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Analysis of Pre-Service Teachers' 21st Century Skills in Indonesia by Gender

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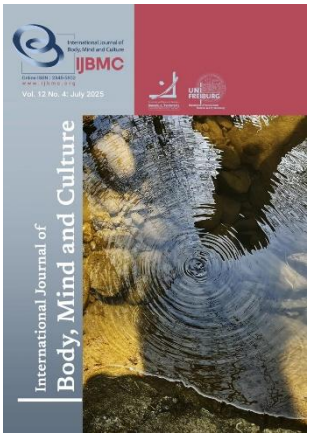

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ABSTRACT

Objective: This study aims to analyze the differences in skills among 21st-century pre-service teachers based on gender.

Methods and Materials: The research method uses a comparative approach. The research population consisted of pre-service teachers at the State University of Surabaya, totaling 1,080 people from 13 study programs. The sampling technique employed a quota sampling method using the Slovin formula, resulting in a total of 411 people. The 21st-century skills instrument uses a questionnaire. The data analysis used was the independent sample t-test.

Findings: By the results of data processing, it can be explained that there are no differences in almost all dimensions of 21st century skills (critical thinking, collaboration, communication, creativity, digital literacy and social skills) with a sig value > 0,05, except for the leadership dimension, there are differences between male and female (sig 0,015 < 0,05).

Conclusion: The differences between male and female leaders are influenced by leadership positions and cultural factors, which shape the role of leadership in determining instructional goals, organizational school climate, and student achievement, taking into account the socio-cultural context within the framework.

Keywords: skills, gender, leadership, pre-service, teacher.

Introduction

The rapidly changing world and developing technology require readiness in all areas, one of which is an education system that must equip students with the skills necessary to succeed in the 21st century (Varas et al., 2023). The educational process in the 21st century requires teachers to be innovative and adaptable to keep pace with scientific developments and technological advances. In the current educational framework, teachers must observe and evaluate the competencies required in each discipline from various dimensions,

including technological, pedagogical, contextual, and humanistic aspects. In the 21st-century learning framework, it is necessary to identify the skills that students must have when entering the workforce; so it is essential to analyze whether the competencies and learning methods that will be designed are appropriate to achieve this (González-pérez & Ramírez-montoya, 2022). A teacher must be able to provide examples in problem-solving, critical thinking, collaboration, communication skills, developing creativity, leadership, and digital literacy (Kim et al., 2019). Teacher competency in 21st-century learning is the basis for meeting the challenges of preparing quality human resources. Teachers have an important responsibility at every stage of the educational process, from elementary school to higher education, in developing 21st-century skills, as this plays a crucial role in shaping students' future lives and careers (Gündüzalp, 2021). 21st-century skills are integrated into the development of teacher professional competencies during the learning process. Research indicates a strong and positive correlation between professional competence and 21st-century skills in teachers (Kuloğlu & Karabekmez, 2022). The dimensions of teacher competency have the potential to help develop teacher professionalism through the concept of learning in the 21st century. It can be used to predict characteristics, pedagogy, professionalism, and information and communication technology, as well as the development of school-based management, which makes a significant contribution to 21st-century skills. Twenty-first-century skills are a crucial factor for teachers in enhancing the quality of learning in response to educational developments in the 4.0 era (Sulaiman & Ismail, 2020). Learning objectives in the 21st century are based on the main principles of learning, which include student-centeredness, collaboration, contextuality, and integration with the needs of society or stakeholders. Therefore, the competence and role of teachers in implementing the 21st-century learning process play a crucial role in realizing a higher quality future for the nation's children. Assessment of 21st-century skills in students can be used to plan and improve teaching and student development, enabling them to face the changes taking place in the world (Ongardwanich et al., 2015).

