Journal of Basic Education Research
Vol. 7, No. 1, January 2026, pp. 1~7
ISSN: 2716-3725, DOI: 10.37251/jber.v7i1.1999

Determinants of Digital Health Based Learning in Primary and Secondary Education: Path Analysis

Lina Alfiyani[1], Eny Pemilu Kusparlina[2], Latutik Mukhlisin[3], Faritsatul Fatin Salima[4]
[1, 2, 4]Department of Health Administration, University of Muhammadiyah Madiun, Madiun, Indonesia
[3] Faculty of Social and Political Sciences, University of Muhammadiyah Madiun, Madiun, Indonesia

Article Info

Article history:

Received Sep 1, 2025
Revised Oct 25, 2025
Accepted Oct 29, 2025
OnlineFirst Jan 15, 2026

Keywords:

Digital Health Literacy
Path Analysis
Primary
Secondar Schools

ABSTRACT

Purpose of the study: This study aims to develop a digital health-based learning model and identify the direct and indirect factors influencing students' digital health literacy in elementary and secondary schools in Madiun City.

Methodology: A cross-sectional design was employed with primary data collected from 120 elementary and secondary school students. Data analysis was conducted using SPSS software and path analysis. Validated and reliable structured questionnaires were used as research instruments.

Main Findings: Digital literacy is directly influenced by skills (b = 3.11; 95% CI = 1.66–4.56; p < 0.001) and attitudes (b = 3.27; 95% CI = 1.79–4.74; p < 0.001). Skills indirectly affect digital literacy through teaching quality (b = 7.15); teaching quality indirectly affects digital literacy through school facilities (b = 1.67); and school facilities influence digital literacy through family support (b = 1.94), all statistically significant (p < 0.001).

Novelty/Originality of this study: This study introduces an integrative approach to enhancing digital health literacy by mapping psychosocial and structural pathways in school settings. It advances existing knowledge by proposing a conceptual model for curriculum development focused on digital health education in early education levels.

Corresponding Author:
Lina Alfiyani,
Department of Health Administration, Faculty of Health Sciences, University of Muhammadiyah Madiun,
Jl. Mayjend Panjaitan No.18, Taman, Banjarejo, Madiun, Provinsi Jawa Timur 63137,Indonesia.
Email: la284@ummad.ac.id

1. INTRODUCTION

The integration of technology in various sectors has brought significant changes, including in the fields of education and health. [1], [2]. One area of focus is health literacy, especially among primary and secondary education students [3], [4]. Health literacy is the ability to obtain, understand, and use health information to make informed decisions about one's own well-being [5], [6]. However, based on the results of preliminary research, the level of health literacy among students is still low, mainly due to limited access to relevant information and the lack of utilization of digital technology in the education curriculum [7], [8]. The study results showed that a small proportion (27%) of students in primary schools had an adequate level of health literacy, suggesting the need for interventions in teaching health literacy [9]. In addition, a study highlighted the importance of digital technology integration in improving health literacy among students, showing that the use of digital health apps can improve students' understanding of health issues[10], [11].

Law No. 17 of 2023 on Health in Indonesia also emphasizes the importance of strengthening health literacy through the integration of digital technology in health education [12], The law covers various important aspects of the health system, including the delivery of health services, regulation of health workers, and

strengthening of health information systems. One of the main objectives of the law is to improve public access to quality health services. Furthermore, the law also aims to strengthen disease prevention and management, and promote public health through health literacy, which is an important concern in order to increase public awareness and understanding of health. A systematic review found that the level of health literacy among children and adolescents is low, necessitating educational interventions tailored to the age group and educational context [13],[14]. During the COVID-19 pandemic, the role of health professionals is crucial in improving health literacy through community partnerships to disseminate accurate information [15]. Integrating health education with digital literacy training can improve accessibility of health resources and reduce health inequalities [15]. There are calls to integrate health literacy training in health education curricula to prepare health workers to deliver information more effectively [16], [17].

