

## Research Article

Anis Rahmawati\*, Nunuk Suryani, Muhammad Akhyar, and Sukarmin

# Technology-Integrated Project-Based Learning for Pre-Service Teacher Education: A Systematic Literature Review

<https://doi.org/10.1515/eng-2020-0069>

Received Nov 07, 2019; accepted Feb 03, 2020

**Abstract:** An alignment between technology and teachers is required to attain a successful integration of technology in the learning process. This alignment should be started at the teacher training program. This article outlines how the literature points toward Project-Based Learning (PBL) with technology integration in pre-service teacher education. The literature review focuses on describing how technology integrated with project-based learning along with the investigation of what influencing the successfulness on PBL's implementation by integration of technology. The five steps on Systematic literature reviews (SLR) are chosen as a systematic approach for reviewing the literature. Based on the defined inclusion and exclusion criteria, 16 technology integration in PBL studies published between January 2015 and July 2019 was remained and selected to be investigated further. Analysis of the selected studies revealed that the most popular technology integrated with PBL was social media, following by a learning management system. The teacher's ability to give guidance during the learning process is the most influential factor for the success of technology integration in PBL.

**Keywords:** Project-based learning, technology integration, pre-service teacher, systematic literature review

## 1 Introduction

21st-century learning is dealing with the challenge of fast transformation in various aspects of human life. 21st cen-

tury learning pushes teachers to be able to create their learning in such a way that they can prepare students for work in the twenty-first-century workplace [1]. By using innovative learning methods that are under the content of the subject matter, the teacher expected to be able to hone such skills needed to take part in 21st-century life, which is creativity, critical thinking, communication skills and also collaboration skills of students [2].

These skills will only be honed if students are actively involved in the learning process. One method for educating students that can stimulate them to be actively involved in learning by utilizing multifaceted projects as a central organizing strategy is Project-Based Learning (PBL) [3]. Through PBL, students acquire knowledge and skills by working on a project over a long time to investigate, answer questions, solve problems, authentic challenges, interesting, and complex [4].

Goldstein [5] mentioned that future teachers who enjoy challenges, as well as a creative process, will value the opportunities the interaction among peers, work in collaboration, dialogue, leadership, as well as the classroom climate changed. They are always enthusiastic and friendly to bring meaningful cognitive learning. PBL has become a key methodology in developing pre-service teachers fundamental skill in critical and research [6]. That ability will make them as innovative teachers who will design their future learning based on recent research. Implementing PBL in the learning process during the teacher preparation program will help the pre-service teacher shape understanding and provide good practice regarding this method.

The integration of technology into learning is part of efforts to achieve competencies that are demanded by the 21st-century workforce. Technology is a tool that will provide convenience in various human activities. Technology coverage is very broad, covering all results of human thought whether in the form of products or processes that aim to meet human needs and desires [7]. This includes computers or information technology.

The integration of technology in learning that will support the achievement of 21st-century competency is through learning methods that use technology to support

\*Corresponding Author: Anis Rahmawati: Universitas Sebelas Maret (UNS); Email: [anisrahmawati@staff.uns.ac.id](mailto:anisrahmawati@staff.uns.ac.id)

Nunuk Suryani: Universitas Sebelas Maret; Email: [nunuksuryani@fkip.uns.ac.id](mailto:nunuksuryani@fkip.uns.ac.id)

Muhammad Akhyar: Universitas Sebelas Maret (UNS); Email: [muhammadakhyar@staff.uns.ac.id](mailto:muhammadakhyar@staff.uns.ac.id)

Sukarmin: Universitas Sebelas Maret; Email: [sukarmin67@staff.uns.ac.id](mailto:sukarmin67@staff.uns.ac.id)

learning goals in certain fields. Technology can integrate into learning in many dimensions. It should provide a rich learning environment, develop a multi-dimensional perspective related to a complex phenomenon for the students, promote a flexible arrangement of information for complex learning contents and meets different needs for different individual characteristics [8]. Further, Pilten [8] mentioned that the successful integration of technology in the learning process should start with the presence of a deal between technology and teachers during the teacher training program. Therefore, it is important to familiarize the pre-service teacher with the integration of technology in the learning process. One of the learning models that enable the use of technology in the learning process effectively is project-based learning.

During 2000-2019, some literature reviews in accordance with PBL have previously conducted with diverse research focus as well as research setting. Kokotsaki, Menzies, and Wiggins [9] explore the literature on project-based learning's field in a variety of different school contexts and phases, from elementary school to tertiary education. On the basis of their evidence, Kokotsaki, Menzies, and Wiggins concluded that factors facilitate the implementation of PBL that are modern digital technology, high quality of group processes, teachers' competency on scaffold students' learning effectively as well as provide guidance and support, balance didactic instruction with in-depth investigation of inquiry methods, and a well-aligned of assessment methods.

