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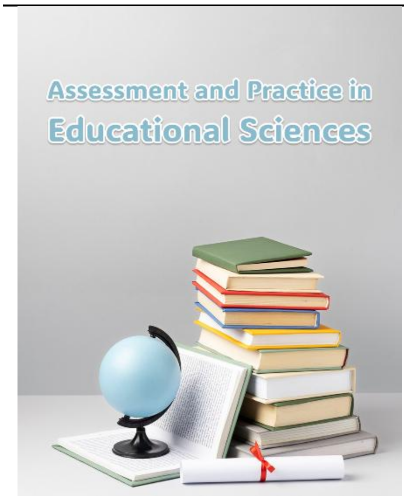

Identification of the Components of a Project-Based Curriculum Model with an Emphasis on the Task-Oriented Approach in Technical and Vocational Education

ABSTRACT

The present study aimed to identify the components of a project-based curriculum model in technical and vocational education. This study was conducted as a systematic review with the purpose of identifying and analyzing curriculum components in higher education. The statistical population consisted of scientific articles published between 2015 and 2024 in the fields of curriculum planning, innovative teaching methods, and learning theories. The search was carried out in reputable international and Persian databases using a combination of keywords. Articles were screened in three stages based on specific inclusion and exclusion criteria, and quality assessment was performed using the PRISMA checklist. Data were analyzed through descriptive qualitative content analysis, and the findings were extracted in the form of thematic categories. The findings revealed that the curriculum based on project-based learning with a task-oriented approach in technical and vocational education comprises three key dimensions. The first dimension, project-based learning, emphasizes experience, problem-solving, and the production of public products, thereby enhancing critical thinking and creativity skills. The second dimension, task-oriented learning, establishes the connection between theoretical knowledge and practical skills through preparation, task execution, and post-action reflection. The third dimension pertains to curriculum development, focusing on industry participation, the integration of technical and soft skills, and flexible learning pathways. Overall, the study results indicate that integrating project-based and task-oriented approaches can provide a comprehensive model for designing innovative curricula in technical and vocational education. Such a model not only enhances specialized knowledge and skills but also ensures responsiveness to the evolving needs of industry and society.

Keywords: curriculum, technical and vocational skills, project-based learning, systematic review

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Introduction

In the 21st century, the landscape of education—particularly in technical and vocational training—has undergone a profound transformation due to rapid technological advances, evolving labor market demands, and the need for learners to acquire not only technical competencies but also adaptive, problem-solving, and creative skills (1). Traditional instructional models centered on rote memorization and teacher-centered instruction have proven insufficient for preparing learners to navigate increasingly complex professional contexts (2). As such, *Project-Based Learning (PBL)* has emerged as a powerful pedagogical framework capable of bridging the gap between theory and practice through authentic, inquiry-driven, and collaborative learning experiences (3). This paradigm emphasizes the learner's active engagement in the design, implementation, and reflection of projects that simulate real-world challenges, thereby fostering a deeper understanding of knowledge construction (4).

Over the last decade, scholars have increasingly recognized the effectiveness of PBL in promoting critical thinking, creativity, and practical competencies across diverse educational levels and disciplines (5, 6). As demonstrated by meta-analytical findings, PBL not only enhances academic achievement but also strengthens learners' motivation, autonomy, and metacognitive awareness (7). In contrast to conventional pedagogies, PBL positions learners as active problem-solvers who construct their own understanding through iterative project cycles involving planning, execution, and evaluation (8). This constructivist underpinning is consistent with Dewey's philosophy of experiential learning and Vygotsky's social interactionist theories (9), highlighting that learning occurs most effectively through experience, reflection, and collaboration.

At its core, project-based learning aligns closely with the constructivist paradigm by situating knowledge within authentic contexts that require active inquiry and decision-making (10). It provides opportunities for learners to explore interdisciplinary problems that mirror real-life conditions, thereby encouraging transferability of knowledge and skills (11). Recent research has shown that such an approach not only cultivates technical expertise but also supports the development of communication, teamwork, and problem-solving skills that are essential for professional adaptability in today's globalized workforce (12). In vocational settings, these outcomes are particularly crucial, as graduates must demonstrate both conceptual understanding and the capacity to perform complex, task-oriented functions in dynamic work environments (13).

