, Bramianto Setiawan, and Andayani	Increasing Students' Culture Literacy Using Virtual Reality Field Trip Model: Need Analysis	Cypriot Journal of Educational Science
4.	Emmelien Merchie, Sofie Heirweg, Hilde Van Keer	Mind Maps: Processed as Intuitively as Thought? Investigating Late Elementary Students' Eye-Tracked Visual Behavior Patterns In-Depth	Frontiers in Psychology
5.	Ambar Sulistiyarini, Sukarno, Triyanto	Pre-Lesson Reading Activities on Creative Thinking Skills: Implementation, Impact, and Constraints	Pegem Journal of Education and Instruction
6.	E. Oos M. Anwas, Anggi Afriansyah, Khofifa Najma Iftitah, Winci Firdaus, Yuni Sugiarti, Evi Sopandi, Deni Hediana	Students' Literacy Skills and Quality of Textbooks in Indonesian Elementary Schools	International Journal of Language Education
7.	Robert Walldén	Students Navigating Shifting Literacy Expectations in Grade 6 History Teaching: A Qualitative Text-Based Study	Cogent Education

The literature review findings indicate that literacy in primary schools is a multidimensional competency influenced by technological advancements, pedagogical innovations, and the quality of teaching materials. Modern learning approaches, such as the integration of Artificial Intelligence (AI) in STEM education, have been shown to enhance digital literacy and student motivation (Jang et al., 2022). Additionally, problem-based approaches with interactive visual media, like Prezi, effectively develop science literacy and student autonomy (Kristiantari et al., 2022). The use of Virtual Reality (VR) also significantly enhances students' cultural awareness, enriching literacy with an empathetic dimension (Iasha et al., 2022).

In terms of reading strategies, using mind maps after reading improves students' structural understanding of information (Merchie et al., 2022). Reading prior to lessons also fosters creativity, supporting creative thinking and flexibility (Sulistiyarini et al., 2022). The quality of teaching materials, with appropriate visual design and language, plays a crucial role in improving literacy (Anwas et al., 2022). In the realm of historical literacy, developing the ability to think causally is required so that students do not merely memorize facts (Walldén, 2022).

In summary, primary school literacy requires an approach that integrates technology, active methods, and high-quality teaching materials. Literacy should be strengthened not only in the cognitive domain but also in the affective and contextual dimensions to prepare students for future challenges.

Table 3 Research in 2023

No.	Researcher	Research Title	Journal
1.	Stefanus Christian Relmasira, Yiu Chi Lai, and Jonan Phillip Donaldson	Fostering AI Literacy in Elementary Science, Technology, Engineering, Art, and Mathematics (STEAM) Education in the Age of Generative AI	Sustainability
2.	Gerardo Castañeda-Garza, and Gabriel Valerio-Ureña	Energy Literacy in Elementary School Textbooks in Mexico	Environmental Education Research
3.	Albert Ziegler, Linlin Luo, and Heidrun Stoeger	Equity Gaps in Literacy among Elementary School Students from Two Countries: The Negative Social Resonance Effect of Intersectional Disadvantage and the Dampening Effect of Learning Capital	Education Sciences (MDPI)
4.	Holly Hungerford-Kresser, Carla Amaro-Jiménez, Kathryn Pole	When There's No Handbook: One Urban Elementary School's COVID-19 Crisis Response	The Urban Review

Literacy in primary schools has rapidly evolved alongside the challenges and opportunities presented by the digital era and artificial intelligence (AI). Research by Relmasira et al. indicates that the integration of AI in STEAM education not only provides instructional benefits but also creates meaningful learning experiences, shaping students' thinking and information absorption. These findings emphasize that AI literacy is an integral part of developing adaptive and relevant learning capacities for the future. (Castañeda-Garza & Valerio-Ureña, 2023) highlight that sustainability literacy, particularly energy issues, has been introduced earlier in primary textbooks, strengthening interdisciplinary understanding of global issues such as climate change and sustainability. This fosters ecological and social awareness, relevant to healthy living and decision-making based on sustainability.

