

## PROFESSIONAL ABILITY OF PROSPECTIVE ELEMENTARY SCHOOL TEACHER THROUGH PROJECT-BASED LEARNING MODEL IN PRIMARY EDUCATION

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### ABSTRACT

Today's rapid technological advances must be accompanied by the professional competence of educators, especially in integrating technology and project-based learning models. This research is a systematic review study to analyze the professional competency of teachers, the PjBL model in Primary Education, and the relationship between the professional abilities of teachers to implement the PjBL model in learning at elementary school. An article search through the Google Scholar database found 33600 journal articles after inclusion and exclusion were carried out. Ten journals were obtained for systematic review. From the results of a systematic study, it was found that there were journals that stated that the teacher's motivation in using the PjBL model had a direct impact on increasing the ability of children to develop their mindset towards the material being taught. It was also found that the ability to implement the PjBL model was combined with other learning models and approaches, and the ability of teachers to apply the technology-assisted PjBL model, so, in general, the competence of prospective elementary school teachers can be improved through the PjBL model. Based on the findings of a review of ten relevant journals, it can be said that using the PjBL model in learning presents some difficulties, particularly at the basic education level. Therefore, higher education institutions are expected to design the models and techniques to prepare student-teacher candidates to develop professional competence by innovating, being creative, and utilizing technology through project-based learning.

**KEYWORDS:** PjBl Model, Primary Education, Professional Competency, Prospective Elementary School Teachers.

### ABSTRAK

Kemajuan teknologi yang pesat saat ini harus dibarengi dengan kompetensi profesional pendidik, khususnya dalam mengintegrasikan teknologi dan model pembelajaran berbasis proyek. Penelitian ini merupakan kajian tinjauan sistematis yang bertujuan untuk menganalisis kompetensi profesional guru dalam mengimplementasikan model PjBL dalam pembelajaran di sekolah dasar. Pencarian artikel melalui database Google Scholar ditemukan 33600 artikel jurnal, setelah dilakukan inklusi dan eksklusi didapatkan 10 jurnal untuk review sistematik. Dari hasil kajian sistematik di dapatkan artikel yang menyatakan bahwa kemampuan mahasiswa calon guru sekolah dasar dalam menggunakan model PjBL berdampak langsung pada peningkatan kemampuan anak untuk mengembangkan pola pikirnya terhadap materi yang diajarkan, ditemukan juga bahwa kemampuan penerapan model PjBL dipadukan dengan model dan pendekatan

pembelajaran lainnya, serta kemampuan mahasiswa calon guru sekolah dasar dalam menerapkan model PjBL berbantuan teknologi. Dapat disimpulkan bahwa berdasarkan hasil kajian terhadap 10 jurnal yang relevan dapat diketahui bahwa terdapat berbagai tantangan penerapan model PjBL dalam pembelajaran khususnya di jenjang pendidikan dasar, oleh karena itu diharapkan perguruan tinggi dapat merancang model dan teknik yang diperlukan untuk mempersiapkan calon guru untuk mengembangkan kompetensi profesional dengan mampu berinovasi, kreasi dan mampu memanfaatkan teknologi melalui pembelajaran berbasis proyek.

**KATA KUNCI:** Kompetensi Profesional, Model PjBl, Mahasiswa Calon Guru, Sekolah Dasar.

## INTRODUCTION

Technology and information systems are overgrowing from 4.0 (industrial revolution) to 5.0 (society), where the use of technology is currently a significant need not only in the industrial world but also in the world of education. The core of the educational process is the teaching and learning process, involving the activities of teachers and students to achieve the learning objectives that have been set, with the output of changes in overall student behavior. The success of teaching and learning activities is determined by the school and curriculum, primarily by the competence of the teachers who teach and guide them (Juuti et al., 2021; Pitrawati & Yuniarni, 2017).

The recent pandemic has changed educational trends learning is no longer centered on teachers but has integrated technology, which requires an educator's professional ability. John Dewey has claimed that student learning occurs through experience when teachers consider their needs and interests and spend time considering how to accommodate them (Dewey, 1959). This issue affects all levels of education, from elementary to tertiary. In addition to mastering technology, educators need to choose appropriate learning methods that can help students develop higher-order thinking skills, one of which is a project-based learning model.

