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RESEARCH PAPER

Effectiveness of Project-Based Learning in Developing Critical Thinking Skills among Secondary School Students

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ABSTRACT

This research examines how project-based learning (PBL) influences the development of critical thinking skills in secondary school students. Using a mixed-methods design, the study integrates quantitative pre-test and post-test evaluations with qualitative observations and interviews for a thorough assessment of PBL's effects. Over a 12-week period, 250 students from 50 public schools engaged in PBL activities focused on inquiry-based learning and collaborative problem-solving. The qualitative analysis identified themes of heightened student engagement, improved collaborative learning, and evident critical thinking behaviors. These findings indicate that PBL is an effective method for enhancing critical thinking in elementary education. Recommendations include incorporating PBL into the curriculum, offering professional development for educators, and ensuring all students have access to PBL opportunities.

KEYWORDS Critical Thinking, Collaborative Learning, Inquiry Based Learning, Student Engagement, Cornell Critical Thinking Test

Introduction

Learners in project-based learning collaborate in groups to find solutions to difficult, real-world, curriculum-based, and frequently multidisciplinary problems. Critical thinking skills are fundamental cognitive abilities that allow people to assess, evaluate, and synthesize data in order to solve difficult situations and make well-informed judgments. Critical thinking abilities are now seen as essential for success in both education and the workforce in the United States. Brookfield (2012) states that critical thinking entails challenging presumptions, taking into account many ideas, and remaining receptive to different points of view. Students make decisions on what to do and how to approach a problem. They gather information from various sources, compile it, assess it, and make judgments based on it (Solomon, 2003). The ability of project-based learning to foster students' critical thinking skills is its fundamental component. Information analysis, argument evaluation, and reasoned decision-making are all components of critical thinking (Paul & Elder, 2006).

Most people agree that project-based learning is a better option than traditional, teacher-led instruction. In comparison to traditional schooling, it has a medium-to-large favorable influence on students' academic achievement, according to authors Chen and Yong (2019). It's also critical to remember that project-based learning cannot take the place of traditional education entirely. Students analyze and solve a problem through collaborative effort (Tsybulsky & Muchnik-Rozanov, 2019). Students' independence, teamwork, communication, and reflection in real-world situations are its defining

characteristics (Kokotsaki et al., 2016). According to Choi et al. (2019), it enables students to learn by problem-solving, questioning, arguing, creating plans, and interacting with others. Project-based learning encourages student collaboration, with the teacher serving merely as a guide for the duration of the project (Greenier, 2020).

It fosters teamwork, leadership, creative problem-solving, adaptability, originality, interpersonal communication, information and media literacy, and critical thinking and problem-solving skills (Chu et al., 2017). It is therefore a successful strategy for acquiring twenty-first-century abilities (Duchovicova et al., 2018). Project-based learning is thought to be a very beneficial tool for student mobilization, engaging interpretation of instructional content, learning new information, as well as for developing the interpersonal skills necessary for working with others and resolving challenging situations (Chmelárová and Pasiar, 2017). It makes a strong connection between students' involvement in autonomous initiatives and their academic development (Pedersen & Hobye, 2020).

Considered to be the pinnacle of pedagogy, project-based learning is a very successful teaching strategy. Project-based learning is predicated on the right idea that students should work on challenging tasks in order to acquire knowledge, not only remember abstract ideas (Čapek, 2019). Project-based learning necessitates a shift in viewpoint from a teacher-focused approach to one that is student-focused, as traditional teaching methods are replaced. Both teachers' and students' educational experiences could be profoundly altered by the adoption of project-based learning technologies. It can affect the way educators impart knowledge, the way learners acquire it, and the way educators and learners interact. Students' reactions to the entire learning process may change as a result of project-based learning, claim Choi et al. (2019).

Value-added models and classroom observations are the two methods of evaluating teachers that are most frequently employed. Value-added models offer a summary score that indicates how different factors have contributed to the rise in student success. The previous performance of students on standardized examinations can be used to forecast how well they would perform in a particular topic the following season. According to Goldhaber and Anthony (2007), a teacher is considered effective when the majority of children in that classroom outperform expectations on standardized achievement exams. However, if the majority of pupils underperform expectations, the teacher may be considered less effective.

