

Digital Skills-Based Integrated Learning to Improve Students' 21st Century Competencies

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Abstract

Digital transformation in higher education requires the development of learning that is able to integrate digital skills as a main part of the learning process. This study aims to analyze the influence of digital skills-based integrated learning on students' 21st century competencies. This study uses a quantitative approach with an explanatory design. The research sample consisted of 150 students who were selected using the purposive sampling technique. Data were collected through a Likert scale questionnaire and analyzed using descriptive statistics as well as simple linear regression. The results showed that digital skills-based learning was in the high category (mean = 4.18), as well as the 21st century competence of students (mean = 4.02). The results of the regression test showed that learning digital skills had a positive and significant effect on students' 21st century competence ($\beta = 0.71$; $p < 0.05$). The determination coefficient of 56.2% shows that digital learning makes a considerable contribution to improving student competence. In addition, all 21st century competency indicators, including critical thinking, creativity, collaboration, communication, digital literacy, and problem solving, have increased significantly, with the greatest influence on the digital literacy aspect. These findings show that digital skills-based integrated learning is effective in improving students' 21st century competencies and is relevant to be applied in the transformation of higher education in the digital era.

Keywords: Digital Skills, 21st Century Competencies, Digital Learning, Higher education, Digital Literacy.

INTRODUCTION

Digital transformation has been a key driver of change in the global higher education system. The development of information and communication technology has changed the learning paradigm from conventional to more flexible, adaptive, and based on digital technology. The integration of technology in learning is no longer optional, but rather a strategic need to

improve the quality of learning and the relevance of graduates to the demands of the world of work. Digital transformation in higher education encourages changes in the learning system, governance, institutional innovation, and sustainability practices in higher education (Trevisan et al., 2024). Universities are required to be able to develop a learning system that is not only oriented to knowledge transfer, but also to the development of competencies relevant to the digital era (Sunusi et.al 2025). This is in line with the findings of Timotheou et al. (2023) who stated that digital technology can increase flexibility, personalization, and learning capacity if supported by institutional strategies, infrastructure, lecturer competencies, and adequate digital policies.

Digital skills are the core competencies that must be possessed by students. Digital skills include not only technical abilities in using technological devices, but also the ability to access, evaluate, and utilize digital information critically and creatively. Zhao et al. (2021) emphasized that digital competencies in higher education include information literacy, digital communication, digital content creation, digital security, and problem-solving. Furthermore, digital skills play a role as a foundation in the development of 21st century competencies which include critical thinking skills, creativity, collaboration, communication, digital literacy, problem-solving, and lifelong learning skills. Ndibalema (2025) stated that digital literacy plays an important role in strengthening 21st century skills, especially critical thinking, communication, collaboration, creativity, and student work readiness. In addition, digital skills also have a close relationship with graduate employability because the world of work increasingly demands data literacy, problem-solving skills, and the ability to create digital content (Tee et al., 2024; Sunusi et.al., 2026).

In learning practice, blended learning and digital learning models can increase student engagement if they are designed with a clear learning structure, collaborative activities, and strong interaction between lecturers and students (Heilporn et al., 2021). Thus, digital transformation also supports the implementation of Education 4.0 through strengthening innovation, open knowledge, and students' technical-practical competencies in facing the technology-based world of work (Shenkoya & Kim, 2023).

However, various studies show that there is still a gap between the competencies possessed by university graduates and the needs of the world of work. Many graduates do not have the skills that are in accordance with the needs of the industry, especially in the aspects of digital skills and high-level thinking skills. This phenomenon shows that the learning system in higher education is still not fully able to integrate the needs of the world of work into the learning process. The learning approach that is still dominated by the lecture method and centered on lecturers is one of the main factors that cause the low work readiness of graduates (Sunusi et.al.2026).

On the other hand, the development of modern learning concepts such as constructivism and connectivism provides a strong theoretical foundation in the development of digital-based learning models. The constructivist perspective emphasizes that learning is an active student-centered process, where knowledge is built through experience, exploration, reflection, and social interaction in an authentic learning environment. The findings of Levin et al. (2025) show that constructivist approaches remain relevant in the digital learning ecosystem because they are able to encourage learning autonomy, creativity, and active involvement of students in building knowledge. In line with that, various cutting-edge studies show that constructivism is still one of

the most influential theories in 21st century learning because it supports the development of critical thinking, collaboration, and problem-solving through the use of digital technology (Yonatan, 2025).