Another review conducted by Quint & Condliffe [10] which focuses on the effectiveness of PBL to improve students' outcomes in the K-12 education program. Quint & Condliffe's study found that the PBL approach holds promise for improving students' outcomes but there is still a lot to be learned about its effectiveness and about how to strengthen its implementation. A systematic literature review that discusses the integration of technology in instructional learning with PBL has not been found. For this reason, this article outlines how the literature points toward how technology integrated with PBL. The discussion focused on the form of technology and how technology is used in the learning process, along with the investigation of what influences the success of implementing PBL with technology integration. With that information, it expected that future studies could be designed PBL course with technology integration which will deal with these challenges.

## 2 Theories of Project-based Learning

The PBL approach based on Dewey's [11] theory which mentions that the focus of education is to make students feel the meaning of truth and principles through their own experience. In Dewey's point of view, knowledge does not only show facts in abstract concepts. Rather, knowledge itself is gained by human beings through experiences. According to Dewey's perspective, an issue about knowledge is connected with all of the processes to solve life problems. Further, Dewey stated that teaching must focus on guiding students to carry out a self-directed intentional inquiry related to real-world problems.

Vygotsky's theory [12] regarding the importance of social interaction in the learning process also underlying the PBL approach which generally carried out collaboratively. The social constructivism theory of Vygotsky considers the separation of social and practical elements in learning should not occur because the most important moments in the course of intellectual development occur precisely when social communication and practical activities, two previous separate development paths, meet. Through practical activities, student builds meaning at the level in his self, while communication connects this meaning with the interpersonal world shared by students and their culture.

The inability of students to connect their desire to learn with the curriculum requirements in schools often make obstacles in the learning process. The methodology of PBL could reinforce students desire to learn naturally by it's characteristics such as the formulation of prioritizing learning based on problems or needs made by students themselves, through the practical way students enhance the ability to integrate knowledge, and provides meaningful and relevant learning [6]. Further, Basilotta Gómez-Pablos et al. stated that the implementation of PBL consists of three fundamental phases that are planning, creating, and processing. The two main activities during the planning phase are choosing the topic and organize the required materials such as the project tasks, the project schedule and the steps for executing the project. The creation phase contains students' activities in developing and documenting the project's ideas from the group, combining all project group's members' ideas, coordinating to work on the end product. Reflection on and follow-up of the project done during the processing phase through activities in sharing the products in project groups or with the whole class, receive feedback and reflect on the learning undertaken.

The emphasis on constructivism theory in technology integration in learning is more placed on the use of technology to support meaningful learning, which is characterized as active, intentional, authentic, cooperative or collaborative, and constructive learning. Technology can support meaningful learning when the ways of utilizing technologies are technology-as-partner in the learning process, rather than technology-as-teacher. In this way, students will learn by using technology, not learning from technology [13].

One way of conceptualizing technology integration in constructivism learning is through activity theory [14]. As core activity is a subject (student or teacher) acting on an object (human or non-human component of the system) to achieve results (learning goals). Elements as mediation from core activities are tools used by the subject in their involvement with objects. In the context of technology integration in learning, the tool is the technology that is used to support several activities designed for learning.

### 3 Methodology

Systematic literature reviews (SLR) chosen as a systematic approach for reviewing the literature. SLR is defined as a process of identifying, assessing, and interpreting all available research evidence in order to provide answers for certain research questions [15]. This study following the five steps in conducting a systematic review as described by Khan, Kunz, Kleijnen, and Antes [16]. Those steps consist of framing the question, identifying relevant articles, assessing study quality, summarizing the evidence, and interpreting the findings. The activities along with the results for each step are described next.

Research questions build based on the objectives of the study. Identifying relevant articles step contains an attempt to identify articles that address the research questions. An explanation of the search procedures used to locate the relevant articles and the inclusion, as well as exclusion criteria, are described in this step. After articles have been selected, in-depth assessments for each article were conducted during the assessing study quality step to avoid the risk of various biases of the evidence. In the summarizing the evidence step, the selected articles then extracted to aggregate the evidence which is data that contribute to answering the research questions concerned in this literature review. The data is summarized to facilitate the synthesis process. The aggregation of many single pieces of small evidence can be even stronger evidence.

The data were presented in a manner consistent with the research questions.

The last step is interpreting the findings, that is a step to interpret the findings related to the research questions obtained from the previous steps. The conclusions or recommendations given must refer to the available evidence.