In its realization, it can be seen Turkey and California, where teachers reveal that they do not have good information about Project Based Learning (PjBL), including being unable to guide students in this process. Besides the availability of technology-based infrastructure, these are the main issues that are either supporting factors or barriers to teachers and students actively participating in the learning process (Baysura et al., 2016; Miller, Reigh, et al., 2021). In a study of prospective teacher students and preservice teachers, it was found that using the PjBL model increases professional competence as an educator, encourages them to learn more effectively, and enhances their research, management, and social skills (Uebe Mansur et al., 2019).

Based on some preliminary studies conducted in several countries found that the application of project-based learning models faces several obstacles, including prospective teacher students having difficulty in designing project plans that follow the teaching material. That occurs due to a lack of experience and opportunities to attend training and guidance on how to make project-based learning fun and able to make children develop their ability to think critically to complete the given project (Fernandes, 2014; Viro et al., 2020)

Project-based learning is commonly considered a teaching method in which students respond to real-world questions or challenges through an extended inquiry process using models that can involve them in real-life situations in which students can explore and apply subject matter to complex and relevant problems. With professional practice, they are preparing for (Chiang & Lee, 2016). It is relevant to several studies that state that having good professional competence when educators apply the PjBL model positively impacts student development. However, in practice, time allocation becomes a problem and is considered insufficient to achieve the complete learning objectives (Chen & Yang, 2019).

Based on the problems above, it is necessary to have a meta-analysis study to see the level of professional competence of prospective elementary school teachers in selecting and implementing project-based learning models in the learning process in primary education. The purpose of this study is to be able to analyze the professional competency of prospective elementary school teachers in implementing the PjBL model.

## **METHODS**

This study conducted a systematic review following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). Like all research, the results of a systematic review depend on rigorous methods, transparent reporting, and the application of scientific strategies to limit the possibility of error and bias (Valverde-Berrocso et al., 2020). Therefore, the basic idea of SLR is that the review can be replicated by other researchers from the review to arrive at the same body of evidence and the same conclusions. A systematic review includes a thorough search of designated databases (e.g., Web of Science and Scopus), additional literature that may not be available through these databases, and a thorough process of analyzing and synthesizing relevant information. A stand-alone systematic review has the same general structure as a scholarly scientific article, with an introduction/background, a methods section (defining sampling and

Sarah Fazilla, Yulita Molliq Rangkuti, *Professional Ability of Prospective Elementary School Teacher through Project-based Learning Model in Primary Education*

analysis), a results section outlining key findings, and a discussion and conclusion detailing theoretical contributions or new research directions.

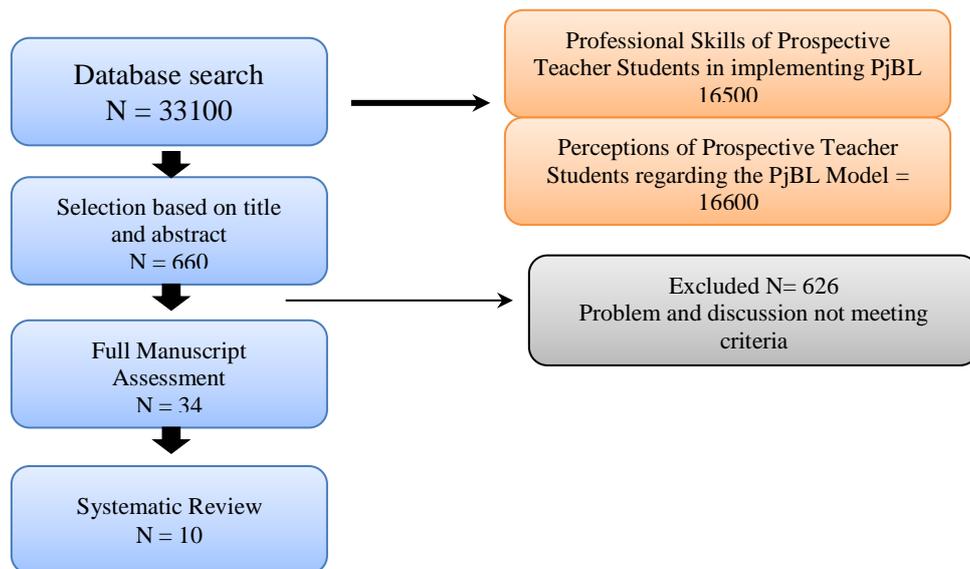
The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) process was conducted to assess the professional competence of prospective student teachers in implementing project-based learning models in elementary schools. The search process was carried out using the Google Scholar electronic database and Elsevier database, while the article search process was done from 2020 to 2021.