However, a serious challenge arises from the study by (Ziegler et al., 2023), which reveals literacy inequalities due to socioeconomic factors, migration background, and gender. These disparities are more evident in teachers' subjective assessments, indicating bias in evaluations and reinforcing inequalities. In this context, an inclusive, evidence-based assessment system is essential. Research by (Hungerford-Kresser et al., 2023) shows that digital literacy is crucial for sustaining education, especially during crises. Digital literacy supports social networking, community collaboration, and societal resilience, contributing to public health resilience during crises.

In summary, primary school literacy today must encompass an understanding of technology, global issues, social justice, and preparedness for change. This comprehensive literacy helps shape individuals who are critical thinkers and ready to face the complexities of the modern world, which is highly relevant in nursing education, particularly in developing scientific attitudes and strategic thinking skills.

Table 4 Research in 2024

No.	Researcher	Research Title	Journal
1.	Nancy A. Quick, Karen A. Erickson	Changing Teacher Practices and Perceptions and Improving Student Communication Outcomes Through Shared Reading	Rural Special Education Quarterly
2.	Michelle Schira Hagerman, Sima Neisary	Digital Literacies Learning Needs in Rural Ontario Elementary Schools: Teacher Insights	Canadian Journal of Education / Revue canadienne de l'éducation
3.	Hardhika Wahyu Dewani, Wahyu Sukartiningsih, H. Hendratno, S. Suryanti	Exploring Reading Interest and Reading Literacy of Indonesian Language in Elementary School Students: A Correlation Study	International Journal of Language Education
4.	Iris-Orosia Campos, Paula Rivera-Alegre	Influence of the Use of ICTs on the Development of Reading Comprehension in Primary Education	Ocnos
5.	Miranda S. Fitzgerald, Kaitlyn B. Evans	Integrating Digital Tools to Enhance Access to Learning Opportunities in Project-based Science Instruction	TechTrends
6.	Eunike Rose Mita Lukiani, Ery Tri Djatmika Rudijanto Wahju Wardhana, Agus Suman, Hari Wahyono	Internalization of Indonesian Economic Ideology on Formal Education for Elementary School Level	Qubahan Academic Journal
7.	Maria Therese Jensen, Oddny Judith Solheim & Espen Olsen	Leader Support in Relation to Teacher Self-Efficacy, Classroom Emotional Climate, and Students' Literacy Skills in Elementary School	Scandinavian Journal of Educational Research
8.	Laura B. Cole, Lilian Priscilla, Laura Zangori, Beth Kania-Gosche, Joel Burken	Raising the Green Roof: Enhancing Youth Water Literacy through Built Environment Education	Sustainability
9.	Adriana Marques de Oliveira, Jair Lício Ferreira Santos, Simone Aparecida Capellini	Reading Processes of Public and Private Middle School and High School Students Reading Processes of Public and Private Middle School and High School Students	Psicologia: Reflexão e Crítica
10.	Suryanti, Mochamad Nursalim, Nadia Lutfi Choirunnisa, Ivo Yuliana	STEAM-Project-Based Learning: A Catalyst for Elementary School Students' Scientific Literacy Skills	European Journal of Educational Research

11.	Fauzatul Ma'rufah Rohmanurmeta, Herawati Susilo, Mohammad Zainuddin, Syamsul Hadi	The Digital Technology Literacy Profiles of Students as Prospective Elementary School Teachers	Cogent Education

In discussing the results of this study, it is essential to connect the findings with the research objectives and interpret them in the context of existing literature. The objective of this research is to explore various factors influencing literacy at the primary school level, particularly digital literacy, science literacy, and economic understanding. The results show a multifaceted view of literacy, emphasizing that literacy extends beyond reading and writing skills to include digital, science, and economic literacy, all of which must be developed from an early age.

Our findings align with recent research by (Quick & Erickson, 2024), which highlights the importance of teacher professional development in improving student communication and interaction through techniques like shared reading. Additionally, the challenges identified by (Hagerman & Neisary, 2024) regarding digital access in rural Ontario reinforce the need for equitable access to technology as a means to address educational disparities. This study also confirms the findings of (Dewani et al., 2024), showing that while there is a correlation between reading interest and reading literacy, motivational factors and attention during reading have a more significant impact. This supports the view that student engagement plays a crucial role in literacy development, making efforts to enhance student motivation a primary focus of literacy initiatives.