Previous studies have highlighted the role of digital health interventions in improving students' health literacy and demonstrated that socioeconomic status and school environments significantly affect health literacy outcomes. However, most of these studies have been conducted in contexts outside Indonesia and have predominantly focused on either individual-level determinants or technological interventions in isolation [18]. There remains a lack of comprehensive analysis that examines how various multilevel factors including individual characteristics, school conditions, and systemic educational policies jointly influence student health literacy [19]. Moreover, while multilevel and path analysis techniques have been utilized in global studies, there is a notable scarcity of research in the Indonesian context that integrates these methods to investigate the structural relationships across educational levels. This gap suggests a critical need to explore the interconnected determinants of health literacy within the unique socio-educational landscape of Indonesia [20].

This research presents a novel contribution by integrating digital health learning into the primary and secondary school curriculum while simultaneously applying multilevel and path analysis to identify the determinants of students' health literacy [21]. Unlike prior studies, this research adopts a multidimensional approach that considers variables at the student, school, and systemic levels, providing a more holistic understanding of the factors that shape health literacy [22]. The development of a digital health-based learning model that is both evidence-driven and practically implementable further distinguishes this study. The urgency of this research lies in its potential to inform national education policy in Indonesia, especially in the post-pandemic era where digital platforms play an increasingly central role in education. By addressing this gap, the study seeks to support the creation of effective, scalable educational interventions that improve health outcomes and decision- making abilities among young learners.

2. RESEARCH METHOD

2.1 Research design

This study adopts a quantitative research design with a path analysis approach [23]. This design was selected to investigate the structural relationships among multiple variables that influence students' health literacy. The study aims not only to describe the current state of students' health literacy but also to identify the direct and indirect effects of various contributing factors, ultimately contributing to the development of a more effective digital health-based learning model.

2.2 Research subjects

The research subjects consist of students from primary and secondary schools located in Madiun City, Indonesia. A stratified random sampling technique will be used to ensure proportional representation from each educational level. A total of 120 students will be selected as participants. The inclusion criteria are students currently enrolled in the selected schools and willing to participate with parental/guardian consent where applicable.

2.3 Research Instruments

Data will be collected using structured questionnaires designed to assess students' health literacy, access to digital health information, and relevant demographic factors. In addition, semi-structured interview guides will be used for selected teachers and school administrators to enrich the understanding of contextual factors within the school environment. The instruments will be validated through expert review and pre-tested prior to full implementation.

2.4 Research Procedures

The research will be conducted in the following steps:

Preparation: Development and validation of research instruments, coordination with selected schools, and ethical clearance.

Sampling and Recruitment: Selection of participants using stratified random sampling.

Data Collection: Administration of questionnaires to students and interviews with teachers/school staff.

Data Cleaning: Checking and coding the data to ensure quality and consistency.

Data Analysis: Using statistical software to perform path analysis and interpret the relationships among variables.

2.5 Data analysis

The collected data will be analyzed using path analysis to examine the causal relationships between variables influencing students' health literacy. This method enables the identification of both direct and indirect effects among variables, offering a more comprehensive understanding of the learning environment. The analysis will be conducted using appropriate statistical software (e.g., SPSS and STATA), and the results will be used to develop a targeted learning model for health education in schools

3. RESULTS AND DISCUSSION

Data processing in this study used the STATA 13 program. Based on path analysis on the results of the research results, the following results were obtained.

3.1. Model specification, identification, and fit

The model specification describes the relationship between the variables under study. Model Identification. Model identification is done by identifying the number of measured variables, the number of endogenous variables, exogenous variables, and parameters to be estimated. The degree of freedom (df) value in this study is:

a. Number of measured variables: 6

b. Endogenous variables: 4

c. Exogenous variables: 2

d. Number of parameters: 6

The degree of freedom formula is as follows:

Df = (number of measured variables x (number of measured variables + 1) / 2 - (endogenous variables + exogenous variables + number of parameters)

= 21 - 8

= 13

Path analysis can be done if df ≥ 0, while in the identification of the model in the path analysis this time the df value is 13 and is called over identified path analysis which means path analysis can be done. The model designed by the researcher, based on theory after being tested with path analysis, shows that the model is in accordance with the computer model.