Moreover, the integration of *task-based learning (TBL)* principles within project-based frameworks has gained increasing attention as a means to enhance learner engagement and performance outcomes (14). TBL emphasizes the completion of meaningful, goal-directed tasks that replicate authentic workplace activities, fostering the application of theoretical knowledge in practical contexts (15). This approach supports learners' transition from passive recipients of information to active performers capable of critical analysis, planning, and self-evaluation (16). When combined, PBL and TBL form a synergistic model that unites inquiry-driven exploration with structured task performance, thereby strengthening both cognitive and procedural dimensions of learning (17).

The growing relevance of PBL and TBL in vocational education has also been linked to advances in digital technology and the emergence of hybrid and online learning environments (18). Modern educational technologies—such as learning management systems, digital simulation tools, and collaborative platforms—have made it possible to extend the benefits of PBL to virtual contexts while maintaining authenticity and learner agency (19). In particular, the integration of digital project management tools has enabled students to coordinate group efforts, track progress, and reflect on their contributions in real time (20). These developments are essential for vocational education systems that aim to produce graduates who can adapt to technology-driven industries while maintaining human-centered competencies (21).

Another critical factor influencing the success of project-based approaches is the degree of *industry participation* in curriculum design and implementation (22). Vocational programs that involve partnerships with employers, industrial experts, and professional associations are better equipped to ensure the relevance and applicability of educational outcomes (23). Through these collaborations, learners gain exposure to authentic professional challenges, thereby developing employability and entrepreneurial skills (5). The inclusion of industry stakeholders in curriculum development also enhances the feedback loop between educational institutions and labor markets, aligning learning objectives with evolving economic and technological realities (24).

In addition to aligning with labor market needs, project-based learning supports the holistic development of learners by emphasizing emotional intelligence, social interaction, and reflective practice (6). Studies in early and higher education contexts have demonstrated that PBL nurtures interpersonal communication and empathy through collaborative engagement (25). By confronting real-life challenges and working collectively toward shared goals, students develop a sense of responsibility and professional ethics that extend beyond technical proficiency (26). Such soft skills are essential for effective teamwork, leadership, and adaptability in modern organizations (27).

Within technical and vocational education, the integration of *task orientation* into project-based models is particularly critical because it ensures that learning remains directly connected to job performance (12). The TBL dimension focuses on sequencing learning experiences through structured stages of preparation, task execution, and post-task reflection (14). This structure mirrors the workflow of professional practice, enabling learners to develop habits of continuous improvement and self-assessment (28). Moreover, the reflective phase promotes metacognitive awareness, allowing students to evaluate their strategies and outcomes in alignment with both academic and professional standards (13).

Recent literature underscores the importance of flexibility and personalization in implementing project- and task-based models, especially in the context of diverse learner needs and rapidly changing industrial environments (12). Flexible learning pathways supported by digital tools enable learners to pursue individualized trajectories while maintaining alignment with curriculum goals (18). As (7) and (19) emphasize, this flexibility not only enhances learner autonomy but also improves engagement and persistence, particularly in online or hybrid modalities. Furthermore, technological integration helps preserve experiential authenticity through simulations, virtual labs, and augmented reality experiences that mirror real-world scenarios (20).

The meta-analytic findings presented by (7) provide strong empirical support for the effectiveness of PBL in improving student learning outcomes, especially in technical fields that demand the integration of theoretical and procedural knowledge. Similarly, (4) and (3) argue that embedding engineering design processes within project-based contexts fosters not only domain-specific skills but also systems thinking and creative problem-solving. These findings resonate with (29), who demonstrated that PBL enhances students' self-efficacy and academic engagement through experiential learning cycles. Additionally, (11) and (9) highlight how technology-enhanced PBL supports vocabulary development, social identity, and metacognitive growth, demonstrating the model's cross-disciplinary versatility.

Despite the strong evidence supporting PBL's educational benefits, its successful implementation depends heavily on the readiness of instructors and institutions to adopt learner-centered paradigms (17). The shift from traditional didactic instruction to PBL requires educators to take on roles as facilitators, mentors, and designers of authentic learning experiences (16). As (27) points out, national smart learning platforms and digital infrastructures can play a pivotal role in supporting teachers through resources, collaborative tools, and analytics that track learner progress. Furthermore, institutional support—including administrative commitment, resource allocation, and professional development—is essential to sustain project-based reforms (22).