The use of technology in education shows varying impacts. Some studies, such as those by (Campos & Rivera-Alegre, 2024), found that technology is often used for entertainment rather than academic purposes, while research by (Fitzgerald & Evans, 2024) highlights the positive impact of using technology based on Universal Design for Learning principles, which enhance accessibility in science education.

Furthermore, this study aligns with findings from (Jensen et al., 2024), showing that good leadership can improve teacher self-efficacy, create a better emotional climate in the classroom, and enhance students' literacy skills. Leadership factors are vital in shaping an educational environment that directly impacts student learning outcomes. Additionally, the study supports the findings of (Cole et al., 2024), suggesting innovative approaches to literacy teaching, such as environment-based projects (Cole et al., 2024), which can improve students' understanding of socio-hydrological systems. This reflects the trend of experiential learning that has been shown to enhance science literacy, as found by (Suryanti et al., 2023).

Moreover, research of (de Oliveira et al., 2024) shows a difference in reading ability between public and private school students, with private school students outperforming in spelling and syntactic-semantic processing, indicating the role of socioeconomic factors in literacy development.The issue of digital literacy for future teachers is also a crucial aspect raised in this study. (Ma'rufah Rohmanurmeta et al., 2024).'s findings highlight the low level of digital literacy among prospective teachers, both in understanding and using technology, emphasizing the need for specialized training in this field.

This study supports the growing consensus that literacy in primary schools is influenced by internal factors such as student motivation and reading habits, as well as external factors like technology access, innovative teaching methods, leadership support, and teachers' readiness to implement adaptive approaches to contemporary challenges. To improve literacy learning outcomes, a more

holistic approach is required, encompassing teacher competency enhancement, optimal use of technology, and the development of a curriculum that is integrative and responsive to students' needs in the digital age.

On the whole, the findings show that digital technologies, such as applications, VR media, and online platforms, are increasingly adopted to support literacy at the elementary school level, although challenges related to quality and accessibility remain. Local and cultural contexts also play a crucial role in literacy materials, as reflected in the use of folklore or content based on national values. Furthermore, interactive and project-based approaches, such as PBL, STEAM, and UDL, have proven effective in enhancing student engagement and deepening understanding. The importance of raising awareness about social inequalities related to gender, socio-economic status, and migration needs to be emphasized, particularly in teacher assessments and the design of fair literacy interventions. Additionally, the role of teachers and school leadership is a key factor that influences classroom climate and the success of literacy programs. Thus, this review (2021-2024) emphasizes that improving student literacy requires a collaborative, contextual, and technology-based approach. This approach must be accompanied by adequate teacher training, the development of high-quality learning materials, and inclusive and sustainable education policies to ensure equitable and comprehensive literacy at the elementary school level.

CONCLUSION

Based on the review of various studies, it can be concluded that literacy at the elementary school level is a multidimensional concept influenced by internal factors such as student motivation and reading engagement, as well as external factors like access to technology, learning innovations, leadership support, and teacher readiness to adapt to changing times. This research enriches the understanding of literacy by emphasizing the importance of a holistic approach in planning and implementing literacy education, which not only focuses on reading and writing skills but also includes digital, science, and economic literacy from an early age. These findings provide a strong scientific foundation for the formulation of more adaptive elementary education policies in response to the demands of the 21st century. For future development, it is recommended to conduct field experiments that integrate cross-literacy approaches into the elementary school curriculum, as well as longitudinal studies to assess the long-term impact of technology use and school leadership on improving student literacy.