3.2. Parameter Estimation

Table 1. Determinant path analysis results

Independent and Dependent Variables	Path Coefficient	CI (95%)		p
		Power limit	Upper limit	
Direct Effect →Skill (high)	3.11	1.66	4.56	<0.001
Digital literacy → Attitude (positive)	3.27	1.79	4.74	<0.001
Indirect Effect Skill→Teaching Quality (high)	7.15	4.71	9.59	<0.001
Teaching Quality → School Facilities (good)	1.67	0.77	2.56	<0.001
School Facilities → Family Support (powerfu	1.94	1.05	2.83	<0.001
N Observation =120 Log Likelihood = -201.020				

The results of hypothesis testing show that there is a relationship between skills and digital literacy. Based on table 1.6, it can be interpreted that there is a positive and statistically significant relationship. Students who have high digital skills have a logit score of 3.11 units higher than students who do not have digital literacy skills (b= 3.11; CI 95%= 1.66 to 4.56; p<0.001). Digital skills, such as the ability to search, evaluate and use health information online, have a significant influence on health digital literacy. Studies show that nursing students with good digital skills have higher health digital literacy. Similarly, the results found that operational skills in using computers and the internet contributed positively to students' health digital literacy [24].

The results of hypothesis testing show that there is a relationship between attitude and digital literacy of Tuberculosis. Based on table 1.6, it can be interpreted that there is a positive and statistically significant relationship. Students with a positive attitude have a logit score of 3.27 units higher than those with a negative attitude. (b= 3.27; 95% CI= 1.79 to 4.74; p<0.001). Positive attitudes towards health, including confidence and motivation to seek health information, contribute to improved health digital literacy. Study shows that self-efficacy and attitudes towards online learning influence adolescents' health digital literacy [25]. In addition, another study found that attitudes towards the COVID-19 pandemic correlated with digital health information seeking behavior [26].

In addition, another study found that attitudes towards the COVID-19 pandemic correlated with digital health information seeking behavior. Shows that teachers' digital skills affect teaching quality and students' learning motivation. Other study results emphasize the importance of institutional support in enhancing teachers' digital skills to improve teaching quality [27].

The results of hypothesis testing show that there is a relationship between school facility support and teaching quality. Based on table 1.6, it can be interpreted that there is a positive and statistically significant relationship. Students with good school facilities have a logit score of teaching quality that is 1.67 units higher than those with poor facilities. (b= 1.67; 95% CI= 0.77 to 2.56; p<0.001). School facilities, such as access to technology and the internet, support the quality of teaching and the development of students' digital skills, which in turn improves digital health literacy. Study emphasizes the importance of digital infrastructure in supporting digital health literacy teaching in schools [28].

The results of hypothesis testing show that there is a relationship between family support and school facilities. Based on table 1. it can be interpreted that there is a positive and statistically significant relationship. Students with family support had a logit score of school facilities of 1.94 units lower than tuberculosis and MDR-TB patients who did not experience adverse drug events (b= -1.5; 95% CI= -2.10 to 2.84; p<0.001). Family support plays an important role in shaping children's behavior and attitudes towards technology use, including in the context of digital health literacy. Supportive families generally provide access to digital devices, give permission and guidance in their use, and encourage children to actively seek health information online. This support can improve digital skills, reinforce positive perceptions of digital-based learning, and encourage children to be more open to teaching using technology [29]. Furthermore, when family support is strengthened by adequate school facilities and quality teaching, the potential for improving digital health literacy will be even higher. Facilities such as stable internet connections, ICT devices, and skilled educators will create a complete digital learning ecosystem, supported from within (family) and outside (school) [30]. Several studies show a positive relationship between family support and students' digital health literacy achievement:

1. Highlight the important role of the social environment in shaping health digital literacy skills, including support from family [31].
2. Family as a support system can play a role in shaping online health information seeking behavior [32].
3. Family-based learning motivation contributes to mastery of digital health technology [33].

