Examine Students' 21st Century Skills in Team-Based Project Learning: Evidence from Indonesian Higher Education

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Abstract
This research aims to find a portrait of students' 21st-century skills after attending mandatory curriculum courses that apply the team-based project learning method at one of state university at Semarang, Indonesia. This research applies a quantitative approach with a survey research type. The population in this study was 250 students who came from a pilot class implementing mandatory project-based curriculum courses. The sampling technique applied in this research is a saturated sampling technique involving the entire population in data collection. The data in this research was collected using a questionnaire that was analyzed descriptively. The research results showed that 82.55% of students were minimally competent in all 21st-century skills surveyed (communication, collaboration, critical thinking, and creative thinking). Collaboration skills obtained the highest percentage, namely 90.91%. Meanwhile, communication skills obtained the lowest 78.37% compared to the other three skills. Generally, the portrait of 21st-century skills of students who have taken part in learning that applies to the team-based project method leads to positive data. This research will be more valid if the number of research samples can be increased.

1. Introduction

21st-century skills are an important aspect of preparing competent human resources in this era of globalization. These 21st-century skills are known as 4C: communication, collaboration, critical thinking, and creative thinking (Montessori et al., 2023). These four skills equip students to have the skills to become skilled communicators, creative creators, critical thinkers, and adaptive collaborators, in addition to having mastery of basic skills such as reading, writing, and arithmetic (Kurniasih et al., 2022). Human resources equipped with four 21st-century skills can easily survive and adapt to the dynamic era of globalization with uncertain conditions. Providing human resources with 21st-century skills can be done by integrating these four skills in learning activities at all levels of education in Indonesia, from basic to higher education.

Higher education, as the final peak of education, has a central role in preparing quality human resources because it is directly related to determining a person's career (Khaeruman et al., 2023). This implies that graduates from tertiary institutions are prepared to face job competition in various sectors of life (Makhin, 2021). The current situation, which is so close to the speed of information acquisition, digital literacy, development of creativity, and independent learning, provides a challenge for higher education institutions to truly prepare their graduates with the skills needed according to the existing situation and conditions (Abbas & Marwa, 2023). This indicates that students in the 21st century have at least mastered 21st-century skills to become quality human resources ready to face the challenges and competition of the world of work in the global era.

Mastery of 21st-century skills can be achieved through the provision provided to students while attending lectures. Efforts to improve students' 4C skills can be made with various approaches, such as updating the curriculum, learning through research, implementing active learning models that are student-centered, and using learning media that utilizes advanced information and communication technology (ICT) and can also by combining all or some of these alternatives (Elisa & Wiratmaja, 2019; Kembara et al., 2019). In addition, through decision Number 3/M/2021 concerning Main Performance Indicators for State Universities and Higher Education Service Institutions, the Ministry of Education and Culture emphasizes collaborative learning and authentic student experiences (Ahmar, 2023). Therefore, quality learning strategies and methods are needed to produce human resources with character, excellence, and attitude skills. This encourages university to design and implement innovative learning involving students in higher-level thinking activities and a better understanding of learning content. The form of innovative learning applied in learning is the team-based project method.

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Ahmadi and Yulianto (2017) stated that educators (lecturers) can use the team-based project method to improve problem-solving abilities and develop student competencies. The team-based project learning method is an active learning method through small groups both in and outside of class. Team-based project learning is an innovative method involving project work where students observe, discover, research, and solve problems and find solutions to existing problems (Syam, 2022). This learning method supports students in analyzing a problem and trying to find a solution in the form of product output. Applying team-based project learning is very important for students to improve their analytical skills with solutions with clear recommendations (Farindhani & Wangid, 2019). Thus, this creates student-centered learning, where students build their learning process, which is then translated into an actual project or product. The advantages of the team-based project method that have been mentioned are relevant in efforts to equip students with 21st-century skills (You, 2024). Through the team-based project learning method, students can hone these four skills.

Based on the description above, implementing the team-based project learning method at university is an effort to equip students with 21st-century skills. This method has been applied to all mandatory curriculum courses at university so that it can become a source of research data. This research aims to find a portrait of students' 21st-century skills after attending lectures that apply the team-based project learning method at one of the state university at Semarang, Indonesia. Thus, the research results obtained can be a basis for evaluating the application of this method so that it can be implemented optimally.