## 4 Result and Discussion

Following the five steps of the systematic review, the results of this current study are described here.

### 4.1 Step 1: Framing the question

This literature review study intends to understand what the education researcher has done in integrating technology in project-based learning during preservice teacher preparation programs. The specific research questions guiding this literature review are:

- Q1: How the integration of technology and PBL is applied in the teacher preparation program?
- Q2: What are influencing factors at the successfulness of PBL integration in the teacher preparation program?

The motivation underlying the emergence of each research question addressed by this study are listed in Table 1.

**Table 1:** Research questions and motivation on current literature review

| Code | Research Question   | Motivation  |
|------|---|---|
| Q1   | How the integration of technology and PBL is applied in the teacher preparation program?                  | Identify the types of technology used in PBL and how to integrate it during the learning process    |
| Q2   | What are influencing factors at the successfulness of PBL integration in the teacher preparation program? | Identify all aspects that may influence the success of implementing PBL with technology integration |

## 4.2 Step 2: Identifying relevant articles

The search for articles was conducted in six scientific databases, i.e. Science direct, Sage journals, Tylor and Francis Online, Eric, Elsevier, and Emerald. Multiple search procedures were used to collect research articles that fitted with the aims of this current study. The first step was conducted to identify appropriate studies. During this step, the six scientific databases were consulted in July 2019, using the following search term: project-based learning. Total 1029110 hits obtained from six databases. Besides, results were refined with advance search terms: "project-based learning" AND "pre-service teacher", resulted in 230 hits. To focus the study on the recent research, the result from the latest search step then limited to articles published between (January) 2015 and (July) 2019 and gain 146 hits of journal titles.

Afterward, to keep the review focused along with appropriate studies selection, some inclusion and exclusion criteria were applied. The inclusion criteria utilized in this study were: (a) The study considered if they met the three fundamental phases of a project-based learning method as defined by Basilotta Gómez-Pablos et al. [6] (b) The setting of the study is in the pre-service teacher education, and (c) articles published written in English.

The article will exclude when fitting with at least one of these criteria: (a) studies which do not integrate technology with project-based learning in the learning process, (b) The full text article was not available for the authors, and (c) The article comes from book (chapter) reviews. 26 articles remained after excluding papers based on title and

abstract. The author then selected relevant articles by judging the full text against the criteria for inclusion and exclusion. In this way, 19 publications were fulfilled all inclusion criteria but 3 of them suitable with one of excluding criteria, that was not integrating technology with PBL in the learning process. Therefore the final 16 articles were included in this literature review. An overview of the search procedure is displayed in Figure 1.

## 4.3 Step 3: Assessing study quality

The objective of the included studies was to describe what the education researchers have done regarding the learning instructional which implements the project-based learning with technology integration during preservice teacher preparation programs. This recent study reviewing instructional study from the four components [17] that are tasks, supportive information, procedural information, and directed practice. The full texts of all selected articles are consulted with those components. The study should describe the instructional process in detail, such as the learning model used along with the learning procedures taken, the time of the study, the subjects of study, the learning goal, the project task as well as the learning outcome. Further, there were examination on how the effect of the instructional method on student outcome was established, and whether it supported by relevant theories. All prior selected articles have been met those criteria.

## 4.4 Step 4: Summarizing the evidence

This section starts with providing an overview of the contexts of the selected articles, following by describing the results for each of the two research questions. The backgrounds of the study from sixteen articles studied here are the majority in English education (25%). The general education or studies which are not in the specific field of the teacher training program and early childhood education are in the next place with a 19% number of studies, following by computer education (13%). Other studied held in physic education, Psychology education, music pedagogy, and introduction to education, as described in Figure 2.

The studies majority used the case study as the study method (44%), following by a qualitative phenomenological approach (13%) as seen in Figure 3. Other methods used in integration technology with PBL studies are mix method, action research, design-based research, empirical research, quantitative research, content analysis, as well as descriptive research.