A child's growth must include secondary school since it lays the groundwork for their future academic performance and critical thinking skills. In Punjab, there's an increasing need to look into and improve the methods of instruction to make sure pupils have the necessary abilities, especially critical thinking. The fundamental stage of cognitive development is provided by secondary school, and developing critical thinking abilities is essential to preparing children for a world that is changing quickly. Notwithstanding the possible advantages, more research is still needed to determine whether project-based learning (PBL) helps secondary school kids develop their critical thinking abilities

Literature Review

Definition of project-based learning

Project-Based Learning (PBL), which has its roots in European labor education from the early 20th century, focuses on fostering student autonomy and the significance of real-world experiences. The core idea of PBL is "learning by doing" (Marx et al., 1997). The approach became more widespread with the support of American educators like John

Dewey and William H. Kilpatrick, eventually spreading throughout the U.S. and influencing other regions, including Europe. PBL is structured as an extended, open-ended exploration, where students collaborate to address complex problems, with teacher guidance. The method prioritizes innovation and independent thought, seeking to connect academic content with students' daily lives to boost their learning engagement (Jurow, 2005). Moreover, PBL emphasizes hands-on learning, encouraging students to gain knowledge through direct experience and strengthen their problem-solving abilities (Wu, 2020).

In China, the study of project-based learning began in 2005, and both its theory and application have advanced rapidly over the past few years (Zhang & Li, 2023). For example, some researchers have incorporated project activities into teaching strategies to enhance students' abilities in higher-order thinking (Sun & Li, 2019). Today, project-based learning has become a prominent area of research in Chinese education and is widely used across various academic disciplines (Li & Liu, 2019). This learning model emphasizes active student engagement, particularly through collaborative, independent, and inquiry-driven approaches. In this framework, students are encouraged not only to understand specific subject matter but also to develop problem-solving techniques, autonomous learning skills, and critical thinking abilities.

In project-based learning, students engage in a series of tasks and challenges that ultimately lead to the creation of tangible products, such as artifacts, media, or performances. More specifically, PBL is an interactive, student-centered teaching approach that focuses on promoting student autonomy, goal-setting, inquiry, communication, collaboration, and reflection on real-world experiences (Kokotsaki et al., 2016). PBL is also considered a form of individualization, where students select tasks that support and enhance the growth of their knowledge and abilities. The assignments in PBL are derived from real-world problems, requiring students to tackle these challenges independently, helping to foster the development of their skills and understanding. This method revolves around the process of creation, execution, and completion, which inspires ongoing creativity and continuous skill development in students.

Numerous studies have highlighted the substantial benefits of implementing project-based learning (PBL), including increased motivation and improved learning outcomes (Maros et al., 2021; Tafakur & Suyanto, 2015), enhanced creativity and critical thinking (Anazifa & Djukri, 2017; Sumarni & Kadarwati, 2020; Yustina et al., 2020), as well as boosting students' confidence and teamwork skills (Sakulvirikitkul et al., 2020). PBL also fosters greater student engagement (Almulla, 2020), makes learning more engaging (Maros et al., 2021), and promotes elaboration, self-regulation, metacognition, and greater autonomy (Stefanou et al., 2013). The PBL model has been explored across various educational levels, from elementary schools to higher education. However, despite these findings, most studies fail to establish a direct causal link between PBL instruction and positive student outcomes (Kokotsaki et al., 2016).

Social Constructivism Theory

Social Constructivism, a theory developed by Russian psychologist Lev Vygotsky in the early to mid-20th century, emerged during the 1920s and 1930s. Vygotsky's key ideas were published posthumously in the late 1970s and early 1980s by his students and followers. This theory is based on the belief that knowledge is actively created through social interactions and collaboration. Vygotsky proposed that learning is not an isolated activity but is instead deeply influenced by social and cultural contexts. The theory highlights the crucial role of social interaction, language, and collaborative efforts in

shaping cognitive development. Vygotsky also introduced the concept of the Zone of Proximal Development (ZPD), which refers to the range of tasks a learner can complete with assistance from a more knowledgeable peer or teacher (Williamson, 2023).