An additional layer of complexity arises when integrating PBL and TBL within multicultural or multilingual educational settings, where learners' prior experiences and cultural expectations shape their engagement (15). Studies conducted in English as a Foreign Language (EFL) contexts have revealed that project-based approaches significantly improve reading comprehension, vocabulary acquisition, and collaborative communication when properly scaffolded (16). Similarly, (6) and (5) demonstrate that these methods enhance entrepreneurial thinking and creativity, equipping students to generate innovative solutions within real-world constraints.

In this evolving landscape, *design thinking* has also emerged as a complementary framework that strengthens the problem-solving and innovation potential of PBL (23). By emphasizing empathy, ideation, prototyping, and testing, design thinking enriches project-based pedagogies with user-centered approaches that align with professional design and engineering practices.

This synergy further reinforces the value of PBL as a comprehensive model capable of integrating technical, cognitive, and emotional dimensions of learning (24).

Ultimately, the confluence of project-based, task-based, and technology-enhanced learning models reflects the global trend toward competency-based education that prioritizes learner autonomy, creativity, and employability (1, 2). Within technical and vocational education, these frameworks provide a foundation for cultivating lifelong learners who can adapt to continuous industrial transformation, contribute innovatively to their professions, and collaborate effectively across disciplines and cultures (20, 27).

The present study aims to identify and analyze the components of a project-based curriculum model with an emphasis on a task-oriented approach in technical and vocational education.

Methods and Materials

The present study, in terms of its objective, falls within the category of developmental–applied research and, in terms of nature, adopts a mixed-methods approach with a qualitative dominance. To answer the first research question, the *Systematic Review* method was employed, which is specifically suitable for collecting, analyzing, and synthesizing findings from prior studies in defined scientific domains. The statistical population of this study comprised all scientific articles published between 2015 and 2024 related to the fields of *curriculum planning*, *innovative teaching methods*, and *learning theories*. These articles were collected through a systematic search in reputable international databases such as *Web of Science*, *Scopus*, *ProQuest*, *ERIC*, *SpringerLink*, *Taylor & Francis Online*, and *ScienceDirect*, as well as in authoritative Persian databases such as *Noormags*, *Magiran*, *IranDoc*, and *SID*.

To ensure comprehensiveness and precision, both English and Persian main and combined keywords were used, including *Curriculum Planning*, *Higher Education Curriculum*, *Project-Based Curriculum*, *Task-Based Learning*, *Innovative Teaching Methods*, and *Learning Theories*, alongside their Persian equivalents. The inclusion criteria for the articles were: publication within the specified time period (2015–2024), written in Persian or English, published in credible academic journals, full-text accessibility, and a research-based or review nature. Conversely, duplicate articles, conference abstracts, unrelated studies, and sources with low scientific quality were excluded.

The search and screening process followed the standard *PRISMA* protocol and was conducted in three stages. In the first stage, a systematic search was carried out, and the articles were saved in *EndNote* software. In the second stage, the titles and abstracts of the articles were carefully reviewed, and duplicates or irrelevant items were eliminated. In the third stage, the full texts of the selected articles were examined, and their quality was assessed using the *PRISMA* checklist. Finally, data extracted from the articles were analyzed, coded, and categorized using the *Qualitative Content Analysis* method to enable the identification and analysis of curriculum model dimensions and components. This approach enhanced the coherence and systematicity of the research process, strengthened the validity and reliability of the findings, and provided the basis for a deeper analysis of the main research question.

Findings and Results

To address the research question, a library-based and documentary analysis was conducted using articles and books related to project-based learning, and the curriculum components based on this learning model were identified from relevant databases, as presented in Table 1.

Table 1. Dimensions of the Project-Based Learning Curriculum with an Emphasis on the Task-Oriented Approach

Dimensions	Components	Sources
Theoretical foundations of project-based learning	Constructivist learning, experiential learning, situated learning, social interaction	(1-4)
Key elements of the PBL model	Driving challenges, continuous inquiry, authenticity, student voice, reflection, critique and revision, public product	(5, 6, 20, 27)
Adaptability to diverse educational contexts	Flexibility, responsiveness to technical and vocational needs, maintaining effectiveness	(12, 13, 26)
Educational effectiveness of PBL	Student engagement, knowledge retention, problem-solving enhancement	(10, 11, 29)
Task-Based Learning (TBL) approach	Meaningful tasks, pre-task preparation, task execution, post-task reflection and analysis	(14-16)
Integration of theory and practice in vocational education	Designing authentic tasks, applying theoretical knowledge to practice, problem-solving flexibility	(9, 17, 22)
Development of technical and tactical competencies	Mastery of skills, application in diverse contexts	(19, 25, 28)
Professional curriculum design	Industry participation, responsiveness to labor market changes, development of technical and soft skills	(7, 23, 24)
Technology and educational flexibility	Digital learning, flexible learning pathways, preservation of practical experiences	(8, 18, 21)
Key factors in implementing PBL in vocational education	Instructor preparation, organizational support, availability of resources	(6, 20, 27)
Learning outcomes in project-based vocational education	Development of technical skills, problem-solving ability, job readiness	(1, 19, 28)