2. Method

This research applies a quantitative approach with a survey research type. This survey research aims to describe the 21st-century skills of students taking mandatory project-based curriculum courses. The population in this study was 250 students who came from a pilot class implementing mandatory project-based curriculum courses at one of the state university at Semarang and from different study programs and faculties. The sampling technique applied in this research is a saturated sampling technique involving the entire population in data collection. The saturated sampling technique aims to minimize errors in generalizing research data. The research results in the form of survey data will provide mapping data on students' 21st-century skills to be used as a basis for designing projects in learning mandatory curriculum subjects that can improve students' skills.

The data in this research was collected using a questionnaire technique. The type of questionnaire used to determine students' 21st-century skills is a closed questionnaire where respondents choose the answers provided by the researcher an adaption from Purnawirawan et al. (2019), who developed an instrument for assessing 21st-century skills. Four skills were surveyed, including communication, collaboration, critical thinking, and creative thinking, and they were then distributed into thirty-five statements. The questionnaire is a Likert scale consisting of five alternative answer choices: extraordinarily competent, competent, exceptionally competent, less competent, and not competent. The validity and reliability of the questionnaire are 0.62 and 0.88, which fall into the valid and reliable categories. Data analysis in this research uses descriptive analysis. The descriptive analysis describes students' 21st-century skills in mandatory project-based curriculum classes, which are classified into several categories.

3. Results and Discussion

21st-century skills, which include communication, collaboration, critical thinking, and creative thinking, are the focus of higher education to prepare students who are professionally competent and ready to face the demands of the ever-growing world of work. Implementation of Team-based Project Learning provides opportunities for students to develop these four skills through learning activities. The following is a description of each student's 21st-century skills from the results of the data collection that has been carried out.

3.1. Students' Communication Skills in Implementing Team-based Project Learning

Students show a tendency to have competent communication skills, as shown in the results of the questionnaire. The average percentage in the very competent category was 20.07%, while those categorized as competent reached 58.3%. However, there is also a percentage of 20.81% who are classified as less competent and only 0.80% who are declared incompetent. The average communication skills score reached 78.37, which shows the potential for further improvement of students' communication skills. Communication skills are students' ability to convey ideas and information clearly and respond effectively to suggestions when communicating with other people. The survey results regarding the communication skills of students who have taken courses that implement team-based projects are presented in Figure 1.

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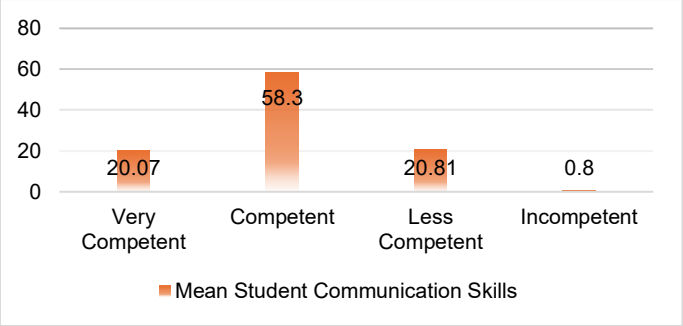

Figure 1. Mean Student's Communication Skills

Several indicators used in assessing student communication skills include expressing ideas well orally and in writing, conveying opinions firmly, giving clear instructions, and inspiring others through speaking skills. Communication skills are one of the competencies that students need to master and continue to train to be ready to face the challenges of the 21st century. Higher education has an essential role in preparing students with skills relevant to the demands of the times. Integrating learning methods that encourage the development of students' communication skills can be done through group discussion activities, project presentations, and teamwork. Improving students' communication skills can equip them to develop themselves to compete in the world of work.