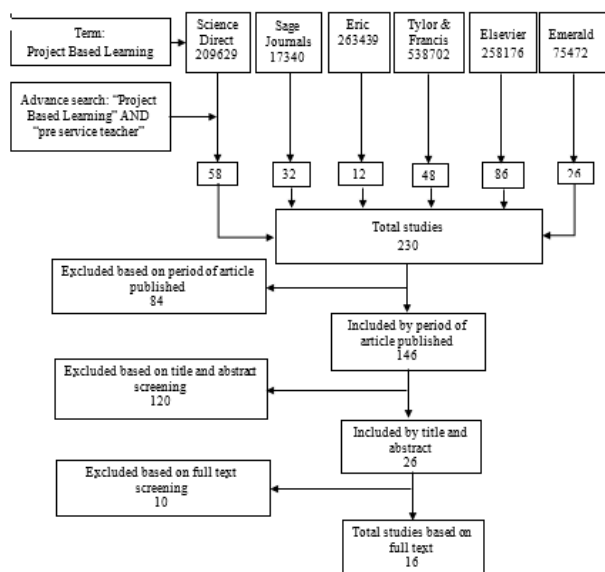


Figure 1: Search procedure of literature

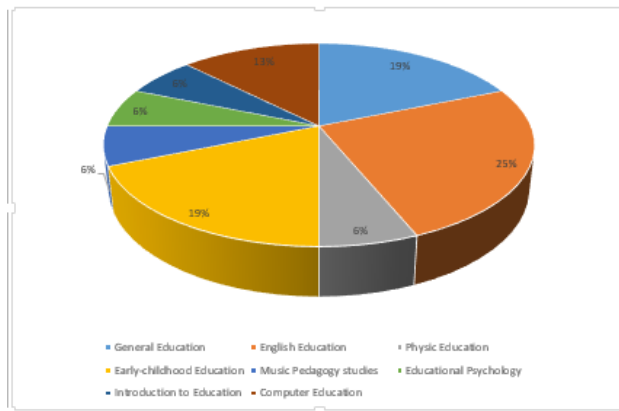


Figure 2: Background of the studies

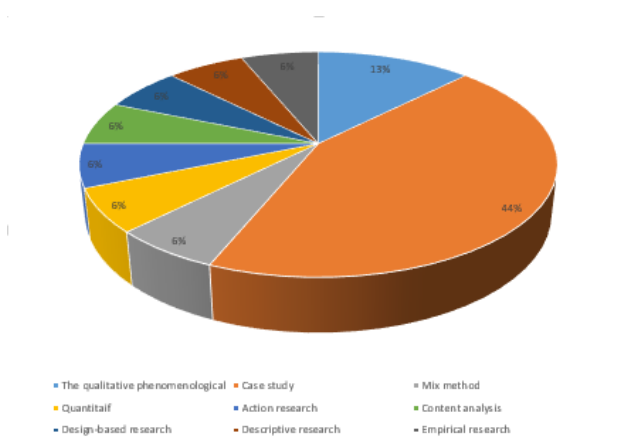


Figure 3: Method of the studies

Types of technology used in integration with the learning process which implement PBL can be grouped into two main categories that are computer-based technology and technology modeling. While computer-based technology mainly in the four forms, that are social media, cloud computing, learning management system, computer programming, and website. Figure 4 describes the distribution of technological integration forms in this study.

This study identifies several aspects that may influence the success of implementing PBL with technology integration. The instructors' guidance is the most influential factor for the success of technology integration in PBL, following with students' ability in communication including the ability in English. All factors that influence integration technology in PBL are described in Figure 5.