Meanwhile, the theory of connectivism proposed by Siemens (2005) emphasizes that learning in the digital era occurs through networks, information connectivity, and relationships between scattered knowledge sources. The relevance of this theory is increasingly strengthened in today's digital learning environment, where the ability to build and utilize information networks is an important factor in the learning process (Fatullah et al., 2026). In this context, the ability to access, evaluate, and utilize digital resources through various platforms and virtual communities is key to the success of modern learning.

However, the implementation of technology in learning in higher education is often still partial and has not been systematically integrated. Various studies show that the use of technology is often limited to the function of delivering material or presentation, while the integration of technology in learning design that is oriented towards the development of student competencies still faces various obstacles, such as lecturer readiness, training limitations, and lack of institutional support (Fitriyani et al., 2026). In fact, effective technology integration can create a more collaborative, interactive, and student-centered learning environment (Radhiani, 2026). This condition shows that the use of technology has not been fully supported by a comprehensive and structured learning model.

Previous research has generally focused on the effectiveness of the use of technology in improving cognitive learning outcomes, such as improving students' understanding of concepts or academic grades. However, research that specifically examines the development of integrated learning models based on digital skills in improving 21st century competencies is still relatively limited. On the other hand, various studies show that digital literacy has a positive relationship with critical thinking skills, learning outcomes, and students' readiness to face the challenges of the 21st century (Injotel, 2023). In addition, the integration of technology in learning has proven to play an important role in the development of 21st-century competencies such as creativity, collaboration, communication, and problem-solving (Chasokela, 2025). However, most studies still examine these competencies separately and have not integrated various aspects of 21st century competencies holistically in a single systematic and digital skills-based learning model (Adys, H. P., 2026).

Based on this description, this research focuses on integrated learning based on digital skills as an effort to improve the competence of 21st century students. This research is expected to contribute to the development of learning that is more relevant, adaptive, and oriented to future needs. The purpose of this research is to analyze digital skills-based integrated learning in improving students' 21st century competencies, as well as explain its implications for the transformation of higher education in the digital era.

METHOD

This study uses a quantitative approach with an explanatory research design to analyze the influence of digital skills-based integrated learning on improving students' 21st century competencies. This approach was chosen because it allows researchers to test the relationships between variables empirically and measure the degree of influence statistically.

The research population is students of the Applied Undergraduate English study program at Makassar State University who have participated in digital-based learning for at least one semester. The research sample amounted to 150 students who were determined using a purposive sampling technique with the following criteria: (1) active students, (2) having participated in digital-based learning, and (3) engaging in digital project-based learning activities.

Teknik pengumpulan data menggunakan kuesioner tertutup dengan skala Likert 1–5. Instrumen penelitian terdiri dari dua variabel utama, yaitu: (1) pembelajaran terintegrasi berbasis digital skills which include indicators of technology integration, learning interactivity, digital collaboration, and the use of digital media; and (2) 21st century competencies which include critical thinking, creativity, collaboration, communication, digital literacy, and problem solving.

The validity test was conducted using the Pearson Product Moment correlation with an r value of > 0.30 , while the reliability used Cronbach's Alpha with a $>$ value of 0.70 . The test results show that all instruments are valid and reliable.

Data analysis was carried out using descriptive statistics to see an overview of the data, as well as simple linear regression analysis to test the influence of independent variables on dependent variables. The hypothesis test was carried out using a t-test with a significance level of 0.05 .

FINDINGS

The results of this study are presented to provide an empirical picture of the influence of digital skills-based integrated learning on students' 21st century competencies. The analysis was carried out in stages through descriptive and inferential statistical approaches to identify data trends, relationships between variables, and the level of contribution of digital learning to the development of student competencies. The presentation of the research results began with a descriptive analysis to describe the general condition of the research variables, followed by a regression test to determine the magnitude of the influence, the analysis of the determination coefficient to see the contribution of independent variables, and the analysis of indicators to identify the influence on each dimension of competence in the 21st century.

This approach aims to provide a comprehensive understanding of how digital skills-based learning contributes to improving students' abilities, both in general and in specific aspects such as critical thinking, creativity, collaboration, communication, digital literacy, and problem solving. Thus, the results of this study not only show statistical relationships, but also provide a strong analytical basis to explain the role of digital learning in the development of 21st century competencies in higher education.