3.2. Students' Collaboration Skills in Implementing Team-based Project Learning

The next 21st-century skill that is tried to be measured is collaboration skills. The results of surveys that have been conducted show that more than 90% of students have excellent collaboration and teamwork skills. Survey data shows that only 9.09% have collaboration skills, which fall into the less competent and incompetent categories, with figures of 8.65% and 0.45%. Based on the survey data presented shows that students who have taken courses that apply the team-based project method tend to have good collaboration skills. The technique has honed students' ability to work synergistically in groups, respect everyone's contribution to the group, adapt to various productive roles and responsibilities, and have empathy by respecting different points of view in effectively achieving common goals. The presentation of data related to student collaboration skills in implementing the team-based project method can be seen in Figure 2.

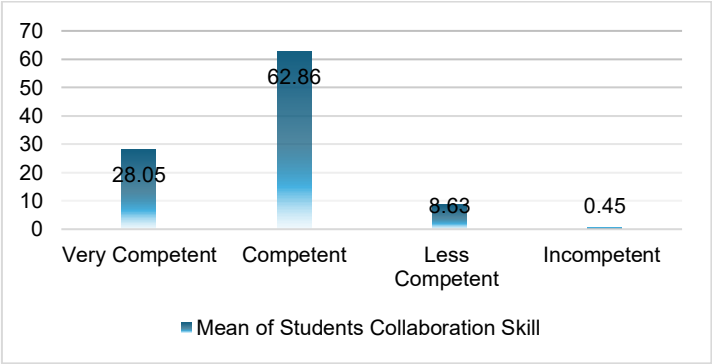

Figure 2. Mean of Student's Collaboration Skills

Collaboration skills applied in groups are a component of implementing the team-based project learning method. The presentation of survey data showing positive results from using the team-based project method in learning proves that the technique successfully equips students to master collaboration skills. Understanding and applying practical collaboration skills is essential in supporting the common goals the group wishes to achieve. These collaboration skills ensure students can contribute optimally in complex and dynamic teamwork contexts. Thus, implementing team-based project learning becomes an effective means of supporting and improving student collaboration skills.

3.3. Students' Critical Thinking Skills in Implementing Team-based Project Learning

Critical thinking skills are the 21st-century skills surveyed. The survey results show that the third skill also shows positive data. More than 80% of students have critical thinking skills that fall into the competent and competent category, and the remaining 19% fall into the less incompetent category. Applying the team-based project method in learning provides students with experience in analyzing information carefully, evaluating

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arguments correctly, and making decisions based on evidence and logical thinking. Data showing the critical thinking skills of students who have applied the team-based project method in learning is presented below in Figure 3.

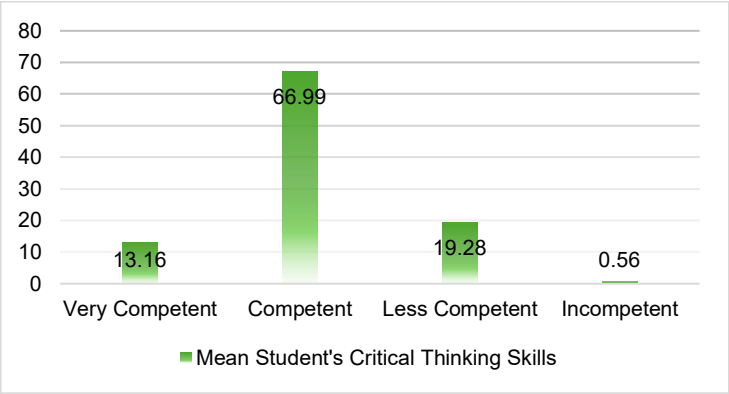

Figure 3. Mean of Student's Critical Thinking Skills

Critical thinking skills include accessing, analyzing, and synthesizing information that can be learned, practiced, and mastered. Critical thinking skills are not static but can be learned, practiced, and mastered. Students can develop their skills in analyzing and evaluating to respond effectively to environmental changes. Strong critical thinking skills can equip students to be better prepared to face complex dynamics in work and everyday life. Critical thinking skills are essential in an academic context and in facing challenges in the 21st century. The current situation, which is filled with rapidly developing information and unexpected changes, can be faced by students by mastering this skill. Applying the team-based project method provides students with experience in processing, interpreting, and making decisions based on rational and logical thinking. Therefore, higher education emphasizes developing critical thinking skills by applying innovative learning methods.