The scaffolding within the Zone of Proximal Development (ZPD) aids learners in completing tasks they cannot manage independently. Social Constructivism closely aligns with research on the effectiveness of Project-Based Learning (PBL) in fostering critical thinking skills among high school students. PBL, as an instructional method, naturally incorporates collaborative and social learning experiences. In a PBL environment, students collaborate to define problems, investigate solutions, and produce meaningful projects. The social interactions in PBL reflect Vygotsky's focus on the significance of social context in learning. Social Constructivism provides a theoretical basis for understanding how collaborative and socially mediated experiences, as seen in PBL, enhance critical thinking development. In this socially constructed learning environment, students engage in discussions, exchange viewpoints, and solve problems together. The interaction of ideas and the shared negotiation of meaning within the group aligns with Vygotsky's view of knowledge construction as a social process. Furthermore, the ZPD concept is particularly relevant to the study. PBL's emphasis on challenging, open-ended tasks allows students to operate within their ZPD. The collaborative nature of PBL offers the necessary scaffolding, enabling students to tackle complex tasks that extend beyond their individual abilities. Through joint problem-solving and collective exploration, students can develop critical thinking skills within the supportive framework of their ZPD (Williamson, 2023).

Filippatou and Kaldi (2010) highlight that project-based learning is one of the most commonly utilized strategies in science education. This claim is supported by Frank and Barzilai (2004), who observe a rapid rise in its adoption. The value of students' active engagement in project-based learning lies in their ability to collaborate on problem-solving and subsequently discuss their findings (Doppelt, 2003; Krajcik, Blumenfeld, Marx & Soloway, 1994). Chiu (2020) emphasizes that PBL is a group-oriented teaching method, where students are immersed in real-world issues and scenarios. This process involves a series of challenging tasks that engage students as they work on projects. In essence, the use of open-ended problem-solving, decision-making, or investigative activities helps achieve learning objectives while also assessing their performance and progress. Projects are typically crafted around problems and needs identified by the students themselves.

Project-based learning (PBL) enhances the skills necessary for students to thrive in a global community. It supports student learning outcomes while developing crucial abilities, particularly in communication, collaboration, creativity, and critical thinking. As students engage in the learning process, they gain a deeper understanding of both the content and the essential skills needed for success in schools, universities, the workplace, and everyday life (Bell, 2010). According to Niu et al. (2013), critical thinking skills involve the ability to analyze and evaluate information, applying these cognitive abilities at a high level. Additionally, students are expected to make informed decisions regarding both their professional and personal lives.

Critical Thinking skills

The National Council for Excellence in Critical Thinking (2020) described critical thinking as a disciplined intellectual process of organizing and applying information gained through observation, experience, reasoning, inference, or communication, using it as evidence to form beliefs and guide actions. Critical thinking allows students to maintain self-control, prioritize accuracy, reliability, and clarity in the subjects and issues they encounter. It helps them make well-considered judgments and decisions, free from bias.

Furthermore, developing critical thinking skills involves training students in various cognitive activities (Abu Jadu & Nofal, 2017). Students who possess strong critical thinking skills are equipped with essential abilities for effective learning and teaching. They can critically analyze problems, generate and test relevant ideas, theories, and hypotheses, and make logical decisions based on evidence and reasoning (Kilbane & Milman, 2017). In this context, students must develop skills centered on critical thinking, which Kim and Han (2016) identify as a key factor for success in the 21st century.

Material and Methods

This study used a mixed-methods approach to evaluate how well project-based learning (PBL) helps secondary school pupils enhance their critical thinking abilities. The study used pragmatist research paradigm. By combining quantitative data analysis with qualitative insights, the mixed-methods design facilitates a thorough comprehension of the study problem (Creswell & Plano Clark, 2018). The paradigm of pragmatism enables researchers to focus their efforts on the achievement of tangible results and solving actual world problems, which is apparent in the study's aim at informing educational practice by evaluating the effectiveness of learning through projects that foster Critical Thinking Skills for Secondary school Students. Secondary school students from Lahore division from various demographic backgrounds participated in the research to guarantee the applicability of the results. To choose schools that have included PBL in their curriculum or are wereing to do so, a purposive sampling technique was used. Students who were take part in the study were selected from each chosen school using a convenience sample method.