According to Table 1, the project-based learning curriculum with a task-oriented approach consists of several key dimensions, each encompassing specific components that have been examined and validated by leading researchers in the field of technical and vocational education.

The first dimension, project-based learning, is rooted in constructivist learning theories and Dewey's educational philosophy, emphasizing learning through direct experience, social interaction, and problem-solving. The core components of this dimension include driving questions or challenges, continuous inquiry, authenticity, student voice, choice, reflection and revision, and public product creation. These elements contribute to an active and learner-centered environment that enhances mastery of course content while strengthening critical thinking and problem-solving skills.

The second dimension, task-based learning, as a structured approach, focuses on performing meaningful tasks related to real workplace conditions. This approach includes three main stages: pre-task preparation, task implementation, and post-task reflection. Its goal is to build a bridge between theoretical knowledge and practical application so that students can acquire the technical skills and competencies required by the labor market.

The third dimension pertains to curriculum development in technical and vocational education, which requires a balance between academic rigor and responsiveness to industry and labor market needs. This dimension includes components such as active industry participation in the curriculum development process, the integration of technical and soft skills—such as communication, teamwork, and problem-solving—and attention to flexible learning pathways and digital competencies. These elements have become increasingly significant in an era of rapid technological transformation and changing student demographics.

Discussion and Conclusion

The results of the present study identified three core dimensions constituting the foundation of a project-based curriculum model with an emphasis on the task-oriented approach in technical and vocational education. These dimensions include: (1) *project-based learning* as the primary pedagogical framework integrating experiential, constructivist, and inquiry-driven processes; (2) *task-based learning* as a structured complement emphasizing performance, reflection, and contextual application of knowledge; and (3) *curriculum development* focused on the alignment between educational institutions and industry demands, incorporating technological adaptability, flexibility, and soft skills integration. Collectively, these components outline a comprehensive model capable of developing technical expertise, enhancing employability, and fostering lifelong learning competencies among vocational students.

The findings indicate that project-based learning (PBL) enhances both cognitive and metacognitive development by situating learners in authentic, problem-based contexts. This aligns with the argument that PBL supports deep learning through sustained inquiry, reflection, and the production of tangible outputs (7, 10). Learners who engage in projects that require design, implementation, and evaluation not only master subject-specific content but also develop critical thinking and self-regulation (3, 4). These outcomes are consistent with the constructivist foundations established by Dewey and Vygotsky, emphasizing experiential learning and social collaboration (9). The findings further confirm that when learning tasks are embedded in authentic situations, they foster students' ability to apply abstract knowledge to real-world problems, a key outcome in technical and vocational education (12, 13).

Another central result is the synergistic role of task-based learning (TBL) in operationalizing the principles of PBL within structured, outcome-oriented environments. Task-based models emphasize meaningful, context-driven performance stages—preparation, execution, and post-task reflection—that bridge theoretical understanding with practical action (14). These stages cultivate procedural competence and encourage learners to internalize task sequences relevant to real occupational demands (15). The findings are in line with those of (16), who demonstrated that the implementation of task-driven project cycles significantly enhances learners' reading comprehension and engagement in hybrid settings. Likewise, (17) found that project-based STEM instruction leveraging robotics fosters systematic problem-solving skills, suggesting that structured, task-based components increase student focus and persistence. Together, these studies corroborate the notion that integrating TBL principles within PBL frameworks yields more coherent and goal-oriented learning outcomes in technical domains.

Moreover, the findings of this study highlight the importance of flexibility, digital competence, and technology-enhanced learning pathways in strengthening the relevance of vocational curricula. As digital transformation reshapes educational and industrial ecosystems, virtual collaboration, simulation, and digital project management tools have become indispensable in sustaining the authenticity and accessibility of project-based learning (18, 20). The current results support (19), who demonstrated that e-learning environments incorporating project-based approaches significantly improved student engagement and teamwork during the pandemic period. Similarly, (21) confirmed that web-based project environments foster creativity and collaborative problem-solving, validating the adaptability of project-based frameworks in online modalities. These findings collectively reinforce the value of integrating technology-enhanced learning strategies into vocational curricula to sustain learner motivation and enhance professional readiness.