, **Table 1.** Inclusion and Exclusion Criteria for Selection of Article Criteria

Criteria	Description
Inclusion	English Prospective elementary school teachers students through the PJBL learning models
Exclusion	Quantitative, Qualitative Research Methods and Development Learning Models  Learning Media

Based on Table 1, the keywords used in searching for journal articles are "*Prospective teachers' students' perceptions of the project-based learning model's application, The professional competency prospective elementary school teachers through the PJBL learning model,*" Journal articles are filtered by title and abstract, problems, and research results, then selected based on the criteria, namely the professional ability of the teacher, the project-based learning model in primary education and the relevance of the teacher's professional competence in implementing the PjBL model in learning at the basic education level. Journals that are not relevant will be issued, and the journals are then evaluated based on inclusion criteria.

Figure 1 presents the search terms and databases used and the number of results obtained. From 3300 articles obtained in the database, an initial selection was made according to existing indicators. Articles were selected based on titles and abstracts relevant to the research title; 660 articles were obtained. Next, the problem analysis and discussion were carried out so that those that did not fit the criteria were excluded. The results obtained 34 articles that could be examined for full texts. The examination results of the article obtained ten articles whose contents followed the research title.



**Figure 1.** Research Search Flowchart

## RESULT AND DISCUSSION

### Results of Analysis of Research Articles

Based on the search results of research conducted by inclusion and exclusion, it was found that there were ten journals with research methods, namely quantitative and qualitative research, with the research design primarily using descriptive and comparative designs, PjBL learning model in primary education. The articles' findings that match the research criteria are presented in table form, as in Table 2, by including the title, author, year of publication, research location, research objectives, research methods, research samples, and research results.

**Table 2.** Results of *Systematic Review*

<b>Title (Author, Year, Location)</b>	<b>Purpose Study</b>	<b>Design Study</b>	<b>Results Study</b>
Supporting Equity in Virtual Science Instruction Through Project-Based Learning: Opportunities and Challenges in The Era of Covid 19 (Miller, Reigh, et al., 2021), USA	To examine how elementary school teachers have innovated to offer high-quality virtual science instruction that is accessible to all their students	Development Design	The results showed that the main component of the PPA model that was predominantly used was the virtual instruction that teachers used during the training sessions. Virtual instruction is undoubtedly different from face-to-face and affects the active involvement of students in the classroom. Thus, project-based learning can be adapted to a virtual form focusing on community connection and collaboration and supported by literacy skills.
Alrajeh. Project-based Learning to Enhance Preservice Teachers' Teaching Skills in Science Education (Alrajeh, 2021), Saudi Arabia	For look preparation o prospective student teachers to become science teachers in implementing the PjBL model for increased practice teaching and use in the teaching process in the time future	Qualitative (Literature Study)	The literature on the challenges of implementing PPA focused primarily on program policy, professional development, the environment, and student willingness. Professional development sessions for faculty members, collaborations with local and international specialist organizations in this field to conduct research, and long-term evaluation of current programs can all be effective strategies for implementing PPA when designing teacher preparation programs. Study findings support the need for teachers and student teachers to expand their use of modern teaching tools.
A Teacher–Researcher Partnership for Professional Learning: Co-Designing Project-Based Learning Units to Increase Student	To gain a better understanding and encourage student involvement in science by involving teachers to co-design, implement,	Quantitative	The t-test results showed significance levels in almost every case. The GLM was first applied with scientific practicum with and without controlling for student responses. Significant differences existed between the years when student responses were not controlled and when scientific practicum was included in the model. Of the 11 practices, there were significant