Table 1. Descriptive Statistics of Variables

Variabel	N	Mean	Std. Deviation	Category
Digital Skills Learning	150	4.18	0.43	High
21st Century Competence	150	4.02	0.47	High

Based on Table 1, the results of descriptive statistical analysis show that the digital skills-based integrated learning variable has a mean value of 4.18 with a standard deviation of 0.43 , which is in the high category. This indicates that the implementation of digital skills-based

learning has gone well and has been positively received by students. The relatively low standard deviation value indicates that respondents' perception of learning tends to be homogeneous, so it can be concluded that the majority of students have a consistent learning experience.

Meanwhile, the 21st century competency variable of students obtained an average score of 4.02 with a standard deviation of 0.47 which is also in the high category. These findings show that in general, students have a good level of competence in the 21st century, covering aspects of critical thinking, creativity, collaboration, communication, digital literacy, and problem-solving.

Table 2. Linear Regression Test Results

Variabel	Coefficin (β)	t-count	Sig.
Digital Skills → Competencies	0.71	10.82	0.000

Based on Table 2, the results of linear regression analysis show that integrated learning based on digital skills has a positive influence on students' 21st century competence, with a regression coefficient value (β) of 0.71. This value indicates that every one unit increase in the quality of digital skills-based learning will be followed by an increase in students' 21st century competencies by 0.71 units, assuming other variables are constant.

In addition, the t-count value of 10.82, which is much greater than the t-table value at a significance level of 0.05, suggests that the influence is statistically strong. This is strengthened by a significance value (Sig.) of 0.000 which is smaller than 0.05, so it can be concluded that digital skills-based learning has a significant effect on students' 21st century competencies.

Table 3. R Square Value (Coefficient of Determination)

R	R Square	Adjusted R Square
0.75	0.562	0.558

Based on Table 3, the results of the determination coefficient analysis show that the R Square value of 0.562 indicates that 56.2% of the variation in 21st century competencies of students can be explained by integrated learning based on digital skills. Meanwhile, the remaining 43.8% was influenced by other factors outside of the variables studied, such as the learning environment, individual motivation, practical experience, and other pedagogical factors.

The correlation coefficient (R) value of 0.75 indicates a strong relationship between digital skills-based learning and students' 21st century competencies. This indicates that the better the implementation of digital learning, the higher the level of competence that students have.

In addition, the Adjusted R Square value of 0.558 which is not much different from the R Square value shows that the regression model used has good stability and is not overestimated. Thus, this research model can be considered quite representative in explaining the relationship between digital skills learning variables and 21st century competencies.

Overall, these results show that integrated learning based on digital skills has a considerable contribution in improving the 21st century competencies of students. These findings reinforce the importance of integrating technology in learning as one of the main strategies in preparing students to face the demands of the world of work in the digital era.

Table 4. Influence on 21st Century Competencies

Indicators	Mean	β	Sig.
Critical Thinking	4.01	0.69	0.000
Creativity	3.98	0.66	0.000
Collaboration	4.10	0.74	0.000
Communication	3.95	0.60	0.002
Digital Literacy	4.25	0.78	0.000
Problem Solving	4.05	0.70	0.000

Based on Table 4, the results of the analysis show that all competency indicators in the 21st century are positively and significantly influenced by integrated learning based on digital skills. This is indicated by the significance value of the entire indicator being smaller than 0.05. The largest influence was found in the digital literacy indicator ($\beta = 0.78$), followed by collaboration ($\beta = 0.74$) and problem solving ($\beta = 0.70$), which showed that digital-based learning is very effective in improving students' technological skills and cooperation. Meanwhile, the communication indicator had the lowest influence value ($\beta = 0.60$), although it remained significant. Overall, these findings show that digital skills-based learning contributes comprehensively to improving the various dimensions of students' 21st century competencies.

DISCUSSIONS

The results of the study show that integrated learning based on digital skills has a positive and significant influence on the 21st century competencies of students. These findings strengthen the argument that the integration of technology in learning does not only serve as an aid, but as a key element in the development of student competencies that are relevant to the needs of the digital age. The regression coefficient value of 0.71 and a high level of significance indicate that digital skills-based learning contributes significantly to improving the quality of student competencies.