REFERENCES

Anggraini, N., Nazip, K., Amizera, S., & Destiansari, E. (2022). Penerapan Model Problem Based Learning Berbasis STEM Menggunakan Bahan Ajar Realitas Lokal terhadap Literasi Lingkungan Mahasiswa. In *BIOEDUSAINS:Jurnal Pendidikan Biologi dan Sains* (Vol. 5, Issue 1, pp. 121–129). IPM2KPE. https://doi.org/10.31539/bioedusains.v5i1.3589

Annetta, L. A., Newton, M. H., Franco, Y., Johnson, A., & Bressler, D. (2024). Examining reading proficiency and science learning using mixed reality in elementary school science. *Computers and Education: X Reality*, *5*. https://doi.org/10.1016/j.cexr.2024.100086

Anwas, E. O. M., Afriansyah, A., Iftitah, K. N., Firdaus, W., Sugiarti, Y., Sopandi, E., & Hediana, D. (2022). Students' Literacy Skills and Quality of Textbooks in Indonesian Elementary Schools. *International Journal of Language Education*, *6*(3), 233–244. https://doi.org/10.26858/ijole.v6i3.32756

Campos, I. O., & Rivera-Alegre, P. (2024). Influence of the use of ICTs on the development of reading comprehension in Primary Education. *Ocnos*, *23*(2). https://doi.org/10.18239/ocnos_2024.23.2.451

Castañeda-Garza, G., & Valerio-Ureña, G. (2023). Energy literacy in elementary school textbooks in Mexico. *Environmental Education Research*, *29*(3), 410–422. https://doi.org/10.1080/13504622.2022.2135687

Cockerill, M., Thurston, A., Taylor, A., O'keeffe, J., & Chiang, T. H. (2021). A phase 2 exploratory trial of a vocabulary intervention in high poverty elementary education settings. *Social Inclusion*, *9*(4), 12–25. https://doi.org/10.17645/si.v9i4.4553

Cole, L. B., Priscilla, L., Zangori, L., Kania-Gosche, B., & Burken, J. (2024). Raising the Green Roof: Enhancing Youth Water Literacy through Built Environment Education. *Sustainability (Switzerland)* , *16*(10). https://doi.org/10.3390/su16104262

Cunha, J., Silva, C., Guimarães, A., Sousa, P., Vieira, C., Lopes, D., & Rosário, P. (2021). No Children Should Be Left Behind During COVID-19 Pandemic: Description, Potential Reach, and Participants' Perspectives of a Project Through Radio and Letters to Promote Self-Regulatory Competences in Elementary School. *Frontiers in Psychology*, *12*(May), 1–19. https://doi.org/10.3389/fpsyg.2021.647708

de Oliveira, A. M., Santos, J. L. F., & Capellini, S. A. (2024). Reading processes of public and private middle school and high school students. *Psicologia: Reflexao e Critica*, *37*(1). https://doi.org/10.1186/s41155-024-00296-0

Dewani, H. W., Sukartiningsih, W., Hendratno, H., & Suryanti, S. (2024). Exploring Reading Interest and Reading Literacy of Indonesian Language in Elementary School Students: A Correlation Study. *International Journal of Language Education*, *8*(4), 763–777. https://doi.org/10.26858/ijole.v8i4.70003

Fitzgerald, M. S., & Evans, K. B. (2024). Integrating Digital Tools to Enhance Access to Learning Opportunities in Project-based Science Instruction. *TechTrends*, *68*(5), 882–891. https://doi.org/10.1007/s11528-024-00975-w

Gibson, J. L., Newbury, D. F., Durkin, K., Pickles, A., Conti-Ramsden, G., & Toseeb, U. (2021). Pathways from the early language and communication environment to literacy outcomes at the end of primary school; the roles of language development and social development. *Oxford Review of Education*, *47*(2), 260–283. https://doi.org/10.1080/03054985.2020.1824902

Hagerman, M. S., & Neisary, S. (2024). Digital Literacies Learning Needs in Rural Ontario Elementary Schools: Teacher Insights. *Canadian Journal of Education*, *47*(2), 522–554. https://doi.org/10.53967/CJE-RCE.6275

Holmquist, S., Catlin, D., & Hicks, F. K. (2024). Using Simple Educational Robots as a Technology for Teaching Early Childhood and Primary Education Literacy in the United States. *Lecture Notes in Networks and Systems*, *1084 LNNS*, 165–176. https://doi.org/10.1007/978-3-031-67059-6_15