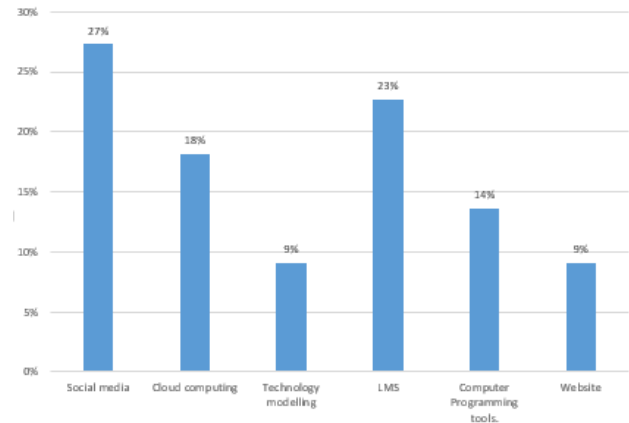


Figure 4: The distribution of technological integration forms

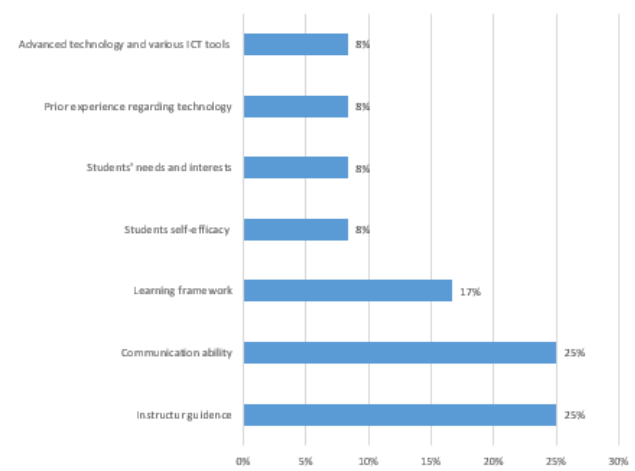


Figure 5: Influential factors in PBL with technology integration

## 4.5 Step 5: Interpreting the findings

### 4.5.1 How the integration of technology and PBL is applied in the teacher preparation program?

Social media is widely used as learning aid technology-based because of its characteristics that are easy to use and well known by most students these days. Social media as a kind of Computer-supported collaborative learning (CSCL) has been a rising paradigm that presents in utilizing technology as a mediating tool in the process of collaborative learning. The existence of technology in collaborative learning can enhance interactions among students as well as teamwork in groups. It is also beneficial in giving sharing facilities and distributing knowledge and expertise among community members. Chuang [18] explores the roles played by social media technology in facilitating a learning community for online group collaborative learning. Chuang study takes place at a teacher education



center by involving 31 pre-service teachers who come from three different courses as participants. Four online learning groups were formed with members come from three different courses. Each group collaboratively creating WebQuest as a project they have to do. The face-to-face interaction between group members in real-time almost does not occur at all. They have to work collaboratively in cyberspace. Facebook used as a social networking site in the Chuang study. Online teamwork certainly presents both a social and emotional challenge. Chuang claims that social media such as Facebook helped to build social presence and communication among group members.

Another study that used social media as technology integrated with the pre-service teacher learning program was conducted by Waldman & Harel [19]. Their study aims to provide pre-service English as a foreign language (EFL) teachers both in Israel and German an apprenticeship on how technology can be used in learning to transcend classroom boundaries for mobility and virtual cooperation. The pre-service teacher from two countries worked collaboratively in student teams whereas comprising three Israeli and two Germany students. The project-based learning tasks in Waldman & Harel's study were comparing and critically analyzing the ways EFL is taught in Israel and Germany, following by co-constructing electronic posters showcasing students' findings. The social media sites as synchronous tools chosen in Waldman & Harel's study were Skype and WhatsApp. The pre-service teachers used social media to communicate among team members regularly during do their projects through videoconference as well as text communications.

A telecollaboration project between a pre-service teacher from Thailand and Mongol had been designed and implemented which aim to provide 21st-century learning experiences among the pre-service teachers. This study conducted by Makaramani [20] with participants were 33 third-year Early Childhood pre-service teachers from Thailand and 24 third-year Russian and English pre-service teachers from Mongol. This project-based learning study used information and communication technology (ICT) to increase the quality of education. Aculearn system, Google+, and hangouts were ICT tools utilized for telecommunication between pre-service students from two countries. Group projects formed in each country which consists of 6 members for each group. A project proposal and action plans with the theme of Food for Life written by each group. A Food for Life community creates in Google+ used for communicating upcoming activities and assignments among group members. Each group working on their projects, communicating and reporting their progress through the Food for Life online Community and

Google+ Hangouts. Pre-service students from Thailand present on-line lesson to Mongol students used a University teleconference system called AcuLearn. Otherwise, they have to attend the on-line presentation of Mongol students' projects via Google+ Hangouts. A website was constructed by each group to present their PBL project results. At the end of the learning process, the individual pre-service teacher gives their reflection of learning experience through posting on the online community.

The project-based learning study held by Goldstein [5] also integrates social media in the learning process. Goldstein's study aims to describe the impact of the PBL approach on learning and teaching physics. By taking pre-service elementary school teacher who enrolls in the "Fundamentals of Physics" course as the subject of study, Goldstein used social media site YouTube as technology-supported learning. The PBL tasks in the Goldstein study were to select ready-made video clips that are relevant to the field of mechanics from YouTube and create video clips that contain explanations of physical phenomena. The pre-service teachers then have to upload their video creations on YouTube. Through this PBL approach, pre-service teachers enhance their technological skills in forms of video downloading and uploading, using the screen capture tools, and editing of video clips.

Ng [21] conducted a study which aims to investigate whether self-regulated learning is a viable pedagogy to improve the quality of students' wiki-based projects. Participants of this study were 76 pre-service early-childhood teachers at a teacher training institute in Hong Kong. The participants work collaboratively to accomplish a project task in creating educational wiki sites for young children to learn about a specific topic. The project task for each group was to create learning material about any topic chosen by applying the knowledge and skills they have learned in the classroom that aims to enable kindergarten students to learn. Google wiki sites were chosen as a platform used for students' group projects because the teacher training institute has provided Gmail accounts for all the students. Each group has three to five members.