The role of teachers in 21st-century learning today is not only limited to transferring knowledge, but also focuses on discussing and evaluating student learning progress, so that they know when remedial or enrichment learning is needed. For example, innovative classroom design in schools can enhance various aspects of student knowledge, not just in terms of infrastructure (Timenko, 2021). The research results indicate a growing interest in skills and competencies in line with the development of information and communication technology, globalization, and the need for innovation (Chalkiadaki, 2018). This is one of the reasons why prospective professional teachers who are prepared through pre-service teacher professional education programs need to master 21st-century skills.

For pre-service teachers to become 21st-century teachers, considerable preparation and training are required (Alahmad et al., 2021). This initiative aims to enhance the competencies and skills necessary for teaching preparation. Pre-service teacher training needs to be prioritized to ensure that future teachers' competency aligns with developments in science and technology. The study's results revealed important new insights into pre-service teachers' opinions on 21st-century skills and how these perceptions evolve during their teacher education (Häkkinen et al., 2017). To develop the competence of pre-service teachers, prerequisites are needed, including an understanding of ICT and the learning curriculum, as well as the development of a collaborative and learner-centered learning environment. One implementation of ICT in learning is the application of Technological Pedagogical Content Knowledge (TPACK) (Reyes et al., 2017). The application of digital literacy skills or competencies is crucial for pre-service teachers to conduct learning analyses according to educational level and student characteristics (Howard et al., 2021). Apart from that, the use of learning methods and approaches needs to be considered to enhance student competence, internalize spiritual values, and foster character development (List et al., 2020). Apart from mastering 21st-century skills, character development also needs to be learned by pre-service teachers, so that they will develop holistically (Afandi & Suryani, 2019).

The learning process for pre-service teachers is conducted both online and offline through the Learning Management System (LMS), where they study materials related to teacher competencies. Apart from studying pedagogical and professional material relevant to their field of study, students are also required to master 21st-

century skills, including critical thinking to solve problems, collaborating on projects, communicating effectively, and developing skills in Information and Communication Technology (ICT), among others. The results of research on the development of 21st-century skills in pre-service teachers indicate that collaboration, interaction, social impact, and social responsibility occurred during a six-week training process (Hilliker & Loranc, 2022). Additionally, literacy will affect collaboration and communication skills, with a notable lack of focus on life and career skills related to creativity and innovation, digital literacy, and citizenship. The transfer of other acquired skills into real-world contexts, for example leadership and communication, as well as how pre-service teachers can identify potential skills development to design specific skills development programs for students, create learning innovations for teacher professional development, and make changes to the learning process at the school (Varas et al., 2023; Zhong et al., 2022). After receiving material on campus through course assistance with lecturers, students are asked to apply their competencies in the field through a field experience program, according to their field of study.

Several factors that can influence 21st-century skills, according to the results of the literature review, include need factors, which will determine communication and collaboration skills, personality and psychological factors, which determine social skills and digital skills, and are influenced by demographic and socio-economic factors (van Laar et al., 2020a, 2020b). In addition, gender differences in pre-service teachers' readiness for using and applying instructional technology remain a factor that requires further analysis (Diquito et al., 2022; Scherer et al., 2023; Spector et al., 2014). Previous research on the implementation of 21st-century skills has shown that gender partly influences and is related to Higher Order Thinking Skills (HOTS) and students' numerical literacy, where male students tend to outperform female students, and male students' numerical literacy skills are generally lower than those of female students (Sepriyanti et al., 2022). Thus, based on the description above, this study will examine the skills of prospective 21st-century teachers, specifically their mastery of the learning process, by gender, to determine whether there are differences in their abilities.

Methods and Materials

The purpose of this research is to analyze and differentiate 21st-century skills (critical thinking, collaboration, creativity, communication, digital literacy, social skills, leadership) of pre-service teachers based on gender. The type of research employed is comparative research, utilizing a quantitative approach, which aims to identify, analyze, and explain similarities and differences across contexts (Iranifard & Roudsari, 2022). The research population consisted of pre-service teachers at the State University of Surabaya, totaling 1,080 people from 13 study programs. The sampling technique employed a quota sampling method using the Slovin formula, resulting in a total of 411 people. The instrument used in this research was the 21st-century skills questionnaire (Diquito et al., 2022). The value of the instrument validity is 0.098 with a reliability value of 0.969. The data analysis technique used is the independent sample t-test. Since the data are not normally distributed (0.001 < 0.005), non-parametric analysis is required. The Mann-Whitney U test was a nonparametric version of the parametric t-test used to determine differences between two groups. When the data do not meet the parametric assumptions of the t-test, the Mann-Whitney U is more appropriate. The interpretation of the questionnaire results is as follows.