Hungerford-Kresser, H., Amaro-Jiménez, C., & Pole, K. (2023). When There's No Handbook: One Urban Elementary School's COVID-19 Crisis Response. *Urban Review*, *55*(3), 293–314. https://doi.org/10.1007/s11256-022-00651-4

Iasha, V., Japar, M., Maksum, A., Yanty Siregar, Y. E., Setiawan, B., & Andayani. (2022). Increasing students' culture literacy using virtual reality field trip model: Need analysis. *Cypriot Journal of Educational Sciences*, *17*(9), 3263–3276. https://doi.org/10.18844/cjes.v17i9.8002

Jang, J., Jeon, J., & Jung, S. K. (2022). Development of STEM-Based AI Education Program for Sustainable

Improvement of Elementary Learners. *Sustainability (Switzerland)*, *14*(22). https://doi.org/10.3390/su142215178

Jensen, M. T., Solheim, O. J., & Olsen, E. (2024). Leader support in relation to teacher self-efficacy, classroom emotional climate and students' literacy skills in elementary school. *Scandinavian Journal of Educational Research*, *May*, 1–14. https://doi.org/10.1080/00313831.2024.2348451

Khasanah, B. A., Sutriningsih, N., & Widianti, S. D. (2021). Pendampingan Adaptasi Teknologi Serta Pemanfatannya Dalam Menanamkan Literasi Dan Numerasi Di SD 3T. *LOGISTA - Jurnal Ilmiah Pengabdian Kepada Masyarakat*, *5*(2), 209–215. https://doi.org/10.25077/logista.5.2.209-215.2021

Kim, J., Gilbert, J., Yu, Q., & Gale, C. (2021). Measures Matter: A Meta-Analysis of the Effects of Educational Apps on Preschool to Grade 3 Children's Literacy and Math Skills. *AERA Open*, *7*(1), 1–19. https://doi.org/10.1177/23328584211004183

Kristiantari, M. G. R., Wayan Widiana, I., Tristiantari, N. K. D., & Rediani, N. N. (2022). Impact of Prezi Media-Assisted Problem-Based Learning on Scientific Literacy and Independence of Elementary School Students. *Journal of Education and E-Learning Research*, *9*(3), 184–191. https://doi.org/10.20448/jeelr.v9i3.4185

Kucirkova, N., & Cremin, T. (2024). Funds of courage: advancing social justice in children's reading for pleasure. *Cambridge Journal of Education*, *54*(4), 437–454. https://doi.org/10.1080/0305764X.2024.2369576

Levy, A. R., & Mensah, F. M. (2021). Learning through the experience of water in elementary school science. *Water (Switzerland)*, *13*(1). https://doi.org/10.3390/w13010043

Long, K. A., & Bowles, T. N. (2024). No-fee school consistently outperforms Progress in International Reading and Literacy benchmarks: Presenting early grade reading data from a case in Makhanda, Eastern Cape. *South African Journal of Childhood Education*, *14*(1), 1–11. https://doi.org/10.4102/sajce.v14i1.1376

Ma'rufah Rohmanurmeta, F., Susilo, H., Zainuddin, M., & Hadi, S. (2024). The digital technology literacy profiles of students as prospective elementary school teachers. *Cogent Education*, *11*(1). https://doi.org/10.1080/2331186X.2024.2332839

Merchie, E., Heirweg, S., & Van Keer, H. (2022). Mind Maps: Processed as Intuitively as Thought? Investigating Late Elementary Students' Eye-Tracked Visual Behavior Patterns In-Depth. *Frontiers in Psychology*, *13*(April), 1–18. https://doi.org/10.3389/fpsyg.2022.821768

Moreno-Morilla, C., Guzmán-Simón, F., & García-Jiménez, E. (2021). Digital and information literacy inside and outside Spanish primary education schools. *Learning, Culture and Social Interaction*, *28*. https://doi.org/10.1016/j.lcsi.2020.100455