3.4. Students' Creative Thinking Skills in Implementing Team-based Project Learning

The last 21st-century skill surveyed was creative thinking skills. The survey results show the same positive trend as the three previous skills. As many as 80.78% of students have creative thinking skills categorized as competent and competent. 19.22% fell into the inadequate and incompetent category. Applying the team-based project method stimulates students to produce new ideas and innovative solutions in working on projects in learning. Students get the opportunity to solve problems by providing alternative solutions based on the results of their thinking in groups. An illustration of students' creative thinking skills in implementing the team-based project learning method can be seen in Figure 4.

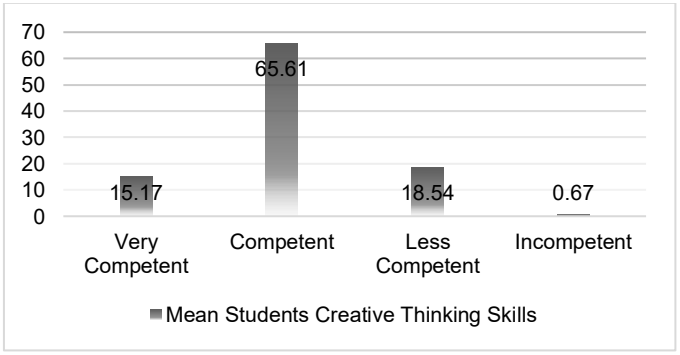

Figure 4. Mean of Student's Creative Thinking Skills

Students' creative thinking skills, such as understanding creative challenges, identifying sources of information, generating and selecting ideas, having original ideas, and providing valuable and practical solutions, have been indirectly honed through the application of the team-based project method in learning. Students can continue to develop their creativity in more depth. This makes a significant contribution to personal progress and can act as an agent of change who can solve complex challenges and provide innovative solutions in the form of clear and professional recommendations according to the problems that need to be resolved. Creative thinking skills are essential in finding solutions to problems and opening the door to new thinking, revolutionary ideas, and inspiring projects. Thus, creative abilities are essential and a provision for students facing everyday life problems.

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3.5. Portrait of Students' 21st Century Skills in Implementing Team-based Project Learning

Learning in mandatory project-based curriculum courses or implementing team-based projects is a learning method that can stimulate and provide opportunities for students to develop 21st-century skills that every individual needs to become quality and substantial human resources. This is evident from the survey results at the end of the lecture, which applied the team-based project method, showing a positive tendency related to students' 21st-century skills. The four skills, which include communication, collaboration, critical thinking, and creative thinking, are generally possessed by students who apply project-based learning in mandatory curriculum subjects. The percentage achievement of each skill for the highly competent and competent categories includes 78.37% for communication skills, 90.91% for collaboration skills, 80.15% for critical thinking skills, and 80.87% for creative thinking skills (see Figure 5). These four figures mean that more than 75% of students who have taken part in learning that applies the team-based project method have 21st-century skills honed during the learning process.

In general, when students participate in a learning process that applies project-based learning, they practice communicating effectively with their groups when carrying out projects. Students can also understand their roles and tasks in carrying out assigned projects. Analyzing the factors that cause problems and determining appropriate alternative solutions have also been honed through critical thinking activities. Submission of ideas to resolve problems contained in the project has also been carried out. These four skills are interrelated as preparations for becoming quality human resources in the 21st century.