Table 1

Interpretation of 21st Century Skills

Scale value	Range	Description	Interpretation
5	4.20 – 5.00	Very High	Respondents strongly agree
4	3.40 – 4.19	High	Respondents agree with a statement
3	2.60 – 3.39	Neutral	Respondents disagree with this statement
2	1.80 – 2.59	Low	Respondents disagree with a statement
1	1.00 – 1.79	Very Low	Respondents disagree with a statement

Findings and Results

This section presents the research results, data analysis, and discussion related to the 21st-century skills of prospective teachers at Surabaya State University, who represent several provinces in Indonesia. The data were obtained by filling out a Google Form questionnaire with a sample size of 411 pre-service teachers at Surabaya State University, which comprises 13 study programs.

The data described in the following table are the results of calculating the data descriptions of 21st-century skills dimensions, which include critical thinking, collaboration, creativity, communication, digital literacy, social skills, and leadership (Table 2).

Table 2

Description of Data

Variable	Mean	SD	Min	Max
Collaboration	33.74	3.15	24	40
Critical Thinking	32.20	3.65	22	40
Creativity	32.95	3.93	21	40
Communication	33.47	3.59	21	40
Digital Literacy	34.29	3.66	24	40
Social Skills	33.76	3.61	23	40
Leadership	31.22	3.54	23	40

Based on Table 2 above regarding the description of the dimensions of 21st century skills, the highest mean value is the digital literacy dimension of 34.29, and the lowest mean value is the leadership dimension of 31.22. Meanwhile, the highest standard deviation (SD) value is in the creativity dimension, at 3.93, and the lowest SD value is in the collaboration dimension, at 3.15. According to the SD results, it can be observed that the values on the items become increasingly accurate as the mean increases.

Meanwhile, the 21st-century skills category is based on the results of a questionnaire completed by a sample of 411 people, comprising 96 males and 315 females. The following results were obtained in Table 3.

Table 3

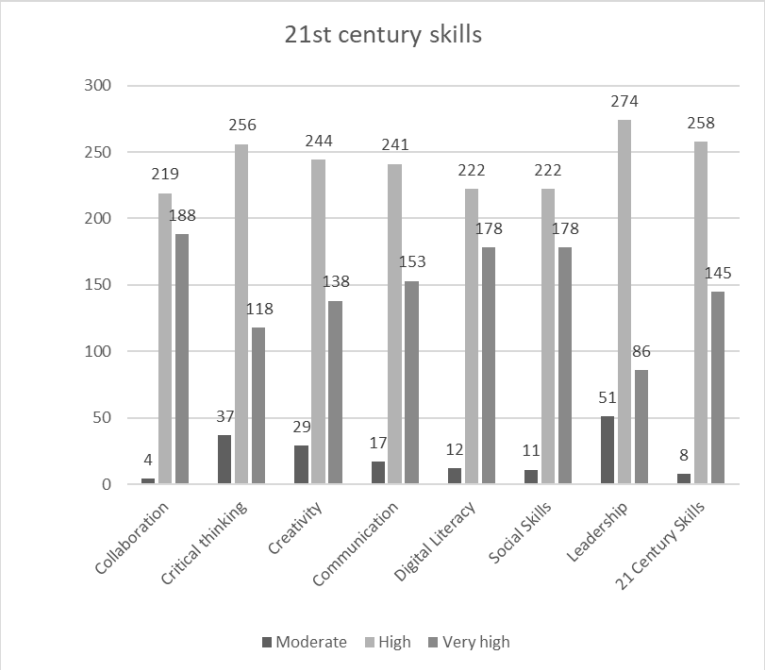
Pre-service teacher 21st century skills category