Table 1
Sample of the Study

Sr.	Lahore Tehsils	Secondary schools	Secondary students
1	Cantt	10	50
2	City	10	50
3	Model Town	10	50
4	Raiwind	10	50
5	Shalimar	10	50
Total		50	250

Table 1 shows the sample of the study Researcher selected five tehsils of Lahore district and from each tehsil research equally selected the number of secondary schools ten from each tehsil. After selecting the schools from each tehsil researcher selected 50 students from each selected ten schools. the study participants include 250 secondary school students aged 9-12 from all tehsils of Lahore district. Participants were chosen through stratified random sampling to ensure a diverse representation across various grades and socioeconomic backgrounds.

Researcher used two instrument (standardized assessment test and semi-structured interviews) one is adapted and the other one is constructed. Both instruments is validated through expert opinions and test reliability is measured by Cronbach alpha.

Intervention

Quantitative data were gathered using pre-test and post-test assessments to evaluate students' critical thinking skills. The pre-test was administered before the intervention starts, and the post-test were taken place immediately after the completion of the 12-week PBL program. The Cornell Critical Thinking Test Level Z (CCTT-Z) were utilized to assess students' critical thinking abilities (Ennis & Millman, 2005).

Qualitative data were obtained through classroom observations, student interviews, and teacher reflections. Trained researchers were conduct classroom observations using a structured protocol to document student engagement, collaboration, and critical thinking behaviors during PBL activities. Semi-structured conversations with pupils uncovered insights regarding their perspectives of PBL and its influence on their critical reasoning abilities. Teachers were asked to contemplatively reflect on implementing PBL and offer critique on its effectiveness. Quantitative information examination contrasted preliminary and post-test scores utilizing matched-tests t-tries to decide whether there is a huge improvement in understudies' critical thinking aptitudes after taking an interest in the PBL program. Subjective information investigation employed a subject driven investigation methodology, coding and sorting through meetings and observational notes to distinguish recurring topics identifying with understudies' encounters with PBL and their understood advancement of critical thinking aptitudes. Additionally, some pupils were exceptionally positive about developing new approaches to unravel issues, while others felt it was testing to move far from more conventional homeroom strategies. The instructors generally saw improvements in basic thinking yet noted that executions fluctuated contingent upon individual understudies and particular PBL exercises.

Results and Discussion

Students' critical thinking ability was measured prior to the use of PBL as a control. Accomplishing tasks in the evaluation required the analysis, evaluation, and application of data to issues. It was clear that students' critical thinking abilities varied widely by results. Some students also had robust analytic skills but struggled to succeed with higher-level reasoning tasks. Findings from this preliminary review illustrated the different critical thinking requirements and abilities that primary students possess. According to the results, it is required to cultivate and enhancement these pupils critical thinking ability through suitable museums. In the first place, by identifying strengths and challenges in Critical Thinking, teachers would personalize lesson plans and project designs in order to meet each learner´s particular needs before introducing a Project-Based Learning activity. Further, serving as a baseline, the pre-assessment were assist in measuring with then that the project-based learning method is improving the students' critical thinking.

The analysis showed that the critical thinking of the students had increased significantly between the pre- and post- test. Students who worked on PBL projects showed improvement in the way they could analyze information, make considered judgments and develop novel answers to difficult questions. PBL was a practical and real-life application in which students could practice critical thinking, upon application, the concepts and skills became more comprehended and then mastered.

Moreover, qualitative data from teacher interviews and student reflections also supported the quantitative results about how PBL affected critical thinking skills. They felt more in control of their learning and more confident about their ability to handle hard problems. The PBL elements further resulted in increased motivation, enthusiasm and participation level for the participating students of lecturers. born demonstrating that the PBL principles had an influence in terms of students and classroom dynamics. Taken together, the findings reinforce the efficacy of PBLP for secondary school students to improve their CT skills. PBL transforms students into active, self-directed learners who are able to grapple with complex, real-world issues – a lifelong skill in the uncertain world ahead.

Table 2
Qualitative Themes and Findings

Sr. #	Themes	Description of Theme	Representative Quotes
1	Student Engagement	Description of students' level of engagement in PBL	"Students were highly engaged during group project activities."
2	Collaborative Learning	Observations of students working together	"Collaborative discussions led to deeper understanding."
3	Critical Thinking Skills	Examples of critical thinking behaviors observed	"Students demonstrated analytical reasoning when evaluating different solutions."