Through their study in teacher Education College's environment, Goldstein and Peled [22] try to examine pedagogical approaches in using wikis in teaching and learning. The Goldstein&Peled's study focused on pedagogical, cognitive, social and administrative aspects of wiki-based teaching. The wiki assignment held along with some additional assignments, such as sharing an idea in a forum or exam. The assignments typically consisted of several steps, that were introduction of a wiki environment; group project formation, topic selection, acknowledge the topic in the wiki; looking for meaningful resources; writing a

wiki entries; provide feedback to peer entries; rewrite the entry based on the feedback from instructor as well as from peers, and create cross-links between entries.

The other technology based on the computer which used as educational aid was computer programming. Thompson *et al.*, [23] created digital simulations to support pre-service teachers to enhance their communication ability, named Teacher Moment. Designed with scenarios from in-person simulations, Teacher Moment used to prepare pre-service teachers for taking conversations with parents. The pre-service teacher who enrolled in an Introduction to Education course do an approximation of practice. This kind of practice was a set of experiences that purposefully focus on specific aspects of teaching with varying levels of complexity. In Thompson's study, a specific aspect was referred to the communication skill. All of the participants did homework assignments individually to complete Teacher Moments simulations. The pre-service teacher used Teacher Moments in this study to respond to a text-based or video-based simulation experience. After a participant completing all responses, a summary page with all of the text scenarios and participant's responses will provide. This summary allows participants to review responses that have been given, as well as to share with peers in class.

Jordan [24] conducted a study that focuses on infusing teacher preparation programs with design-based pedagogies to support pre-service teacher's development of design thinking. Design-based pedagogies are useful to equip pre-service teachers with the adaptive skills needed to deal with the complex and unpredictable problems of practice. At an undergraduate elementary education program, Jordan did his study in an educational psychology course which the purpose was to prepare pre-service teachers in designing instructional innovations. Pre-service teachers participate in various design projects collaboratively to overcome authentic instructional problems through iterative cycles of design. Pre Service teachers explore various resources such as research articles, teacher blogs, as well as YouTube videos to seek expert and potential user perspectives on strategies to improve children's academic learning. Each group project creates two different instructional products, which were an engaging, participatory learning environment for their pre-service teacher colleagues and a set of learning resources for elementary students' parents or family members. The latest design ideas have to post online before class sessions.

Park [25] conducted a blended learning study that aims to describe the benefits of using drama projects in the Teaching of English as a Foreign Language in different teaching situations. The technology used in this study was

in the form of a Professor's website which provides all the lesson content, information, resources, and assignments. The project task was made a shortened English version and wrote a Korean transcription of a classic drama, then rehearsed the edited version and performed it.

A study that aims to investigate the role that online technologies can play in PBL held by Chanpet, Chomsuwan, and Murphy [26]. In the context of the EFL teacher preparation program in Thailand, pre-service teachers have to do a project task to collaboratively create learning resources (artifacts) such as a video to teach learners vocabulary about a particular topic. A learning management system (LMS) hosted on the university's servers was used as education technology. The open-source tools such as a general-purpose scripting language (PHP) in conjunction with an open-source database management system (MySQL) used to construct LMS. The LMS provides communication tools in the form of the discussion forum, CHAT rooms, and an internal email system. The LMS also provided an activity report for each learner include their activity in the discussion and CHAT room. Instructors use the activities reports as a part of assessment tools. This study revealed that the technology provided a foundational scaffold to support both the learners' and the instructor's activity and interaction.

Dağ, [27] conducted a study that aims to develop pre-service teacher professional skills to teach computer programming skills during the teacher's training program. The setting of this study was at an elective course organized for pre-service computer teachers which consist of 26 pre-service teachers as participants. The digital story design and presentation were the project tasks that must be done by pre-service students. Technology integration in learning in this study was in the form of LMS. At the beginning of the course, students need to enroll at Moodle LMS. All learning content, documents, information and materials related to the course shared through the Moodle LMS, along with homework presentations by students and the evaluations by the instructor. Moodle LMS gives the possibility for the instructor and the students to be in contact with each other outside of the class hours.

Another form of technology integrating with the learning process was cloud computing. The study by Çakiroğlu & Erdemir [28] intended to explore the roles of the instructor and students in design activities based on project-based learning via cloud computing technology. The collaborative project task on Çakiroğlu & Erdemir's study was web site development using the affordances of SharePoint Online service. As participants in this study were 13 pre-service computer teachers who enrolled in an internet programming course in an online instructional technologies

program of a public university in Turkey. Carried out along 8 weeks, Çakiroğlu & Erdemir's study uses Office365 during the instructional process. The instructor and the students in the groups interacted via web conferencing at three lesson hours per week.