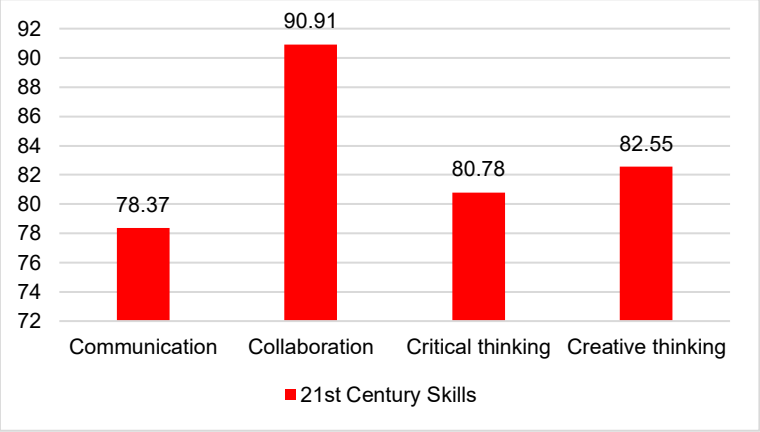

Figure 5. Portrait of Students' 21st Century Skills

3.6. Discussion

This research shows that students who have taken mandatory project-based curriculum courses (team-based project learning) have good 21st-century communication, collaboration, critical thinking, and creative thinking skills. These four skills are important for students to prepare themselves to face various challenges in the future. This finding aligns with the statement by Fernandes et al., (2021) that the application of team-based project learning can increase student awareness of managing projects more effectively through teamwork. Students are trained to communicate effectively with group members by efficiently conveying ideas, exchanging information, and solving problems (Tangahu et al., 2021; Tekad & Pebriana, 2022). Through collaborative team activities, students learn to appreciate different perspectives, hone listening skills, and develop persuasive speaking skills (Bandono, 2020; Hasan et al., 2023; Kembara et al., 2019; Sirait & Amnie, 2023). In group projects, students learn to work synergistically in teams, appreciate individual contributions, and achieve common goals effectively through critical thinking (Aristin & Purnomo, 2022; Espey, 2018; Listiqowati et al., 2022; Picard et al., 2022). In addition, group project assignments encourage students to think outside of the box, create new ideas, and produce innovative solutions (Biazus & Mahtari, 2022; Fajri et al., 2023; Illahi et al., 2022; Le, 2023). Collaborating with teammates can combine different perspectives and experiences to create creative and effective solutions.

The implementation of team-based project learning facilitates students in assigning tasks, monitoring performance, visual management, and feedback, which positively impacts individual abilities and team performance. The opinion Rahmadi et al., (2022) states that applying the case method and team-based projects is an effective learning method and can support and provide opportunities for students to improve their skills, including creative skills, critical thinking skills, communication skills, and collaboration skills. Apart from that, research by Rosidah and Pramulia (2021) shows that the team-based project learning method effectively increases active student participation, which aims to develop student skills, including critical thinking, creativity, collaboration, and communication. This participation has a positive impact on team or group

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performance and is also beneficial for individual students. Implementing team-based projects is related to daily life to train high social skills and foster students' leadership spirit (Taufiqur Rahman et al., 2023). Implementing the team-based project learning method effectively improves 21st-century skills: communication, critical thinking, creativity, and student collaboration.

4. Conclusion

The portrait of students' 21st-century skills in implementing mandatory project-based curriculum courses or team-based project learning shows positive data. The percentage of students who fall into the minimally competent category is 82.55% for all 21st-century skills surveyed. The four skills, which include communication skills, collaboration, critical thinking, and creative thinking, generally fall into the minimum competent category with different percentages from one another. Collaboration skills obtained the highest percentage, namely 90.91%. Meanwhile, communication skills obtained the lowest percentage of 78.37% compared to the other three skills. These data show that, in general, students who take mandatory project-based curriculum courses have competence in mastering 21st-century skills. Research involving students in its implementation provides information and descriptions of data regarding student competencies toward 21st-century skills in implementing mandatory project-based curriculum courses. However, this data still requires further comprehensive study to see the relationship between implementing project-based learning and students' 21st-century skills. The number of research samples involved in data collection is limited to pilot class students from mandatory curriculum courses, so the research results will be more valid if the number of samples involved is more significant.

Author Contributions

All authors have equal contributions to the paper. All the authors have read and approved the final manuscript.

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Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/ or publication of this article.

Data Availability

The datasets generated during and/ or analyzed during the current study are available from the corresponding author on reasonable request.

Declaration on AI Use

The authors declare that no artificial intelligence (AI) or AI-assisted tools were used in the preparation of this manuscript.