Engagement in Science (Juuti et al., 2021), Finland	and reflect together through the PjBL learning model		year-to-year effects in planning investigations (PI), conducting investigations (CI), and analyzing data (AD) after controlling for individual students. The others were found to show little change in the implementation of the PPA model components.
Motivating Teaching, Sustaining Change in Practice: Design Principles for Teacher Learning in Project-Based Learning Contexts. (Miller, Severance, et al., 2021)	To see the impact of design principles in the context of project-based learning carried out by elementary teachers in the teaching and learning process.	Qualitative	Based on the results of the cycle two interviews, all of the teachers stated that there was a need for reinforcement in the application of the PPA model to be maximized in the classroom. According to the findings of teacher and student interviews, both teachers and students can enjoy learning science using PPA because it motivates them to work on and complete projects such as game practice by directly investigating animal structures and being able to share their experiences with others or family members at home.
Analysis of The Use and Integration of The Flipped Learning Model, Project-Based Learning, and Gamification Methodologies by Secondary School Mathematics Teachers (Hossein-Mohand, H., Trujillo-Torres, J. M., Gómez-García, M., Hossein-Mohand, H., & Campos-Soto, A., 2021), Melila	To identify variables of teaching practice, ratios, and indicator math teacher training that can influence choice study models or methodologies.	Quantitative	The results showed that 66% of teachers used the PjBL model. The data analysis also showed that 77.5% of math teachers in AC Melilla did not use the flipped learning model. In line with our findings, the literature postulates that the valuation of project-based learning over traditional methodologies, although positive, does not depend on educational attainment or ratios, regardless of geographical factors, as well as available ICT, teacher and student resources, and student commitment.
Effects of Infusing the Engineering Design Process into STEM Project-Based Learning to Develop	This study looks into the cognitive structure of preservice technology teachers, how they	Quasi Experiment	The findings revealed that the experimental group's preservice technology teachers could define engineering design thinking. The chi-square test results show that there is a statistically significant difference between the experimental and control

Preservice Technology Teachers' Engineering Design Thinking (Lin et al., 2021), Taiwan	construct engineering designs in technology learning activities, and the effects of incorporating process design techniques into project-based and STEM learning.		groups in terms of design techniques, specifically engineering design thinking and teaching it to others, demonstrating a project combining various aspects of knowledge and guiding students to try to build similar objects themselves, teaching and guiding students to think in an integrative way.
The Effect of Project-Based Learning Assisted by Mobile Learning Applications and Learning Motivation on the Competence and Performance of Teachers (Maritasari et al., 2022), Indonesia	To see an increase in teacher competence and performance in utilizing application-based PjBL (mobile learning)	Quantitative	The PjBL model integrated with mobile learning applications affects teachers' pedagogical competence. It can be seen from the average value of teachers' pedagogical competence for students with high and low learning motivation. The average value shows that teacher performance significantly differs for students with high and low learning motivation. In addition, it also shows the average pedagogical competence of teachers who applied the PjBL strategy assisted by mobile learning for students with high learning motivation.
Creating Props: Improving Writing Skills of Teaching Materials of Elementary Teacher Education Students through Project-Based Learning Model (Wardani, DS, Fauzi, MR, Zafira, R., & Kurniawati, D, 2020), Indonesia	To find out the increase in the writing skills of science teaching materials for elementary school students through the Project Based Learning (PjBL) model	Quantitative	PjBL can help prospective teachers improve their abilities to create teaching materials relevant to 21st-century skills, student character, and the applicable curriculum. It is evidenced by significantly improved assessment results, implying that there is an influence in the form of an increase in the use of the PjBL model on teaching material writing skills for elementary school science teachers. Comparing the first and second years revealed that some aspects of PjBL were deemed more interesting in the second year than in the first.
Examining the Mentoring Process in	To investigate how knowledge and practice education	Method Mixture	From the results of the study, it was found that there is a need for assistance for preservice

Sarah Fazilla, Yulita Molliq Rangkuti, *Professional Ability of Prospective Elementary School Teacher through Project-based Learning Model in Primary Education*