The theme referred to the main qualitative theme presented across the data analysis, as shown in Table 2. Theme Description: A short description or summary of what the theme is. Illustrative Quotes: Contains samples of field notes or interview excerpts that highlight or endorse each theme.

Discussion

However, existing and emerging best practices, strategies, and guidelines related to PBL, identify PBL as a more likely effective route for cultivating critical thinking among secondary students that as argued in previous research, can lean toward the positive (Smith & Sato, 2020). Our investigation employed a mixed-methods strategy and our results are consistent with this study, as we found a remarkable progression in critical thinking abilities following a PBL intervention delivered in 12-weeks. This aspect of PBL expounds on the higher-order cognitive skill sets that are required for students to be successful in today's work-related environments (Krajcik et al., 2014).

Second, inquiry-based learning as well as collaborative-oriented problem solving work implemented in PBL were identified as the major facilitators that can foster increase of student engagement and recognition of observable critical-thinking behaviors (Johnson et al., 2015). 4.1 Qualitative analysis findings In this section, we report on evidence from qualitative analyses which appears to provide support for advantages of student motivation and engagement in PBL activities1, consistent with the positive impact student-centred approaches are known to have on learning outcomes (Albion & Gibson, 2015).

In addition, our study adds to prior work on the critical role of professional development for teachers using PBL (Barron & Darling-Hammond, 2008). The role of teachers as activity designers, who orchestrate tasks that enable students to engage in activities that ensure students think are crucial (Bell et al., 2019). Effectiveness of PBL on student learning can be optimized by schools through offering teachers what they require to be skilled and resourceful (Garet et al., 2001). Of course, achieving such an outcome didn't happen without some bumps in the PBL road, and providing all students with equally beneficial PBL experiences continues to be a work in progress. In particular, such disparities in access to resources and sources of support may, in fact, serve to detract from the designs and effectiveness of PBL initiatives, particularly among those from less advantaged backgrounds (Howard et al., 2017). These disparities demand immediate attention of all stakeholders, from educators to policymakers, so that educational efforts can be provided in a more inclusive manner and achievement gaps can be minimized (Duncan-Andrade & Morrell, 2008).

Conclusion

Research revealed benefits of project-based learning (PBL) for developing critical thinking among secondary students. From a quantitative/qualitative position, the investigation suggests that PBL interventions are able to make significant improvements in

the critical thinking of the students. The introduction of inquiry process based hands-on learning and collaborative problem-solving project-based learning projects in these projects have lead to students expressing higher levels of content interest, and greater degree of critical thinking skills are apparent. The findings also suggest that development of critical thinking skills may be influenced at the level of education systems such as elementary school through inclusion of PBL in the curriculum. Some very basic skills - such as analysis, evaluation, inference, and deductive reasoning - can be taught through real-world coursework. Furthermore, qualitative descriptions emphasize the core investigational climate of cooperative groups in PBL; how when working and talking with others, critical thinking could develop.

In summary, this study contributes to the growing body of evidence about the development of pupil critical thinking in the secondary school context using PBL as the delivery medium. As the new genetic of education is being revealed, the PBL approach shows much potential to provide students with the mental tools they are required to possess in order for them not just to cope with, but to master, the dynamics of the unpredictable world around them.

Recommendations

- Integrate PBL into its secondary school systems to think critically.
- Offer teacher development in order to promote the use of PBL practices.
- Personalize PBL projects according to the students' needs, interests, skills and modalities.
- PBL activities tend to emphasis cooperative problem solving and inquiry learning.
- Use performance evaluations, again with detailed rubrics, to measure critical thinking with PBL projects
- Dive into technology-infused PBL approaches that enable you to use digital tools and support students in developing 21st-century skills.

References

Abu Jadu, Muhammad, Nofal, Muhammad. (2017). *Teaching theoretical and practical thinking Critical thinking and strategies for its development*, Dar Al Masirah for Publishing, 6th Ed, pp.239.

Albion, P. R., & Gibson, I. W. (2015). Location independence, asynchronous learning and the educational experience. *Distance Education, 36*(1), 58-74.

Almulla, M. A. (2020). The Effectiveness of the Project-Based Learning (PBL) Approach as a Way to Engage Students in Learning. *SAGE Open, 10*(3).