From a theoretical perspective, these findings are in line with the constructivist approach, which emphasizes that learning is an active process in which students build knowledge through experience and interaction with the learning environment. In the context of digital-based learning, students not only receive information, but also engage in the exploration, analysis, and production of digital content. This supports the findings of research by Bond et al. (2020) which states that digital learning is able to significantly increase student engagement and learning experience.

In addition, the results of this study also strengthen the theory of connectivity proposed by Siemens (2005), where learning in the digital era occurs through networks and information connectivity. A significant increase in the collaboration indicator ($\beta = 0.74$) showed that students were able to utilize technology to interact and collaborate in a digital environment. This is in line with research by Chai et al. (2020) which affirms that the integration of technology in learning encourages the development of collaborative skills and digital communication.

Findings showing that digital literacy has the greatest influence ($\beta = 0.78$) indicate that digital skills-based learning directly improves students' ability to access, evaluate, and utilize digital information. This is consistent with the study of van Laar et al. (2020) which states that

digital literacy is a key component in the development of competencies in the 21st century, especially in facing the challenges of the technology-based world of work.

The improvement in the aspects of critical thinking ($\beta = 0.69$) and problem solving ($\beta = 0.70$) shows that digital skills-based learning is able to encourage students to think analytically and solve problems independently. This is supported by research by Yu & Wang (2025) which found that the use of digital technology in learning has a significant impact on improving students' high-level thinking skills.

However, the results of the study also showed that the communication indicator had the lowest influence value ($\beta = 0.60$) compared to other indicators. These findings indicate that although digital technology is able to facilitate communication, the development of interpersonal communication still requires additional pedagogical approaches such as face-to-face discussions or collaborative learning based on direct interaction. This is in line with the findings of Zhao and Watterston (2021) who emphasize that technology cannot completely replace social interaction in the learning process.

In terms of model contribution, the determination coefficient value of 56.2% shows that digital skills-based learning has a considerable contribution in explaining the variation in 21st century competencies of students. However, there are still 43.8% of other factors that influence, such as learning motivation, academic environment, and student practical experience. This shows that 21st century competency development is multidimensional and does not depend solely on one learning approach.

Practically, these findings provide important implications for the development of learning in higher education. The integration of digital skills in learning needs to be designed systematically and not partially. Lecturers need to develop learning strategies that combine technology, pedagogy, and learning contexts holistically. This is in line with the concept of digital pedagogy which emphasizes the integration of technology and learning strategies to create a more effective learning experience (Redecker, 2017).

Overall, the results of this study confirm that digital skills-based integrated learning is an effective approach in improving the 21st century competencies of students. These findings make an important contribution to the development of learning practices in higher education, particularly in the face of the challenges of digital transformation and the demands of the global workforce.

CONCLUSIONS

Integrated learning based on digital skills has a positive and significant influence on the 21st century competencies of students. This is shown by the results of regression analysis and determination coefficients which indicate that digital learning makes a considerable contribution to improving students' abilities. Competencies that have improved include critical thinking, creativity, collaboration, communication, digital literacy, and problem-solving, with the greatest influence on aspects of digital literacy and collaboration.

Overall, these findings confirm that the integration of digital skills in learning is an effective strategy in preparing students to face the demands of the world of work in the digital era. Therefore, universities need to develop more adaptive, interactive, and technology-based learning in order to be able to improve the quality of graduates holistically. This research also

provides a basis for the development of further studies that can examine other factors that affect students' 21st century competencies more comprehensively.