Dag & Durdu, [29] carried out a study that aims to investigate the pre-service teachers' experiences regarding the information and communications technology (ICT)-integrated Project-based learning (PBL) process. The discussion on this study focuses on pre-service teacher's experiences about group work and collaboration, resources, research methods, problems encountered and problem-solving strategies, along with their thoughts toward learning processes in PBL. The setting of Dag & Durdu's study was a course which aims to integrate technology into classroom teaching. The participants of this study were 413 pre-service teachers who come from six different educational programs at a faculty of education. Each group project consists of three to five students who select a project topic that had to be appropriate with their educational program. During the course instruction, the pre-service students participated in face-to-face sessions and an e-learning environment using LMS. The LMS provides course materials in forms of presentations and other documents, activities' schedule, and a forum discussion. All participants had the opportunity to share the problem as well as the knowledge or information through the LMS.

Avsec & Sajdera [30] used Technology modeling in the form of construction sets, construction models, machine elements, as well as technical puzzles and sets to teach technology and engineering education for pre-service preschool teachers. The utilize of technology modeling aim to enhance pre-service teachers' attitudes to technology, enrich their own experiences with engagement in technology and engineering activities, and improve their creativity that could contribute to their engineering thinking. Whereas engineering thinking associated with enhancement of real-world learning, emphasizes system thinking, problem finding and creative problem solving as well as visualizing, improving, and adapting products and processes.

Pre-service preschool teachers who enroll in Technology and engineering education courses attend hands-on laboratory work which is divided into assistant practice (observation) and professional practice in Kindergartens (observation and teaching performance). Technology modeling used to introduce students to the world of design and technology; the specification of machine elements as well as joints, drives and motion transfer, as well as the concept of energy and its forms of use. Taking background studies at the pre-service preschool teachers program, Avsec &

Sajdera mention that technology modeling helpful to prepare pre-service teachers for innovative performance towards enhancing technical knowledge and skills.

Gallagher, [31] conducted a study that intends to examine a technology-enhanced practice-based approach in fostering the knowledge and skills in culturally and linguistically responsive instruction of pre-service teachers. As participants in the Gallagher study were 169 undergraduate preservice teachers in various courses throughout the three semesters. Gallagher's study is a multimedia case study, which focused on one particular type of practice meant to simulate the work of teaching in a controlled environment. In his study, Gallagher used cases of videos and artifacts produced by students and schools as part of a multimedia case in practice-based education intended to simulate teaching work in a controlled environment. Videos and artifacts used interchangeably with written reflections and small group and whole-class discussion. Video cases helpful for pre-service teachers as a connections' bridge between theory and practice and involving them in previously unfamiliar practices and contexts.

#### **4.5.2 What are influencing factors at the successfulness of PBL integration in the teacher preparation program?**

Teacher guidance becomes the first factor that influences the success of influential factors. In the beginning, instructors have to determine the project task regarding the course goal. During the PBL process instructors have to act as a guide. From Çakiroğlu & Erdemir's study, it was reported that at the beginning and during the project, the instructor's guidance helped students in fulfilling the time's responsibilities, constructing groups as well as ensuring the group harmony. Furthermore, Students stated that they received the necessary support from the instructor when they had difficulty regarding the technology used in the learning process. The instructor's experience with the technology used was helpful to support students when met with technical difficulties.

Dag & Durdu [29] from their study conclude that working with technology integration in PBL requires hard work both in students' side nor the teachers' side. Using the internet as resource materials in finding the solution for the project task needs good communication among group members. Exchange of ideas between members is needed, and this process requesting instructor guidance.

Instructor guidance starts in writing a detailed description of tasks to make it easier for students to understand the purpose of the project task. When integrating



technology in the learning process, the instructor needs to prepare guidance materials for using technological tools. It is necessary to reduce the students' time to consume in understanding technology. Especially if the type of technology used is relatively new, or students have never interacted with this kind of technology before. Instructors should be aware of the students' zone of proximal development (ZPD), which is an existence of distance between problems that learners can solve by themselves and what they cannot solve without assist or scaffold from teachers or peers. When learners encounter a new discipline with specific language and concept which is not familiar with, this distance may be more significant. The teacher needs the ability to seek an effective combination of different types of teaching [5].

Most education technology aid developed based on the English language. The technology environment likewise the manual operation guidance prepared in English. Therefore, the students' English ability will influence in implementing PBL with technology integration [20]. Especially when technology is used to establish communication with students from other countries with different languages [29]. The language barrier also will impact the success of students' understanding regarding the subject content when the materials come from the online article written in English [5].