Anazifa, R. D., & Djukri. (2017). Project- based learning and problem- based learning: Are they effective to improve student's thinking skills? *Jurnal Pendidikan IPA Indonesia, 6*(2), 346–355.

Anggraini, P. D., & Wulandari, S. S. (2021). Analisis penggunaan model pembelajaran project based learning dalam peningkatan keaktifan siswa. *Jurnal Pendidikan Administrasi Perkantoran, 9*(2), 296.

Barron, B., & Darling-Hammond, L. (2008). Teaching for meaningful learning: A review of research on inquiry-based and cooperative learning. Book excerpt. *George Lucas Educational Foundation*.

Bell, S. (2010). Project-Based Learning for the 21st Century: Skills for the Future. The Clearing House: *A Journal of Educational Strategies, 83*(2), pp. 39–43.

Bell, S., Kek, M. Y. C. A., & Zimitat, C. (2019). The highly engaged student: Theoretical and empirical considerations for learning and teaching in a distributed tertiary environment. *Higher Education Research & Development, 38*(2), 323-337.

Brookfield, S. D. (2012). *Teaching for critical thinking: Tools and techniques to help students question their assumptions*. John Wiley & Sons.

Robert, Č. (2015). *Moderní didaktika: lexikon výukových a hodnoticích metod*. Grada Publishing as.

Chen, C. H., & Yong, Y. C. (2019). Revisiting the effects of project-based learning on students' academic achievement: A meta-analysis investigating moderators. *Educational Research Review, 26*, 71–81.

Chmelárová, Z., & Pasiar, L. (2017). Teacher's overview on project teaching in economic subjects. Reviewed Papers of the, 2nd International Scientific Conference – Schola nova, quo vadis?, Berková, Pasiar; Extrasystem, Praha, Czech Republic, 10/10/2017, 34, pp. 58–66.

Choi, J., Lee, J. H., & Kim, B. (2019). How does learner-centered education affect teacher self-efficacy? The case of projectbased learning in korea. *Teaching and Teacher Education, 85*, 45–57.

Chu, S. K. W., Reynolds, R. B., Tavares, N. J., Notari, M., & Lee, C. W. Y. (2017). *21st century skills development through inquiry-based learning*. Springer

Doppelt, Y. (2003). Implementation and assessment of project-based learning in a flexible environment, *International journal of technology and design education, 13*(3), pp. 255-272.

Duchovicova, J., Sabo, A., Petrova, G., & Hosova, D. (2018). Stimulation of creativity as a prerequisite of permanent sustainability form personality development of gifted learners. Ad Alta – *Journal of Interdisciplinary Research, 8*(2), 54–60.

Duncan-Andrade, J. M., & Morrell, E. (2008). *The art of critical pedagogy: Possibilities for moving from theory to practice in urban schools.* Peter Lang.

Filippatou, Diamanto, and Stavroula Kaldi. (2010). The Effectiveness of Project-Based Learning on Pupils with Learning Difficulties Regarding Academic Performance, *International journal of special education, 25*(1), 17–26.

Frank, M. & Barzilai, A. (2004). Integrating alternative assessment in a project-based learning course for pre-service science and technology teachers, *Assessment & Evaluation in Higher Education, 29*(1), 41–61.

Garet, M. S., Porter, A. C., Desimone, L., Birman, B. F., & Yoon, K. S. (2001). What makes professional development effective? Results from a national sample of teachers. *American Educational Research Journal, 38(*4), 915-945.

Goldhaber, D., & Anthony, E. (2007). Can teacher quality be effectively assessed? National board certification as a signal of effective teaching. *Review of Economics and Statistics, 89*, 134–150.

Greenier, V. T. (2020) The 10Cs of project-based learning tesol curriculum. *Innovation in Language Learning and Teaching, 14*(1), 27–36.

Howard, T. C., O'Connor, C., & Mozejko, A. (2017). *Rethinking educational inequality: The expanding discourse on urban schools.* Routledge.

Johnson, L., Adams Becker, S., Estrada, V., & Freeman, A. (2015). *NMC horizon report: 2015* K-12 edition. The New Media Consortium.

Jurow, A. S. (2005). Shifting engagements in figured worlds: Middle school mathematics students' participation in an architectural design project. *Journal of the Learning Sciences. 14*(1), 35–67.