Variable	Category						Total
	Moderate		High		Very high		
	M	F	M	F	M	F	
Collaboration	0	4	49	170	47	141	411
Critical thinking	10	27	55	201	31	87	411
Creativity	5	24	53	191	38	100	411
Communication	4	13	54	187	38	115	411
Digital Literacy	3	9	51	171	43	135	411
Social Skills	2	9	51	171	43	135	411
Leadership	10	41	56	218	30	56	411
21 Century Skills	1	7	57	201	38	107	411

Based on the data above, it can be observed that the average 21st-century skills of pre-service teachers in all dimensions fall within the high category. To clarify the findings, they can be explained in the figure below:

Figure 1

Pre-service teacher 21st century skills category



The results of calculating test data for different dimensions of 21st-century skills are as follows (Table 4).

Table 4

The Mann-Whitney U test in 21st-century skills between males and females

Variable	Z	p-value	Conclusion
Collaboration	-1,432	0,152	No Difference
Critical thinking	-1,122	0,262	No Difference
Creativity	-1,439	0,150	No Difference
Communication	-0,112	0,911	No Difference
Digital Literacy	-0,562	0,574	No Difference
Social Skills	-1,126	0,260	No Difference
Leadership	-2,438	0,015	Difference

Based on Table 4 above, it can be explained that there are no differences in the six dimensions (collaboration, critical thinking, creativity, communication, digital literacy and social skill) of 21st century skills with a sig value > 0,05 and only one dimension, namely leadership, has a difference between male and female (sig 0,015 < 0,05).

Discussion and Conclusion

In the 21st century, learning demands require teachers to master 21st-century skills that will be integrated into the learning process. These skills include: critical thinking, collaboration, communication, creativity, digital literacy, social skills, and leadership. By the research results, it was found that the 21st century skills of pre-service teachers for all components were on average in the high category, with details in the medium category of 8 people (1,96%), high of 258 people (62,77%) and the highest of 145 people (35,28%). This indicates that students are prepared to enter the teaching field, enabling them to apply 21st-century skills to students and address the challenges of the 4.0 era. During the learning process, these skills must be explicitly conveyed to students. In the 21st century

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learning process, teachers need to adapt or combine the dimensions of 21st century skills (collaboration, critical thinking, communication, creativity, digital literacy, social skills and leadership) to improve their teaching and develop better teaching strategies to produce deep learning for students (Kaur et al., 2020).

According to the results of data analysis, it can be concluded that there are no significant differences in most dimensions of pre-service teachers' 21st-century skills, except for the leadership dimension. This finding aligns with research on teachers in Turkey, which indicates that there is no difference in the use of 21st-century skills among teachers based on gender or professional experience. Still, the level of 21st-century skills increases as teachers' critical thinking abilities in learning also increase (Kuloğlu & Karabekmez, 2022). As prospective professional teachers, pre-service teachers must understand the teacher's professional identity and make efforts to develop their own professional identity, improving it significantly through communication with colleagues. Training is seen as a way to redefine the professional role in the development of their teaching careers. Teachers who are aware of their roles and responsibilities are learning friends for their students, involving them in the exploration and development of knowledge, fostering positive learning attitudes, and promoting cooperation with students in facing change, acceptance, and tolerance within a learning experience. Another role of teachers in facilitating 21st-century learning is to identify four important roles: engaging students in problem-based learning, encouraging critical thinking, assisting group-based learning processes, and responding to class diversity to empower all learners to learn (differentiation) (Roshid & Haider, 2024).