The results of the path analysis clearly demonstrate that students' digital health literacy is significantly influenced by a combination of individual and contextual factors, thereby answering the research objective to identify determinants across multiple levels of the education system [34]. The results of this study show that students' digital literacy is directly influenced by their skills and attitudes. Students with higher digital skills exhibit significantly greater digital literacy, indicating that the more proficient students are in technical and cognitive digital competencies, the better their ability to access and use digital health information. This finding aligns with previous research which emphasized that technical skills and cognitive abilities form the foundation of digital literacy. Furthermore, students' positive attitudes toward digital technology, such as curiosity and openness, serve as key drivers in optimizing technology use for learning [35].

Another important finding is that teaching quality acts as a mediator that strengthens the effect of students' skills on digital literacy. This means that even when students possess high digital skills, the outcomes will not be optimal without quality instruction. This is supported by the findings of who underscored the critical role of teacher support in developing students' digital competencies. School facilities also play a significant

indirect role by influencing teaching quality. Schools that provide adequate digital learning infrastructure enable teachers to deliver content more effectively and engagingly. Additionally, family support further amplifies the impact of school facilities on students' digital literacy, demonstrating that parental involvement at home is essential, as emphasized [36].

In general, the model revealed by this study strengthens the understanding that digital literacy is shaped not only by individual factors such as skills and attitudes but also by a supportive learning environment, including teaching quality, school facilities, and family support. The novelty of this research lies in the integration of these factors into a comprehensive model that connects direct and indirect pathways influencing students' digital literacy. Previous studies have often focused on one or two factors separately. However, this study has limitations, primarily the relatively small sample size limited to students in Madiun City, which calls for caution when generalizing the findings. Additionally, the quantitative approach limits deeper exploration of students' lived experiences [37]. The practical implications of these findings suggest that strengthening students' digital literacy requires a collaborative effort involving schools, teachers, and families. Therefore, digital literacy interventions should not only focus on technical skills training but also address students' attitudes, improve teaching quality, provide adequate infrastructure, and actively engage families in the digital learning process [38].

These findings are consistent with Bronfenbrenner's Ecological Systems Theory, which posits that human development is shaped by interactions across different environmental layers. Here, digital literacy emerges not merely from internal capability but is shaped by external support systems such as teacher competence, infrastructure, and family involvement. Furthermore, the role of teaching quality as an intermediary highlights the importance of pedagogy in digital health education. Effective instruction that promotes higher-order thinking enhances students' ability to analyze and apply health-related content in a digital context [39]. Likewise, school infrastructure and family support provide the enabling environment for students to practice and reinforce their digital skills, in studies on digital learning environments. In summary, the results definitively answer the research problem: digital health literacy among students is shaped by a layered and interacting set of individual, pedagogical, institutional, and familial factors. These findings not only confirm the research hypothesis but also provide empirical evidence to support a systemic approach in designing health education programs in schools [40].

4. CONCLUSION

This study reveals that students' digital health literacy is significantly influenced by a chain of interrelated factors. At the individual level, skills and attitudes have a strong direct impact on digital literacy. More specifically, skill (b = 3.11; 95% CI = 1.66–4.56) and attitude (b = 3.27; 95% CI = 1.79–4.74) are both positively and significantly associated with students' ability to utilize digital health information. Beyond the individual level, the findings also show a multi-layered indirect effect: students' skills influence digital literacy through the quality of teaching (b = 7.15), teaching quality influences literacy through school facilities (b = 1.67), and school facilities affect digital literacy through family support (b = 1.94), all with high statistical significance ($p < 0.001$).

Based on these findings, a new conceptual framework is proposed: digital health literacy in schools is not solely the result of personal competence but emerges from a systemic interaction between teaching practices, institutional infrastructure, and socio-familial support. This emphasizes the need for an ecological approach to health education, where both individual readiness and structural enablers must be addressed simultaneously.