The dimension of curriculum development identified in this study underscores the need for collaboration between educational institutions and industry partners. The results show that the participation of industry experts in curriculum design improves the contextual relevance of learning experiences and ensures alignment with labor market expectations (22). This corresponds with (23), who proposed design thinking as a model for connecting creative educational processes with innovation-driven industrial practices. Furthermore, (24) emphasized that self-directed learning competencies, combined with industry-linked project work, significantly enhance students' achievement and motivation. Such collaboration contributes to a more dynamic curriculum model that integrates technical proficiency, creativity, and entrepreneurship (5).

The study also found that PBL and TBL contribute to the development of soft skills, such as communication, teamwork, and leadership. These outcomes echo the work of (6), who linked project-based pedagogies to social-emotional and cognitive development in preschool settings, and (25), who reported similar benefits in early science education. These findings highlight that even in vocational and adult learning contexts, collaborative project environments nurture empathy, cooperation, and adaptability—traits increasingly valued by employers. Moreover, (27) demonstrated that national smart learning platforms can facilitate large-scale adoption of such models by offering digital infrastructures that promote teamwork, feedback loops, and performance analytics. Hence, the convergence of pedagogical design, digital technology, and task orientation appears to be a critical determinant of success in contemporary vocational education.

From a theoretical perspective, the results validate the integration of constructivist, experiential, and situational learning theories in the design of technical curricula. As (4) and (3) demonstrated, when engineering design thinking and collaborative inquiry are infused into project cycles, learners develop the ability to synthesize abstract principles into practical innovations. The present findings confirm that this process enhances both technical knowledge and systems thinking—a competency essential in industries characterized by complexity and interdependence. Additionally, (29) showed that project-based e-learning fosters self-efficacy and academic engagement, while (11) and (9) highlighted improvements in metacognitive skills and social identity, further illustrating the psychological benefits of task-driven project design.

A major contribution of this study lies in its articulation of PBL as an adaptable and inclusive model that accommodates different learner characteristics and institutional contexts. The literature suggests that flexibility in the implementation of PBL is vital for addressing learners' diverse cognitive and emotional needs (12, 13). The integration of reflective practices within task-based frameworks allows learners to evaluate their learning trajectories, thereby improving self-regulated learning (28). Moreover, (26) found that online project-based instruction significantly increases academic achievement when accompanied by active learner participation and engagement monitoring. Together, these findings confirm that flexible, adaptive learning systems foster continuous improvement and personalized progress in technical education.

Another notable finding concerns the role of institutional and organizational support. The study demonstrates that successful PBL implementation depends on systemic readiness, including instructor preparation, infrastructure, and policy frameworks. As (17) noted, the effectiveness of PBL in STEM settings depends not only on pedagogical design but also on teacher professional development and school-level collaboration. (16) similarly stressed the need for teacher training in hybrid project environments to ensure consistency in assessment and feedback. The results of the present study resonate with these findings, highlighting that institutional support mechanisms—ranging from administrative leadership to technological investment—are vital for ensuring the sustainability of project-based reform in vocational education (22).

Furthermore, the convergence of project-based and task-based learning approaches facilitates a pedagogical balance between creativity and discipline. While PBL encourages innovation, reflection, and exploration, TBL provides structure, accountability, and performance benchmarks (14, 15). This integration yields a dual advantage: it promotes learner autonomy while ensuring adherence to professional standards and procedural accuracy. Such balance aligns with (23), who emphasized that design thinking and structured inquiry together form the foundation for creative yet rigorous problem-solving. It also supports (20), who argued that combining PBL with virtual reality and simulation technologies enhances both technical mastery and environmental awareness in applied disciplines such as green building design.

The cumulative evidence from the study and the reviewed literature supports the assertion that integrating project-based and task-oriented frameworks in technical and vocational education can yield transformative educational outcomes. It equips learners with cognitive flexibility, creativity, and practical competence while fostering a lifelong learning mindset essential for navigating the demands of the Fourth Industrial Revolution (24, 27). Furthermore, the alignment between educational design and industry needs ensures the employability and resilience of graduates in rapidly changing labor markets (5, 22).