Collaborative Project-based Learning of Preservice Instructional Technology Teachers (Arslantaş & Kocaöz, 2021), Turki	special could be expanded through activity accompaniment		teachers through teacher training programs to produce effective results pedagogically, personally, and academically. So that later, teachers can apply the PJBL model in the classroom, especially in building children's knowledge through appropriate projects. Preservice teachers can also be trained to teach students with special needs through project-based learning. One of them can be done by using 2D animation for students.
Project-based Learning as a Tool for Student-Teachers' Professional Development: A Study in an Omani EFL Teacher Education Program (Al-Busaidi & Al-Seyabi, 2021) Oman	For look so far which is the PjBL model could develop student professional competence teacher candidate	Quantitative	The research found that some students found difficulties working on the assigned project, such as the need to analyze and write about the project objectives and targets. Overall they responded positively, with project learning enhancing their skills to become better and academically sound future teachers.

Based on the results of the analysis of the journals in Table 1, the researcher categorizes these journals into several categories: teachers' ability to apply PjBL by utilizing technology, Teacher motivation and the impact of implementing PjBL in learning, Teacher creativity in combining the application of PjBL with other learning models, and the development of professional capabilities in prospective student teacher through the PjBL model, as shown in Table 3.

**Table 3.** Overview of the Relationship between Prospective Teachers' Professional Abilities and the Implementation of the PjBL Model in Learning in Primary Education

Overview	Journal Article
The ability of teachers to implement PjBL by utilizing technology.	<ul style="list-style-type: none"> <li>• Miller's research regarding virtual applications with a project-based learning model in 2021.</li> <li>• Aljareh's research and Juuti's research on the ability of prospective science teacher students to design PjBL-based learning in 2021.</li> <li>• Maritasari's research on teachers' motivation and competence in training using mobile applications with the PJBL model in 2021.</li> </ul>
Teachers' motivation and the impact of PjBL implementation in learning.	Design Principles for Teacher Learning in Project-Based Learning Contexts: Motivating Teaching, Sustaining Change in Practice in 2021.
Teacher creativity in combining the application of PjBL with other learning models.	Secondary School Mathematics Teachers' Use and Integration of the Flipped Learning Model, Project-Based Learning, and Gamification Methodologies in 2021.
Professional development of student teacher candidates through the PjBL model.	<ul style="list-style-type: none"> <li>• Lin's research on the thinking ability of engineering design teacher candidates through PJBL and STEM models in 2021.</li> <li>• Wardani's research related to the writing ability of prospective teacher students through the project-based learning model in 2020.</li> <li>• Arslantaş &amp; Kocaöz's research related to the mentoring process of preservice teachers through collaborative learning based on PJBL in 2021.</li> <li>• Al-Busaidi &amp; Al-Seyabi's research on developing teacher professionalism through PJBL in 2021.</li> </ul>

## Discussion

Based on the results of a systematic review from Table 3, it is known that there are journals that state teacher motivation in using the PjBL model directly has an impact on increasing children's abilities in developing their mindset on the material being taught. The general problems in society, especially in science learning materials, are that teachers cannot choose a suitable learning model. The use of relevant learning models, such as project-based learning models, is expected to be able to involve students directly through

project-based learning. Miller et al. stated that using the PjBL model can motivate students to continue learning through various attractive design features, better learning quality, and a change in pedagogical attitudes from responsive and culturally relevant teaching and deep understanding (Miller, Severance et al., 2021). This change process can be initiated by designing a more straightforward curriculum and demonstrating a shared and dynamic understanding of the features of PjBL, cultural and community relevance, and responsive 3-D teaching. In science, responsive teaching involves assessing and harnessing individual ideas and experiences toward scientific learning goals and linking learning to knowledge developing in the classroom and the larger community. That is relevant according to Guo et al., who state that the development of learning with the PjBL model can bring about changes in teaching practice in schools and that its implementation requires motivation and professional competence from teachers, as well as support from related parties, and that this can also be realized by reinforcing practical teaching in preservice teacher education (Guo et al., 2020).

The results of *the systematic review* in Table 3 also obtained journal articles related to the ability to implement PjBL models combined with other learning models and approaches. In his study, Hossein (Hossein-Mohand et al., 2021) stated that the problems in learning mathematics are related to the level of children's understanding of the material presented by the teacher and the learning resources used and that the use of digitally-assisted PjBL models can make the learning process better. Using digital-based PjBL models in mathematics teaching can facilitate the teaching and learning process, support the development of online communities, and broadly promote the dissemination of resources, namely mathematics teachers (Siedel & Stylianides, 2018; Trouche et al., 2020). The combination of technology and pedagogical strategies facilitates critical, systemic, and computational thinking skills, decision-making, and problem-solving, considered "21st-century skills and need active methodologies that contribute to the teaching and learning process." (López Núñez et al. 2020; Ortiz-Colón et al., 2021).