There are differences in leadership dimensions. According to several studies, research results have shown significant gender-based disparities in leadership positions, highlighting the importance of increasing support, guidance, and sponsorship for females to achieve equality (Battaglia et al., 2020). A study of 92 countries found that the index for female leaders was lower than for males, due to certain cultural factors (Karol et al., 2021). UNESCO's analysis of gender gaps in leadership in the education process, using secondary data to identify the representation of females in leadership positions in the four countries studied (Iranifard & Roudsari, 2022). Various variables related to pre-service teachers can influence their opinions on 21st-century skills. For example, gender plays a role in determining the skill areas that teachers are most interested in. In this case, female teachers tend to focus more on developing flexibility, collaboration, administrative skills, and technology than their male counterparts. Teaching experience and field of study also positively influence attitudes towards these skills. Another factor that influences 21st-century skills is the willingness to develop professionalism (Kain et al., 2024). This requires adaptation to changes in the 21st century, leadership competencies and skills, and cultural change processes are essential things that need to be included in strategic plans to ensure the integrity of learning programs in schools (Alpaydın et al., 2020).

The application of teachers' 21st-century skills in the learning process is one way to innovate and adapt to the development of science. To enable the learning process to help students improve their competence and develop other skills, such as creativity, collaboration, and metacognition (Häkkinen et al., 2017). Students' future learning needs necessitate collaboration between critical thinking skills and pedagogy, making it a requirement for pre-service teachers to enhance their ability to make informed decisions that manage the learning process effectively (Häkkinen et al., 2017; Valtonen et al., 2021). In addition to facing complex problems and challenges in the 21st century, it is necessary to create effective strategies for learning and teaching. The use of effective teaching practices, such as digital learning, problem-based learning, cooperative and collaborative learning, and social-emotional learning, can be employed to achieve these goals. 21st-century learning needs to be supported by processes both inside and outside the classroom, utilizing the right systems and support. A learning environment and supporting systems must be built around the learner, family, and community (Reimers, 2021).

The research results conclude that, between males and females, there is no difference in the 21st-century skills of pre-service teachers for the dimensions of critical thinking, collaboration, communication, creativity, digital literacy, and social skills; however, differences are observed in the leadership dimension. Differences between male and female leaders are caused by differences in leadership positions and cultural factors, where the role of leadership in determining

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instructional goals, organizational school climate, and student achievement takes into account the socio-cultural context within the scope of the framework. Thus, in response to the challenges of the globalization era, it is necessary to enhance the 21st-century skills of prospective teachers through training pre-service teachers supported by qualified and experienced specialist teachers who serve as mentors. This approach should provide opportunities for continuous professional development, improve working conditions, and foster public acceptance of the profession's importance.

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Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Declaration of Helsinki, which provides guidelines for ethical research involving human participants. Ethical considerations in this study were that participation was entirely optional.

Transparency of Data

By the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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Authors' Contributions

All authors equally contribute to this study.

References

Afandi, S. A. M., & Suryani, N. (2019). Development frameworks of the Indonesian partnership: 21st-century skills standards for prospective science teachers - A Delphi study. *Jurnal Pendidikan Ipa Indonesia*, *8*(1). https://doi.org/10.15294/jpii.v8i1.11647

Alahmad, A., Stamenkovska, T., & Gyori, J. (2021). Preparing Pre-service Teachers for 21st Century Skills Education. *GiLE Journal of Skills Development*, *1*(1). https://doi.org/10.52398/gjsd.2021.v1.i1.pp67-86

Alpaydın, Y., Demirli, C., & Akgün, B. (2020). *Educational Theory in the 21st Century*. Springer. https://doi.org/10.1007/978-981-16-9640-4

Battaglia, F., Farhan, S. A., Narmeen, M., Karimuddin, A. A., Jalal, S., Tse, M., & Khosa, F. (2020). Does gender influence leadership roles in academic surgery in the United States of America? A cross-sectional study. *International Journal of Surgery*, *83*, 67-74. https://doi.org/10.1016/j.ijsu.2020.08.029

Chalkiadaki, A. (2018). A systematic literature review of 21st-century skills and competencies in primary education. *International Journal of Instruction*, *11*(3). https://doi.org/10.12973/iji.2018.1131a