Despite its comprehensive scope, this study has several limitations. First, the systematic review relied primarily on published journal articles and conference papers between 2015 and 2024, which may exclude relevant gray literature or localized studies that could offer context-specific insights. Second, the qualitative synthesis approach, while effective in identifying major themes, inherently depends on the interpretative judgment of researchers and may introduce subjective bias in coding and theme classification. Third, the absence of empirical data from field implementation limits the generalizability of findings to actual classroom or workshop settings. Finally, the rapidly evolving nature of digital learning technologies may render some findings time-bound, requiring ongoing updates to maintain their relevance.

Future studies should complement systematic reviews with empirical investigations, such as quasi-experimental and longitudinal designs, to examine the causal impact of integrated project- and task-based curricula on learning performance and professional outcomes. Further research could also explore the moderating effects of cultural context, digital literacy, and institutional readiness on the effectiveness of PBL and TBL in technical education. Moreover, comparative studies across different vocational sectors—such as healthcare, engineering, and information technology—could help identify discipline-specific adaptations of the proposed model. Integrating learning analytics and artificial intelligence to assess learner engagement and competency development may also provide more precise insights into how project-based strategies operate in hybrid or fully online learning environments.

Practically, educational policymakers and curriculum designers should adopt a participatory approach involving industry stakeholders, educators, and students to co-design project-based learning modules that align with current labor market needs. Teacher training programs should incorporate modules on project facilitation, digital pedagogy, and reflective assessment to ensure effective implementation. Institutions should also invest in digital infrastructures that support collaborative, flexible, and data-driven learning pathways. Finally, integrating periodic review mechanisms can help maintain curriculum relevance, ensuring that project-based and task-oriented strategies continue to meet both learner expectations and industry standards.

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Authors’ Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

All ethical principles were adhered in conducting and writing this article.

Transparency of Data

In accordance with 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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References

1. Viro E, Lehtonen D, Joutsenlahti J, Tahvanainen V. Teachers' perspectives on project-based learning in mathematics and science. 2020. doi: 10.30935/scimath/9544.
2. Wu X, Chen J, Liu T. Project-based learning and its effectiveness in teaching entrepreneurship at high school level. Journal of Business Education. 2020;32(5):521-30.
3. Juuti K, Lavonen J, Salonen V, Salmela-Aro K, Krajcik J. A Teacher–Researcher Partnership for Professional Learning: Co-Designing Project-Based Learning Units to Increase Student Engagement in Science Classes. Journal of Science Teacher Education. 2021;32(6):625-41. doi: 10.1080/1046560x.2021.1872207.
4. Lin KY, Wu YT, Hsu YT, Williams PJ. Effects of infusing the engineering design process into STEM project-based learning to develop preservice technology teachers' engineering design thinking. International Journal of STEM Education. 2021;8:1-15. doi: 10.1186/s40594-020-00258-9.
5. Santoso RTPB, Priyanto SH, Junaedi IWR, Santoso DSS, Sunaryanto LT. Project-based entrepreneurial learning (PBEL): a blended model for startup creations at higher education institutions. Journal of Innovation and Entrepreneurship. 2023;12(1):18. doi: 10.1186/s13731-023-00276-1.
6. Veraksa N, Veraksa A, Plotnikova VA. Pretend Play and Project-Based Learning as Factors in the Development of Preschool Children. Rudn Journal of Psychology and Pedagogics. 2023;20(3):431-45. doi: 10.22363/2313-1683-2023-20-3-431-445.
7. Zhang L, Ma Y. A Study of the Impact of Project-Based Learning on Student Learning Effects: A Meta-Analysis Study. Frontiers in Psychology. 2023;14. doi: 10.3389/fpsyg.2023.1202728.
8. Lane D. Machine Learning for Kids: A Project-Based Introduction to Artificial Intelligence: No Starch Press; 2021.
9. Pantiwati Y, Kusniart T, Permana FH. The effects of the blended project-based literacy that integrates school literacy movement strengthening character education learning model on metacognitive skills, critical thinking, and opinion expression. European Journal of Educational Research. 2023;12(1):145-58.
10. Sun J. A Project-Based Learning (PBL) Event in a Chinese Rural School: How Can PBL Help Teachers and Students Accomplish Deep Learning? Research and Advances in Education. 2023;2(4):59-68. doi: 10.56397/rae.2023.04.06.
11. Palashi L, Hadad Narafshan M, Anjom Shoa L. The impact of technology-based project-based learning on learners' English vocabulary development and social identity. Educational Technology. 2023;17(4):755-66.
12. Hariyanto VL, Hidayah R, Pratama GNIP, Syamsudin RN. Project-based learning at vocational schools: a case study of the implementation of entrepreneurship learning model. International Journal of Instruction. 2023;16(3):283-306. doi: 10.29333/iji.2023.16316a.
13. Shekh-Abed A. Metacognitive self-knowledge and cognitive skills in project-based learning of high school electronics students. European Journal of Engineering Education. 2024. doi: 10.1080/03043797.2024.2374479.
14. Prasopsuk C, Sutthivirode K, Thongtip T, Pratumsuwan P, editors. Project-Based Learning Integrating 5E Model for Improving Learning Outcome of Heat Transfer for Students in Mechanical Engineering Program. 2024 9th International STEM Education Conference (iSTEM-Ed); 2024; Cham: IEEE.
15. Arabloo P, Hemmati F, Rouhi A, Khodabandeh F. The Effect of Technology-Aided Project-Based English Learning on Critical Thinking and Problem Solving as Indices of 21st Century Learning. Journal of Modern Research in English Language Studies. 2022;9(1):125-50.
16. Assiddiq M, Sasmayunita. Implementing Project-Based Learning in a Hybrid Setting: The Effectuality of the EFL Students’ Reading Comprehension. SHS Web of Conferences. 2022;149:01058. doi: 10.1051/shsconf/202214901058.
17. Coufal P. Project-Based STEM Learning Using Educational Robotics as the Development of Student Problem-Solving Competence. Mathematics. 2022;10(23):4618. doi: 10.3390/math10234618.
18. Ebadi S, Ghanavati Z, Ebadi Z, Taibi Z, editors. Project-based learning and its impact on students' problem-solving skills. First National Conference on New Perspectives in Education Issues; 2024: Ramshir.