Furthermore, in the review results, four journals state the ability of teachers to apply the PjBL model with the help of technology. The existence of a pandemic changes all life processes, including the education system, where information technology is an essential requirement for the continuity of the teaching and learning process. Miller et al. present the results of the research for an overview of the teaching context and provide a summary of the direct implementation of PBL by teachers in terms of four features of PBL, namely explaining the transition to virtual instruction and the priorities set by each teacher during the training session (Miller, Severance, et al., 2021). Teachers implemented the virtual

PBL, highlighting features by comparing instruction face-to-face with virtual and concluding with cross-case comparisons to highlight how teachers apply PJBL differently to encourage the replicable engagement of their particular students. These two cases show that project-based learning can be adapted to virtual forms. In particular, teachers need to learn innovative ways so that the technology used can support PBL features that align with acceptable pedagogies. There needs to be thoroughness and student involvement in implementing technology-assisted PJBL (Al-Busaidi & Al-Seyabi, 2021).

The research of Alrajeh has four obstacles to the PjBL model's implementation: program policies, professional development, environment, and student motivation (Alrajeh, 2021). In order to successfully apply PjBL in teacher preparation programs, there is a need for various levels of professional development for faculty members, partnerships with experts in local organizations and this field of learning, and continual review of present programs. The execution of the teacher preparation program requires the participation of aspiring educators in fully integrating theory and practice; this has a good impact on the student teachers' professional, intellectual, and interpersonal abilities. According to specific research findings, most educational research emphasizes the significance of modifying the learning process in teacher education programs by utilizing (Alrajeh, 2021; Jacka, 2015).

Furthermore, Juuti et al. cite the primary categories of knowledge that educators must include while developing a curriculum or delivering lessons using the PjBL technique as conceptual, factual, metacognitive, and procedural knowledge. Regarding the phases, students are challenged to tackle by looking into their existing knowledge and determining which areas need further information. PJBL, on the other hand, is a multidisciplinary method in which students make products or artifacts due to a process that necessitates developing their driving questions and working together to acquire relevant topic knowledge and skills (Juuti et al., 2021). The study's findings also revealed that the teachers' comprehension of PJBL was not sufficiently clear; they thought that PJBL's goals were to help them with projects and identify their own and administrators' professional development requirements.

In another study conducted by Maritasari et al., who made changes to teaching practices and pedagogical approaches to teachers in Finland, this process was not easy (Maritasari et al., 2022). TRP is linked to an international research project (Finland-USA) in which teachers in both countries design and implement PBL units. The project includes national and international workshops and joint planning sessions with individual teachers or a team of teachers from each school, and researcher about 20 teachers participated. In Sarah Fazilla, Yulita Molliq Rangkuti, *Professional Ability of Prospective Elementary School Teacher through Project-based Learning Model in Primary Education*

the statistical test, it was found that there was an interaction between the application of PjBL strategies assisted by mobile learning and high learning motivation on teacher performance, which was seen from the significance value of  $p < 0.05$  and the average performance of teachers who had high learning motivation was 64.07 compared to students who apply the PjBL strategy and had high learning motivation of 53.47. One-way ANACOVA results were conducted to determine whether there was a statistically significant difference in students' involvement in scientific practice, collaboration, and computer use during the years of study. There was a significant effect of years on planning investigations (PI), conducting investigations (CI), and analyzing the data (AD) after controlling for individual students. It was found that there was little change in the reported frequency of PBL features between the first and second years.