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References

Abbas, M. F. F., & Marwa, M. (2023). Investigasi persepsi mahasiswa terhadap literasi digital dalam memenuhi tuntutan keterampilan abad 21. *Jurnal Pendidikan, 11*(2), 261–270. https://doi.org/10.36232/pendidikan.v11i2.3987

Ahmadi, A., & Yulianto, B. (2017). Descriptive-analytical studies of literacy movement in Indonesia, 2003–2017. *International Journal of Humanities and Cultural Studies, 4*(3), 16–24.

Ahmar, N. (2023). Pengembangan pembelajaran kolaboratif Pancasila dan Kewarganegaraan di perguruan tinggi. *Jurnal Aktualisasi Pancasila, 1*(1), 43–54. https://journal.univpancasila.ac.id/index.php/jap/article/view/5967

Aristin, N. F., & Purnomo, A. (2022). Improving critical thinking skill through team-based projects, is it effective? *Journal of Education Research and Evaluation, 6*(4), 586–594. https://doi.org/10.23887/jere.v6i4.48090

Bandono, A. (2020). The success of team collaboration in supporting systems for development of project management learning model. *International Journal of Progressive Sciences and Technologies, 24*(1), 385–393. http://ijpsat.ijsht-journals.org

Biazus, M. de O., & Mahtari, S. (2022). The impact of project-based learning (PjBL) model on secondary students' creative thinking skills. *International Journal of Essential Competencies in Education, 1*(1), 38–48. https://doi.org/10.36312/ijece.v1i1.752

ISSN: 2797-3174

Elisa, E., & Wiratmaja, I. G. (2019). Augmented reality: Analisis pengembangan media pembelajaran kimia untuk meningkatkan keterampilan 4C mahasiswa. *Journal of the Indonesian Society of Integrated Chemistry, 11*(2), 73–81. https://doi.org/10.22437/jisic.v11i2.8124

Espey, M. (2018). Enhancing critical thinking using team-based learning. *Higher Education Research and Development, 37*(1), 15–29. https://doi.org/10.1080/07294360.2017.1344196

Fajri, G., Ginting, E., & Simanjuntak, M. P. (2023). The effect of the project based learning-STEM model on students critical and creative thinking skills. *JPBI (Jurnal Pendidikan Biologi Indonesia), 9*(3), 244–255. https://doi.org/10.4108/eai.19-9-2023.2340544

Farindhani, D. A., & Wangid, M. N. (2019). Scientific-based pictorial storybook with project-based learning method for improving the critical thinking skills of elementary school students. *Jurnal Prima Edukasia, 7*(1), 94–105. https://doi.org/10.21831/jpe.v7i1.8807

Fernandes, S., Dinis-Carvalho, J., & Ferreira-Oliveira, A. T. (2021). Improving the performance of student teams in project-based learning with scrum. *Education Sciences, 11*(8), Article 444. https://doi.org/10.3390/educsci11080444

Hasan, M., Arisah, N., Ratnah S., Ahmad, M. I. S., & Miranda. (2023). Experiential learning model for the development of collaborative skills through project based learning practicum. *JPI (Jurnal Pendidikan Indonesia), 12*(2), 340–349. https://doi.org/10.23887/jpiundiksha.v12i2.57376

Illahi, P. C., Fitri, R., & Arsih, F. (2022). The effect of project based learning model on creative thinking ability in biol ogy learning. *Journal of Digital Learning and Education, 2*(3), 171–177. https://doi.org/10.52562/jdle.v2i3.441

Kembara, M., Rozak, R. W., & Hadian, V. A. (2019). Research-based lectures to improve students' 4C (communication, collaboration, critical thinking, and creativity) skills. *Advances in Social Science, Education and Humanities Research, 306*, 22–26. https://doi.org/10.2991/icollite-18.2019.50

Khaeruman, K., Hubeis, M., & Yusnita, N. (2023). Human resources management strategy and its role to improve lecturer performance in developing. *International Journal of Economy, Education and Entrepreneuship, 3*(1), 333–343. https://doi.org/10.53067/ije3.v3i1.148

Kurniasih, M. D., Utami, A. D., Prajoko, S., & Salma, A. (2022). Pengembangan buku panduan mini riset mandiri berbasis keterampilan 4C untuk mata kuliah reproduksi dan embriologi tumbuhan. *Bioedusains: Jurnal Pendidikan Biologi dan Sains, 5*(1), 255–266. https://doi.org/10.31539/bioedusains.v5i1.3530