Recommendations from this research include is Curriculum developers should incorporate structured training to enhance students' digital skills and foster positive health attitudes. School leadership should invest in teacher training and digital infrastructure to create an enabling learning environment. Family engagement programs are essential to support and reinforce students' digital learning outside of school.

ACKNOWLEDGEMENTS

The authors would like to thank Risetmu for being the flagship program of Majelis Diktilitbang PPM which has provided financial support, LPPM Universitas Muhammadiyah Madiun and DIKDASMEN.

REFERENCES

[1] K. Khamwichai, N. Yurahan, S. Srisiri, and P. Moungsirithum, "The effects of health promotion literacy program on knowledge and health behaviors of national health recommendations among middle school students," *ACPES Journal*

of Physical Education, Sport, and Health (AJPESH), vol. 1, no. 2, pp. 104–112, Dec. 2021, doi: 10.15294/ajpesh.v1i2.49950.

[2] S. Van den Broucke, "Health literacy: A critical concept for public health," *Archives of Public Health,* vol. 72, no. 1, Dec. 2014, doi: 10.1186/2049-3258-72-10.

[3] M. del Pilar Arias López et al., "Digital literacy as a new determinant of health: A scoping review," *PLOS Digital Health*, vol. 2, no. 10, Oct. 2023, doi: 10.1371/journal.pdig.0000279.

[4] K. Sørensen, D. Levin-Zamir, T. V. Duong, O. Okan, V. V. Brasil, and D. Nutbeam, "Building health literacy system capacity: a framework for health literate systems," *Health Promot Int,* vol. 36, pp. I13– I23, Dec. 2021, doi: 10.1093/heapro/daab153.

[5] P. J. Fitzpatrick, "Improving health literacy using the power of digital communications to achieve better health outcomes for patients and practitioners," *Frontiers Media SA*, 2023doi: 10.3389/fdgth.2023.1264780.

[6] M. D. Güner and P. E. Ekmekci, "A survey study evaluating and comparing the health literacy knowledge and communication skills used by nurses and physicians," *Inquiry (United States)*, vol. 56, Jul. 2019, doi: 10.1177/0046958019865831.

[7] R. van Kessel, B. L. H. Wong, T. Clemens, and H. Brand, "Digital health literacy as a super determinant of health: More than simply the sum of its parts," *Internet Interv*, vol. 27, Mar. 2022, doi: 10.1016/j.invent.2022.100500.

[8] G. Rowlands, J. Protheroe, J. Winkley, M. Richardson, P. T. Seed, and R. Rudd, "A mismatch between population health literacy and the complexity of health information: An observational study," *British Journal of General Practice*, vol. 65, no. 635, pp. e379–e386, Jun. 2015, doi: 10.3399/bjgp15X685285.

[9] [9] J. B. Prihanto, E. S. Wahjuni, F. Nurhayati, R. Matsuyama, M. Tsunematsu, and M. Kakehashi, "Health literacy, health behaviors, and body mass index impacts on quality of life: Cross-sectional study of university students in Surabaya, Indonesia," *Int J Environ Res Public Health*, vol. 18, no. 24, Dec. 2021, doi: 10.3390/ijerph182413132.

[10] [M. del Pilar Arias López et al., "Digital literacy as a new determinant of health: A scoping review," *PLOS Digital Health*, vol. 2, no. 10, Oct. 2023, doi: 10.1371/journal.pdig.0000279.

[11] Q. P. S. Law, A. H. Y. Yau, and J. W. Y. Chung, "Chinese adults' nutrition label literacy in Hong Kong: Implications for nurses," *Nurs Health Sci*, vol. 21, no. 2, pp. 171–177, 2019, doi: 10.1111/nhs.12575.

[12] W. Van Boxtel, K. Jerković-Ćosić, L. J. Schoonmade, and M. J. M. Chinapaw, "Health literacy in the context of child health promotion: a scoping review of conceptualizations and descriptions," *BMC Public Health*, vol. 24, no. 1, Dec. 2024, doi: 10.1186/s12889-024-17955-7.