In general, the competence of prospective teacher students can be improved through the PjBL model. Four journal articles state that the competence of prospective teacher students is increased and improved by familiarizing themselves with the use of the PjBL model in the learning process. Lin et al. argue that the cognitive abilities of preservice teachers are essential to make learning more meaningful for students, especially in solving problems (Lin et al., 2021). The main focus of this research is the effectiveness of EDP-STEM-PBL in developing structures for cognitive technology preservice teachers related to design engineering skills. The results showed that the number of preservice technology teachers who were able to explain problems increased from two (13.39) to eight (53.396) in the experimental group and from four (30.896) to five (38.596) in the control group. As a result, after EDP-STEM-PBL, the experimental group's capacity for defining the fundamental problem—that is, their capacity for articulating the problem's scope and context—significantly improved. The findings of this study provide preliminary evidence of the effects of embedding process engineering design into STEM project-based learning for developing engineering design thinking in preservice technology teachers.

In the study, Wardani et al. stated that one of the competencies of educators is to prepare lesson plans (Wardani et al., 2020). However, learning planning focuses only on learning plans, not preparing teaching materials as a whole. PjBL can improve the skills of preservice teachers. The research results show a significant increase from 2.04 to 3.25, meaning that there is an influence in the form of increased use of the PjBL model on the writing skills of science teaching materials for elementary school teachers.

In research by Arslantaş & Kocaöz, preservice teachers can get context-specific expertise in educating students with exceptional needs through mentorship. The mentors Sarah Fazilla, Yulita Molliq Rangkuti, *Professional Ability of Prospective Elementary School Teacher through Project-based Learning Model in Primary Education*

indicated that their coaching was thought to be helpful after helping students with ID create 2D animation through a formal mentoring process set up using PjBL. Integrating mentoring studies with PjBL approaches into teacher training programs can yield pedagogical, personal, and academic benefits for preservice teachers of any discipline. Students are shown to be pedagogically developed, in addition to interdisciplinary skills, and mainly related to special education (Arslantaş & Kocaöz, 2021). The study of Al-Busaidi & Al-Seyabi demonstrates the understanding of the teacher's capacity to apply the appropriate model, where the findings from the research indicate that student reactions are favorable. Students appreciate the project and concur that it helps them finish much work, whereas the research results indicate that student responses are good. Teachers could implement the principles to create courses and several academic abilities. Students that identified difficulties with the project's need analysis and formulating goals and objectives did so as part of their learning process (Al-Busaidi & Al-Seyabi, 2021).

From the ten journals analyzed, it can be seen that there are various challenges in implementing the PjBL model in learning, especially in primary education. There need to be various efforts to improve the quality of project-based learning at the elementary school level, such as combining various learning strategies, especially by integrating technology through various applications that make it easier for children to complete projects. Besides that, it can also be done by providing a digital library with access to virtual activities, such as virtual laboratories, for free at the school (Ngo & Phan, 2019). This study is expected to contribute to higher education institutions' efforts to design the models and techniques to prepare prospective teacher students to develop professional competence by innovating, being creative, and utilizing technology through project-based learning.

## CONCLUSION

Various studies have been carried out by researchers looking at the relationship between the professional competencies of prospective teacher students and the implementation of the PjBL model in primary education. From the results of a *systematic review study*, it was found that there was a pandemic changing the education system with the integration of information technology in the learning process, one of which was by applying a project-based learning model. Using the PjBL model, children can understand the science material being taught.

Several studies seem to focus on improving teachers' skills by applying the PjBL model in the classroom. In addition, some studies state that teachers' proper application of

Sarah Fazilla, Yulita Molliq Rangkuti, *Professional Ability of Prospective Elementary School Teacher through Project-based Learning Model in Primary Education*

PjBL can improve children's critical thinking and problem-solving skills, especially in science, mathematics, and social studies. The study also found that time constraints were the main problem in implementing the PjBL model. The teacher's ability to design projects that matched the teaching material was needed, especially for prospective students and preservice teachers. The ability of teachers to use PjBL, which is integrated with technology, is still an interesting study to find the right solution to these problems, including making learning more exciting and improving the level of children's understanding of the material.

The limitations of this study are that it has not examined how the ability of prospective teachers in elementary schools, especially in Indonesia, related to professional competence in preparing teaching materials based on project-based learning, especially in preparing learning plans integrated with technology according to current curriculum demands. There needs to be further research to see how the professional competence of prospective teacher students in designing project-based learning, especially in preparing lesson plans integrated with appropriate technology and following the project prepared.

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