Le, S. (2023). Team-based learning in online education: The development of students' creative thinking skills in digital art. *Education and Information Technologies, 28*(11), 14967–14986. https://doi.org/10.1007/s10639-023-11808-3

Listiqowati, I., Budijanto, Sumarmi, & Ruja, I. N. (2022). The impact of project-based flipped classroom (PjBFC) on critical thinking skills. *International Journal of Instruction, 15*(3), 853–868. https://doi.org/10.29333/iji.2022.15346a

Makhin, M. (2021). Hybrid learning: Model pembelajaran pada masa pandemi di SD Negeri Bungurasih Waru Sidoarjo. *Mudir: Jurnal Manajemen Pendidikan, 3*(2), 95–103. https://doi.org/10.55352/mudir.v3i2.312

Montessori, V. E., Murwaningsih, T., & Susilowati, T. (2023). Daring pada mata kuliah simulasi bisnis. *JIKAP: Jurnal Informasi dan Komunikasi Administrasi Perkantoran, 7*(1), 65–72. https://doi.org/10.20961/jikap.v7i1.61415

Picard, C., Hardebolle, C., Tormey, R., & Schiffmann, J. (2022). Which professional skills do students learn in engineering team-based projects? *European Journal of Engineering Education, 47*(2), 314–332. https://doi.org/10.1080/03043797.2021.1920890

Purnawirawan, O., Sudana, I. M., & Harlanu, M. (2019). Assessment of 4C softskills characteristics in learning productive graphic design subject for vocational school. *Journal of Vocational Career Education, 4*(1), 53–60. https://journal.unnes.ac.id/nju/index.php/jvce

Rahmadi, M. T., Nurman, A., Yuniastuti, E., Pinem, M., Berutu, N., Rahmadi, M. T., Maulia, T., Ginting, M. R. P., & Saqina, D. (2022). Analisis penerapan case method dan team based project dalam kebijakan jurusan di Universitas Negeri Medan. *Publikauma: Jurnal Administrasi Publik Universitas Medan Area, 10*(2), 137–143. https://doi.org/10.31289/publika.v10i2.8348

Rahman, T., Fitria, N., Nurhidayah, E., & Yuliandani, I. (2023). Effects of project-based learning on employability skills. *Review of Islamic Studies, 2*(1), 1–10. https://doi.org/10.35316/ris.v2i1.473

Rosidah, C. T., & Pramulia, P. (2021). Team based project dan case method sebagai strategi pengembangan keterampilan mengembangkan pembelajaran mahasiswa. *MENDIDIK: Jurnal Kajian Pendidikan dan Pengajaran, 7*(2), 245–251. https://doi.org/10.30653/003.202172.196

Sirait, J. V., & Amnie, E. (2023). Analysis of students' collaboration skills through project-based learning model. *Gagasan Pendidikan Indonesia, 4*(1), 43. https://doi.org/10.30870/gpi.v4i1.19836

Syam, S. (2022). Penerapan case method dalam meningkatkan hasil belajar mahasiswa. *Jurnal Ilmiah Mandala Education, 8*(2), 1397–1401. https://doi.org/10.58258/jime.v8i2.3127

Tangahu, W., Rahmat, A., & Husain, R. (2021). Modern education in revolution 4.0. *International Journal of Innovations in Engineering Research and Technology, 8*(1), 3–7. https://repo.ijiert.org/index.php/ijiert/article/view/2/1

Tekad, T., & Pebriana, R. (2022). Pengaruh model pembelajaran team-based project terhadap keterampilan komunikasi dan keterampilan kolaborasi pada mata kuliah Bahasa Indonesia. *Jurnal PTK dan Pendidikan, 7*(2). https://doi.org/10.18592/ptk.v7i2.5445

ISSN: 2797-3174

You, J. W. (2024). Relationship between team learning profiles and outcomes in team project-based learning: A cluster analysis. *Studies in Higher Education, 49*(1), 16–32. https://doi.org/10.1080/03075079.2023.2219298

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