Diquito, T. J., Anter, M. C. J., Bulonos, N. J., Fernando, M. R., & et al. (2022). a Survey of 21St Century Skills Acquisition Among the Preservice Teachers of Teacher Education Programs Implementing Deeper Learning and 21st Century Education Reforms Building an Education Renaissance After a Global Pandemic. *European Journal of Open Education and E-learning Studies*, *7*(2), 59-72. https://doi.org/10.46827/ejoe.v7i2.4368 10.1007/978-3-030-57039-2

González-pérez, L. I., & Ramírez-montoya, M. S. (2022). *Sustainability (Switzerland)*, *14*(3). https://doi.org/10.3390/su14031493

Gündüzalp, S. (2021). 21st Century Skills for Sustainable Education: Prediction Level of Teachers' Information Literacy Skills on Their Digital Literacy Skills. *Discourse and Communication for Sustainable Education*, *12*(1). https://doi.org/10.2478/dcse-2021-0007

Häkkinen, P., Järvelä, S., Mäkitalo-Siegl, K., Ahonen, A., Näykki, P., & Valtonen, T. (2017). Preparing teacher-students for twenty-first-century learning practices (PREP 21): a framework for enhancing collaborative problem-solving and strategic learning skills. *Teachers and Teaching: Theory and Practice*, *23*(1). https://doi.org/10.1080/13540602.2016.1203772

Hilliker, S. M., & Loranc, B. (2022). Development of 21st-century skills through virtual exchange. *Teaching and Teacher Education*, *112*. https://doi.org/10.1016/J.TATE.2022.103646

Howard, S. K., Tondeur, J., Ma, J., & Yang, J. (2021). What to teach? Strategies for Developing Digital Competency in Preservice Teacher Training. JO - Computers & Education. *165*. https://doi.org/10.1016/J.COMPEDU.2021.104149

Iranifard, E., & Roudsari, R. L. (2022). Comparative Research: An Old Yet Unfamiliar Method. https://doi.org/10.22038/jmrh.2022.66873.1954

Kain, C., Koschmieder, C., Matischek-Jauk, M., & Bergner, S. (2024). Mapping the landscape: A scoping review of 21st century skills literature in secondary education. *Teaching and Teacher Education*, *151*. https://doi.org/10.1016/J.TATE.2024.104739

Karol, D. L., Sheriff, L., Jalal, S., Ding, J., Larson, A. R., Trister, R., & Khosa, F. (2021). Gender disparity in dermatologic society leadership: A global perspective. *International Journal of Women's Dermatology*, *7*(4), 445-450. https://doi.org/10.1016/j.ijwd.2020.10.003

Kaur, C., Singh, S., Ong, E. T., Singh, T., & Singh, M. M. (2020). Quality Teachers of the 21st Century: An Overview of Theories and Practice. *International Journal of Innovation*,

Creativity and Change, *13*. https://doi.org/10.1108/IJICC-08-2020-0096

Kim, S., Raza, M., & Seidman, E. (2019). Improving 21st-century teaching skills: The key to effective 21st-century learners. *Research in Comparative and International Education*, *14*(1), 99-117. https://doi.org/10.1177/1745499919829214

Kuloğlu, A., & Karabekmez, V. (2022). The Relationship Between 21st-century Teacher Skills and Critical Thinking Skills of Classroom Teachers. *International Journal of Psychology and Educational Studies*, *9*(1), 91-101. https://doi.org/10.52380/ijpes.2022.9.1.551

List, A., Brante, E. W., & Klee, H. L. (2020). A framework of pre-service teachers' conceptions about digital literacy: Comparing the United States and Sweden. *Computers & Education*, *148*. https://doi.org/10.1016/J.COMPEDU.2019.103788

Ongardwanich, N., Kanjanawasee, S., & Tuipae, C. (2015). Development of 21st Century Skill Scales as Perceived by Students. *Procedia - Social and Behavioral Sciences*, *191*, 737-741. https://doi.org/10.1016/j.sbspro.2015.04.716