19. Umar M, Ko I. E-learning: Direct effect of student learning effectiveness and engagement through project-based learning, team cohesion, and flipped learning during the COVID-19 pandemic. Sustainability. 2022;14(3):1724. doi: 10.3390/su14031724.

20. Hou C, Lai JH, Wu H. Project-Based Learning and Pedagogies for Virtual Reality-Aided Green Building Education: Case Study on a University Course. International Journal of Sustainability in Higher Education. 2023;24(6):1308-27. doi: 10.1108/ijshe-06-2022-0197.

21. Jame Bozorg Z, Jafar Khani F, Heidarian MR. Designing a web-based project-based learning environment and its impact on the creativity of fifth-grade elementary students in science. Psychology Growth. 2023;12(6):13-24.

22. Qaddafi H, Hamid H, Haikel S, Sabri H, Loubes M. Needs assessment models and frameworks in project-based learning organizations: New perspectives. Journal of Workplace Learning. 2024;36(1):67-85.

23. Bouhaï N. Design Thinking as an Innovative Approach in a Project-Based Learning Context. European Public & Social Innovation Review. 2025;10:1-19. doi: 10.31637/epsir-2025-1780.

24. Chan SC, Chan WT, Xiao JJ. Learning how to learn: the relationships between students' learning-to-learn (L2L) competence, learning self-efficacy, and achievement in project-based learning. Journal of Educational Business. 2025:1-10. doi: 10.1080/08832323.2024.2449506.

25. DongJin S. Project-Based Learning in Early Science Education a Systematic Review. International Journal of Academic Research in Progressive Education and Development. 2024;13(2). doi: 10.6007/ijarped/v13-i2/21365.

26. Zelhendri Z. Academic achievement: The effect of project-based online learning method and student engagement. Heliyon. 2022.

27. Dan Q. National Smart Learning Platform Supports Project-Based Learning and Activates After-School Activity. Leading Smart Education. 2025. doi: 10.1007/978-981-97-8148-5_42.

28. Senjayani I. Fostering Creative Thinking Skills Through Project-Based Learning Learning Models in Nutritional Balance Practices of High School Students. Journal of Biology Education Research (Jber). 2021;2(1):1-7. doi: 10.55215/jber.v2i1.3420.

29. Moghami HR, Asadi F, Zarei Zavarki E. The impact of project-based e-learning (PBL) on the self-efficacy and academic engagement of sixth-grade elementary students. Educational Technology. 2023;17(4):825-36.