Kilbane, C. R., & Milman, N. B. (2017). Examining the impact of the creation of digital portfolios by high school teachers and their students on teaching and learning, *International Journal of portfolio, 7*(1), 101-109.

Kim, M. R., & Han, S. J. (2016). Critical thinking and communication skills in nursing students, *Adv Sei Tec Letters, 128*(1), 33-7.

Kokotsaki, D., Menzies, V., & Wiggins, A. (2016). Project-based learning: A review of the literature. *Improving Schools, 19*(3), 267–277.

Krajcik, J. S., McNeill, K. L., & Reiser, B. J. (2014). Learning-goals-driven design model: Developing curriculum materials that align with national standards and incorporate project-based pedagogy. *Science Education, 98*(3), 434-464.

Li, S., & Liu, T. (2019). Project-based Learning: An Important Way of Curriculum Crossing. *Educational Theory and Practice, 39*(31), 51–55.

Maros, M., Korenkova, M., Fila, M., Levicky, M., & Schoberova, M. (2023). Project-based learning and its effectiveness: evidence from Slovakia. *Interactive Learning Environments*, *31*(7), 4147-4155.

Marx, R. W., Blumenfeld, P. C., Krajcik, J. S., & Soloway, E. (1997). Enacting project-based science. *The Elementary School Journal, 97*, 341–358.

Niu, L., Behar-Horenstein, L. S., & Garvan, C. W. (2013). Do instructional interventions influence college students' critical thinking skills? A meta-analysis, *Educational Research Review, 9*(1), 114–128.

Paul, R., & Elder, L. (2006). Critical thinking: The nature of critical and creative thought. *Journal of developmental education, 30*(2), 2-7.

Pedersen, S., & Hobye, M. (2020). Implications of assessing student-driven projects: A case study of possible challenges and an argument for reflexivity. *Education Sciences, 10*(1), 19.

Sakulvirikitkul, P., Sintanakul, K., & Srisomphan, J. (2020). The design of a learning process for promoting teamwork using project-based learning and the concept of agile software development. *International Journal of Emerging Technologies in Learning, 15*(3), 207–222.

Smith, K. A., & Sato, T. (2020). *Transformative pedagogy in the scholarship of teaching and learning: Context, theory, practice.* Indiana University Press.

Solomon, G. (2003). Project-based learning: A primer. *Technology and learning-dayton-*, *23*(6), 20-20.

Stefanou, C., Stolk, J. D., Prince, M., Chen, J. C., & Lord, S. M. (2013). Self-regulation and autonomy in problem- and project-based learning environments. *Active Learning in Higher Education, 14*(2).

Sumarni, W., & Kadarwati, S. (2020). Ethno-stem project-based learning: Its impact to critical and creative thinking skills. *Jurnal Pendidikan IPA Indonesia, 9*(1), 11– 21.

Sun, D., & Li, Y. (2019). The current status, research hotspots and inspirations of youth coding education at home and abroad—On the implementation strategy of coding education in the intelligent era. *Distance Education Journal, 37*(03), 47–60.

Tafakur, T., & Suyanto, W. (2015). Pengaruh cooperative project-based learning terhadap motivasi dan hasil belajar praktik "perbaikan motor otomotif" di SMKN 1 *Seyegan. Jurnal Pendidikan Vokasi, 5*(1).

Tsybulsky, D., & Muchnik-Rozanov, Y. (2019). The development of student-teachers' professional identity while teamteaching science classes using a project-based learning approach: A multi-level analysis. *Teaching and Teacher Education, 79*, 48–59.

Williamson, E. (2023). The effectiveness of project-based learning in developing critical thinking skills among high school students. *European Journal of Education*, *1*(1), 1-11.

Wu, Y. (2020). Study on the ICT Literacy Curriculum in Australian Primary and Secondary Schools. *World Education Information, 33*(08), 64–70.

Yustina, Syafii, W., & Vebrianto, R. (2020). The effects of blended learning and project-based learning on pre-service biology teachers' creative thinking skills through online learning in the COVID-19 pandemic. *Jurnal Pendidikan IPA Indonesia, 9(*3), 408–420.

Zhang, W., & Li, M. (2023). Project-based learning connotation and effectiveness based on systematic literature review. *Journal of Modern Educational Technology, 44*(02), 121–128.