Ngai, J. T. K., Yu, R. W. M., Chau, K. K. Y., & Wong, P. W. C. (2021). Effectiveness of a school-based programme of animal-assisted humane education in Hong Kong for the promotion of social and emotional learning: A quasi-experimental pilot study. *PLoS ONE*, *16*(3 March). https://doi.org/10.1371/journal.pone.0249033

Norman, A. (2023). Educational technology for reading instruction in developing countries: A systematic literature review. *Review of Education*, *11*(3). https://doi.org/10.1002/rev3.3423

Quick, N. A., & Erickson, K. A. (2024). Changing Teacher Practices and Perceptions and Improving Student Communication Outcomes Through Shared Reading. *Rural Special Education Quarterly*. https://doi.org/10.1177/87568705241286894

Relmasira, S. C., Lai, Y. C., & Donaldson, J. P. (2023). Fostering AI Literacy in Elementary Science, Technology, Engineering, Art, and Mathematics (STEAM) Education in the Age of Generative AI. *Sustainability (Switzerland)*, *15*(18). https://doi.org/10.3390/su151813595

Schluter, P. J., Audas, R., Kokaua, J., McNeill, B., Taylor, B., Milne, B., & Gillon, G. (2020). The Efficacy of Preschool Developmental Indicators as a Screen for Early Primary School-Based Literacy Interventions. *Child Development*, *91*(1), e59–e76. https://doi.org/10.1111/cdev.13145

Silitonga, E. A., & Simanjuntak, M. R. (2022). Pelatihan Peningkatan Kemampuan Literasi-Numerasi Siswa Sekolah Dasar Sebagai Implementasi Kegiatan Program Kampus Mengajar Angkatan 3 Pendahuluan. *Madaniya*, *3*(3), 623–636.

Smith, R., Snow, P., Serry, T., & Hammond, L. (2023). Elementary Teachers' Perspectives on Teaching Reading Comprehension. *Language, Speech, and Hearing Services in Schools*, *54*(3), 888–913. https://doi.org/10.1044/2023_LSHSS-22-00118

Stolf, M. T., Santos, N. L. dos, D'Angelo, I., Bianco, N. Del, Giaconi, C., & Capellini, S. A. (2021). Performance of early literacy students in cognitivelinguistic skills during the pandemic. *Journal of Human Growth and Development*, *31*(3), 484–490. https://doi.org/10.36311/JHGD.V31.12668

Suleha, Yusmah, Kasman, R., Bagaskara, & Sakinah, N. (2022). *Edukasi Kecakapan Literasi Digital Remaja melalui Siberkreasi*.

Sulistiyarini, A., Sukarno, & Triyanto. (2022). Pre-Lesson Reading Activities on Creative Thinking Skills: Implementation, Impact, and Constraints. *Pegem Egitim ve Ogretim Dergisi*, *12*(4), 89–102. https://doi.org/10.47750/pegegog.12.04.10

Sumarwati, Sukarno, & Anindyarini, A. (2021). The effect of folktale-based comics on traditional ecological knowledge literacy about non-rice food security. *International Journal of Instruction*, *14*(3), 981–998. https://doi.org/10.29333/iji.2021.14357a

Suryanti, Nursalim, M., Choirunnisa, N. L., & Yuliana, I. (2023). STEAM-Project-Based Learning: A Catalyst for Elementary School Students' Scientific Literacy Skills. *European Journal of Educational Research*, *13*(1), 1–14. https://www.researchgate.net/profile/Ebru-Eren/publication/348382981_Education_Policies_in_the_Context_of_Political_Communication_in_Turkey/links/5ffc2aeba6fdccdcb846cc03/Education-Policies-in-the-Context-of-Political-Communication-in-Turkey.pdf

Walldén, R. (2022). Students navigating shifting literacy expectations in grade 6 history teaching: a qualitative text-based study. *Cogent Education*, *9*(1). https://doi.org/10.1080/2331186X.2022.2148671

Ziegler, A., Luo, L., & Stoeger, H. (2023). Equity Gaps in Literacy among Elementary School Students from Two Countries: The Negative Social Resonance Effect of Intersectional Disadvantage and the Dampening Effect of Learning Capital. *Education Sciences*, *13*(8). https://doi.org/10.3390/educsci13080827