Reimers, F. M. (2021). *Implementing deeper learning and 21st-century education reforms: Building an education renaissance after a global pandemic*. Springer Nature. https://library.oapen.org/handle/20.500.12657/42936

Reyes, V. C., Reading, C., Doyle, H., & Gregory, S. (2017). Integrating ICT into teacher education programs from a TPACK perspective: Exploring perceptions of university lecturers. *Computers & Education*, *115*, 1-19. https://doi.org/10.1016/J.COMPEDU.2017.07.009

Roshid, M. M., & Haider, M. Z. (2024). Teaching 21st-century skills in rural secondary schools: From theory to practice. *Heliyon*, *10*(9). https://doi.org/10.1016/J.HELIYON.2024.E30769

Scherer, R., Siddiq, F., Howard, S. K., & Tondeur, J. (2023). Gender divides in teachers' readiness for online teaching and learning in higher education: Do women and men consider themselves equally prepared? *Computers & Education*, *199*. https://doi.org/10.1016/J.COMPEDU.2023.104774

Sepriyanti, N., Nelwati, S., Kustati, M., & Afriadi, J. (2022). The Effect Of 21st-Century Learning On Higher-Order Thinking Skills (Hots) And Numerical Literacy Of Science Students In Indonesia Based On Gender. *Jurnal Pendidikan Ipa Indonesia*, *11*(2), 314-321. https://doi.org/10.15294/jpii.v11i2.36384

Spector, J. M., Merrill, M. D., Elen, J., & Bishop, M. J. (2014). *Handbook of research on educational communications and technology: Fourth edition*. Handbook of Research on Educational Communications and Technology: Fourth Edition. https://doi.org/10.1007/978-1-4614-3185-5

Sulaiman, J., & Ismail, S. N. (2020). Teacher competence and 21st century skills in transformation schools 2025 (TS25). *Universal Journal of Educational Research*, *8*(8), 3536-3544. https://doi.org/10.13189/ujer.2020.080829

Timenko, M. (2021). 21st Century SKILLS IN SCHOOL EDUCATION IN THE UNITED KINGDOM. *THE SOURCES OF PEDAGOGICAL SKILLS*, *26*. https://doi.org/10.33989/2075-146x.2020.26.227654

Valtonen, T., Hoang, N., Sointu, E., Näykki, P., Virtanen, A., Pöysä-Tarhonen, J., Häkkinen, P., Järvelä, S., Mäkitalo, K., & Kukkonen, J. (2021). How pre-service teachers perceive their 21st-century skills and dispositions: A longitudinal perspective. *Computers in Human Behavior*, *116*. https://doi.org/10.1016/j.chb.2020.106643

van Laar, E., van Deursen, A. J. A. M., van Dijk, J. A. G. M., & de Haan, J. (2020a). Determinants of 21st-Century Skills and 21st-Century Digital Skills for Workers: A Systematic Literature Review. *Sage Open*, *10*(1). https://doi.org/10.1177/2158244019900176

van Laar, E., van Deursen, A. J. A. M., van Dijk, J. A. G. M., & de Haan, J. (2020b). Measuring the levels of 21st-century digital skills among professionals working within the creative industries: A performance-based approach. *Poetics*, *81*, 101434. https://www.sciencedirect.com/science/article/pii/S0304422X19300956

Varas, D., Santana, M., Nussbaum, M., Claro, S., & Imbarack, P. (2023). Teachers' strategies and challenges in teaching 21st-century skills: Little common understanding. *Thinking Skills and Creativity*, *48*. https://doi.org/10.1016/J.TSC.2023.101289

Zhong, Y., Guo, K., Su, J., Chu, S. K. W., & Zubaidah, S. (2022). The impact of esports participation on the development of 21st century skills in youth: A systematic review 21st Century Skills: Skills Taught Through Learning. *Computers & Education*, *191*, 1-17. https://doi.org/10.1016/J.COMPEDU.2022.104640