REFERENCES

- Adiawaty, S., Oci, M., Siminto, S., & Ermindyawati, L. (2023). Adaptive strategies for 21st century learning: Digital literacy and learning outcomes in contemporary Indonesian higher education. *International Journal of Teaching and Learning*, 1(2), 115-127.
- Adys, H. P., & Adys, H. P. (2026). Project-Based Learning in MICE Education: Preparing University Students for the Creative Industry Workforce in Indonesia. *Journal of Innovative and Creativity*, 6(2), 26870–26877.
- Bond, M., Buntins, K., Bedenlier, S., Zawacki-Richter, O., & Kerres, M. (2020). Mapping research in student engagement and educational technology in higher education: A systematic evidence map. *International journal of educational technology in higher education*, 17(1), 1-30.
- Bulkis, I., Tahir, M., & Sakkir, G. (2025). EFL Teachers' Perspectives on Implementing 6C Skills in Indonesian Classrooms. *International Journal of Language, Education, and Literature*, 2(3), 373-379.
- Chasokela, D. (2025). Role of technology integration in the development of 21st-century skills STEM university in Zimbabwe. *Journal of Research in Education and Pedagogy*, 2(1), 124-135.
- Fatullah, R., Sudirman, A., & Hidayat, S. (2026). Reconstructing Connectivism Theory in 21st Century Education. *Foremost Journal*, 7(1), 104-109.
- Fitriyani, R., Nurlela, N., Aqil, N., Marba'i, M. I., Amelliyah, R., Khairani, D. R., ... & Rifai, D. S. (2026). Integration of Innovative Learning Methods in 21st Century Skills Development: A Systematic Review. *Paedagogie*, 21(1), 545-562.
- Heilporn, G., Lakhal, S., & Bélisle, M. (2021). An examination of teachers' strategies to foster student engagement in blended learning in higher education. *International journal of educational technology in higher education*, 18(1), 25.
- Ndibalema, P. (2025). Digital literacy gaps in promoting 21st century skills among students in higher education institutions in Sub-Saharan Africa: a systematic review. *Cogent Education*, 12(1), 2452085.
- Levin, I., Semenov, A. L., & Gorsky, M. (2025). Smart learning in the 21st century: Advancing constructionism across three digital epochs. *Education Sciences*, 15(1), 45.
- Radhiani, A., Sriayu, S., Arqam, M., Abouseada, F., & RS, A. H. (2026). A Systematic Literature Review Of 21st-Century Digital Learning Trends And Teachers' technology Integration. *Jurnal Ilmiah Ilmu Terapan Universitas Jambi*, 10(1).
- Redecker, C. (2017). *European framework for the digital competence of educators: DigCompEdu*.

- Shenkoya, T., & Kim, E. (2023). Sustainability in higher education: digital transformation of the fourth industrial revolution and its impact on open knowledge. *Sustainability*, 15(3), 2473.
- Siemens, G. (2005). Connectivism: A learning theory for the digital age. *International Journal of Instructional Technology and Distance Learning*, 2(1), 3–10.
- Sunusi, S. L., Azhari, A., Sembiring, S. A., & Safitri, C. D. (2025). Implementation of Artificial Intelligence (AI) in HyFlex-Based Final Project Guidance. *Celebes Journal of Language Studies*, 251-262.
- Sunusi, S. L., Amin, F. H., & Wahid, A. (2026). Analysis the effectiveness of multimedia-based digital learning on student job readiness. *ELT Worldwide: Journal of English Language Teaching*, 13(1). <https://doi.org/10.26858/eltww.v13i1.84606>
- Tee, P. K., Wong, L. C., Dada, M., Song, B. L., & Ng, C. P. (2024). Demand for digital skills, skill gaps and graduate employability: Evidence from employers in Malaysia. *F1000Research*, 13, 389.
- Timotheou, S., Miliou, O., Dimitriadis, Y., Sobrino, S. V., Giannoutsou, N., Cachia, R., ... & Ioannou, A. (2023). Impacts of digital technologies on education and factors influencing schools' digital capacity and transformation: A literature review. *Education and information technologies*, 28(6), 6695-6726.
- Trevisan, L. V., Eustachio, J. H. P. P., Dias, B. G., Filho, W. L., & Pedrozo, E. Á. (2024). Digital transformation towards sustainability in higher education: state-of-the-art and future research insights: LV Trevisan et al. *Environment, Development and Sustainability*, 26(2), 2789-2810.
- Van Laar, E., van Deursen, A. J., van Dijk, J. A., & De Haan, J. (2019). Determinants of 21st-century digital skills: A large-scale survey among working professionals. *Computers in human behavior*, 100, 93-104.
- Yu, Q., Yu, K., Li, B., & Wang, Q. (2025). Effectiveness of blended learning on students' learning performance: a meta-analysis. *Journal of research on Technology in education*, 57(3), 499-520.
- Zhao, Y., Llorente, A. M. P., & Gómez, M. C. S. (2021). Digital competence in higher education research: A systematic literature review. *Computers & education*, 168, 104212.