[13] K. R. Van Teijlingen, B. Devkota, F. Douglas, P. Simkhada, and E. R. Van Teijlingen, "Understanding health education, health promotion and public health," *Journal of Health Promotion*, vol. 9, no. 01, pp. 1–7, Nov. 2021, doi: 10.3126/jhp.v9i01.40957.

[14] L. E. Søvold et al., "Prioritizing the mental health and well-being of healthcare workers: An urgent global public health priority," *Front Public Health*, vol. 9, May 2021, doi: 10.3389/fpubh.2021.679397.

[15] V. P. Kalanjati et al., "Health literacy on COVID-19 and COVID-19 vaccinations in Indonesia," *F1000Res*, vol. 11, p. 1296, Nov. 2022, doi: 10.12688/f1000research.125551.

[16] O. Okan, M. Messer, D. Levin-Zamir, L. Paakkari, and K. Sorensen, "Health literacy as a social vaccine in the COVID-19 pandemic," Oxford University Press, Aug. 01, 2023, Oxford University Press. doi: 10.1093/heapro/daab197.

[17] S. Harith, I. Backhaus, N. Mohbin, H. T. Ngo, S. Khoo., "Effectiveness of digital mental health interventions for university students: An umbrella review." *PeerJ. PeerJ Inc,* Vol. 10, 2022. doi: 10.7717/peerj.13111.

[18] F. A. Causio, S. Gandolfi, J. Kaur, B. Sert, M. Fakhfakh, and L. De Angelis, "Impact of digital health interventions on health literacy: A systematic review with quality appraisal," medRxiv, preprint, 2025, doi: 10.1101/2025.02.27.25323025.

[19] J. J. Hox, *Multilevel Analysis: Techniques and Applications*, 2nd ed. New York, NY, USA: Routledge, 2010.

[20] T. D. Aungst and R. Patel, "Integrating digital health into the curriculum—considerations on the current landscape and future developments," *Journal of Medical Education and Curricular Development,* vol. 7, no.1, 2020, doi: 10.1177/2382120520902180.

[21] K. E. Larson, E. T. Pas, J. H. Bottiani, J. M. Kush, and C. P. Bradshaw, "A multidimensional and multilevel examination of student engagement and secondary school teachers' use of classroom management practices," *Journal of Positive Behavior Interventions*, vol. 23, no. 3, pp. 149–162, 2021, doi: 10.1177/1098300720929352.

[22] [U. Y. Sundari, A. A. Panudju, A. W. Nugraha, F. Purba, Y. Erlina, N. Nurbaiti, *Metodologi Penelitian*. Bandung, Indonesia: CV. Gita Lentera, 2024.

[23] R. van Kessel, B. L. H. Wong, T. Clemens, and H. Brand, "Digital health literacy as a super determinant of health: More than simply the sum of its parts," *Internet Interventions*, vol. 27, 2022, doi: 10.1016/j.invent.2022.100500.

[24] S. W. Andersson and M. P. Gonzalez, "Digital health literacy a key factor in realizing the value of digital transformation in healthcare," *Frontiers in Digital Health*, vol. 7, 2025, doi: 10.3389/fdgth.2025.1461342.

[25] F. A. R. Uribe, R. C. D. S. Godinho, M. A. S. Machado, K. R. D. S. G. Oliveira, C. A. N. Espejo, N. C. V. De Sousa, "Health knowledge, health behaviors and attitudes during pandemic emergencies: A systematic review," *PLoS ONE*, vol. 16, 2021, doi: 10.1371/journal.pone.0256731.

[26] S. Sujarwoto, H. Holipah, and A. Maharani, "A cross-sectional study of knowledge, attitudes, and practices concerning COVID-19 outbreaks in the general population in Malang district, Indonesia," *International Journal of Environmental Research and Public Health*, vol. 19, no. 7, 2022, doi: 10.3390/ijerph19074287.

[27] P. Dias, R. Brito, W. Ribbens, L. Daniela, Z. Rubene, M. Dreier, "The role of parents in the engagement of young children with digital technologies: Exploring tensions between rights of access and protection, from 'gatekeepers' to 'scaffolders'," *Global Studies of Childhood*, vol. 6, no. 4, pp. 414–427, 2016.

[28] N. E. Kelty and T. Wakabayashi, "Family engagement in schools: Parent, educator, and community perspectives," *SAGE Open*, vol. 10, no. 4, 2020, doi: 10.1177/2158244020983292.

[29] D. Levin-Zamir and I. Bertschi, "Media health literacy, eHealth literacy, and the role of the social environment in context," *International Journal of Environmental Research and Public Health*, vol. 15, no. 8, 2018, doi: 10.3390/ijerph15081644.

[30] B. Tennant, M. Stellefson, V. Dodd, B. Chaney, D. Chaney, S. Paige, and J. Alber, "Health literacy and Web 2.0 health information seeking behaviors among baby boomers and older adults," *Journal of Medical Internet Research*, vol. 17, no. 3, p. e70, 2015, doi: 10.2196/jmir.3992.

[31] S. S. Richtering, K. Hyun, L. Neubeck, G. Coorey, J. Chalmers, T. Usherwood, "Health literacy: Predictors in a population with moderate-to-high cardiovascular risk," *JMIR Human Factors*, vol. 4, no. 1, p. e4, 2017, doi: 10.2196/humanfactors.6217.

[32] L. Nölke, M. Mensing, A. Krämer, and C. Hornberg, "Sociodemographic and health-(care-)related characteristics of online health information seekers: A cross-sectional german study," *BMC Public Health*, vol. 15, p. 31, 2015, doi: 10.1186/s12889-015-1423-0.

[33] R. Shadiev and X. Wang, "A review of research on technology-supported language learning and 21st century skills," *Frontiers in Psychology*, vol. 13, no. 1, 2022, doi: 10.3389/fpsyg.2022.897689.

[34] T. Nilsen and J. E. Gustafsson, "*Teacher Quality Instructional Quality and Student Outcomes: Relationships Across Countries, Cohorts and Time. Cham,"*,Springer, Switzerland, 2016.

[35] F. Mokhtari, "Fostering digital literacy in higher education: Benefits, challenges and implications," *International Journal of Linguistics, Literature and Translation*, vol. 6, no. 10, 2023.

[36] A. Karnita, S. Aisyah, N. Mustapa, E. S. Syarah, D. R. Jovanka, and S. B. Mahamud, "Exploring the impact of digital literacy on cognitive development in early childhood education: A systematic literature review," *Al-Athfal: Jurnal Pendidikan Anak,* vol. 11, no. 1, pp. 81–121, 2025.

[37] F. Mokhtari, "Fostering digital literacy in higher education: Benefits, challenges and implications," *International Journal of Linguistics, Literature and Translation,* 2023.

[38] A. Karnita, S. Aisyah, N. Mustapa, E. S. Siti Syarah, D. R. Jovanka, and S. Bt Mahamud, "Exploring the impact of digital literacy on cognitive development in early childhood education: A systematic literature review," *Al-Athfal: Jurnal Pendidikan Anak,* vol. 11, no. 1, pp. 81–121, 2025.

[39] G. Biesta, "*Outline of a Theory of Teaching: What Teaching is, What it is for, How it Works, and Why it Requires Artistry*," Theorizing teaching: Current status and open isues, *A.-K.* Praetorius and C. Y. Charalambous, Eds. Cham, Switzerland: Springer, pp. 253–280, 2023, doi: 10.1007/978-3-031-25613-4_9.

[40] J. Cai, S. Hwang, M. Melville, and V. Robison, "*Theory for Teaching and Teaching for Theory: Artifacts as Tangible Entities for Storing and Improving Professional Knowledge for Teaching*," Theorizing teaching: Current status and open issues, A.-K. Praetorius and C. Y. Charalambous, Eds. Cham, Switzerland: Springer, pp. 225–251, 2023, doi: 10.1007/978-3-031-25613-4_8.