The other factor which influences the success of PBL implementation with technology integration is a learning framework. Chanpet *et al.*, [26] stated that the success of technology integration in education is not reliance on the advancement of technology itself. A learning framework that supports managing and organizing learning material and structuring of submission of evidence take a more important role in the learning process. The learning process needs to implement various teaching and learning methods as well as assessment activities to enhance the quality of learning and teaching [21].

Students' needs and interests are being another factor that influences the achievement of the implementation of PBL with technology integration [20]. The learning objective and goals should be determined according to students' needs and interests. Nevertheless, by knowing the needs and interests of students, the instructor could arrange the learning plan appropriate for the students

Students prior experiences regarding technology is also influence factor for the success of implementing PBL with technology integration [24], along with the advancement of technology and various ICT tools which are available [20]. And last but not least, students' self-efficacy also plays an important role in the successful implementation of PBL [27].

The articles reviewed in this study clearly illustrate how technology is applied in the learning process. However, it is still rarely found in-depth discussion related to how to assess the learning that implements PBL with technology integration. PBL assessment occurs during and following the learning process or in other words embedded within the learning process [26]. For this reason, special techniques and assessment tools are needed to capture the learning process with the PBL. Especially with the integration of technology in learning, certain assessment techniques are needed to be able to see the mastery of technology by students along with the achievement of learning objectives. Individual as well as group achievements need to be considered.

## 5 Conclusion

The systematic literature review of 16 selected literature related to the studies of Project-Based Learning with Technology Integration in Pre Service Teacher Education revealed that the most popular technology integrated with PBL was social media, following by learning management system, cloud computing, computer programming, and website. The teacher ability in guiding learning process with technology integration is the most influential factor for the success of technology integration in PBL, along with students' ability in communication, learning framework, students' self-efficacy, students' need and interests, prior experience regarding technology, and the advancement of technology and the availability of various ICT tools.

## References

- [1] Jia, Y., Oh, Y.J., Sibuma, B., and Labanca, F., Measuring twenty-first century skills: development and validation of a scale for in-service and pre-service teachers, *Teach. Dev.*, 2016, 20(2), 229–252
- [2] Simeonov, T.S., Blended Project-based Learning for Building 21st Century Skills in a Bulgarian School. *Proceedings of International Conference ICT for Language Learning*. Paper presented at ICT for Language Learning Conference, (Florence, Italy), 2016, November 17–18, 108
- [3] García, C., Project-based Learning in Virtual Groups-Collaboration and Learning Outcomes in a Virtual Training Course for Teachers, *Procedia - Soc. Behav. Sci.*, 2016, 228, 100–105
- [4] B.I. for Education, "What is PBL?", BIE.org, 2019. [Online]. [https://www.bie.org/about/what\\_pbl](https://www.bie.org/about/what_pbl) [Accessed: 22-Jan-2019]

- [5] Goldstein, O., A project-based learning approach to teaching physics for pre-service elementary school teacher education students, *Cogent Educ.*, 2016, 3, 1–12
- [6] Basilotta Gómez-Pablos, V., Martín del Pozo, M., and García-Valcárcel Muñoz-Repiso, A., Project-based learning (PBL) through the incorporation of digital technologies: An evaluation based on the experience of serving teachers, *Comput. Human Behav.*, 2017, 68, 501–512
- [7] Krupczak, J., et al., Defining engineering and technological literacy, *Proceedings of the American Society for Engineering Education*. Paper presented at the 2012 Annual Conference of the American Society for Engineering Education, (San Antonio, Texas), June 10 - 13, 8–14
- [8] Pilten, P., Pilten, G., and Sahinkaya, N., The Effect of ICT Assisted Project Based Learning Approach on Prospective ICT Integration Skills of Teacher Candidates, *J. Educ. Train. Stud.*, 2017, 5(3), 135–147
- [9] Kokotsaki, D., Menzies, V., and Wiggins, A., Project-based learning: A review of the literature, *Improv. Sch.*, 2016, 19(3), 1–11
- [10] Quint, J. and Condliffe, B., Project-Based Learning: A promising approach to improving student outcomes, 2018, [https://www.mdr.org/sites/default/files/Project\\_Based\\_Learning\\_Issue\\_Focus-final3.pdf](https://www.mdr.org/sites/default/files/Project_Based_Learning_Issue_Focus-final3.pdf)
- [11] Dewey, J., *Experience & Education*, 1938, New York: Touchstone, ISBN 978-0-684-83828-1.
- [12] Vygotsky, L.S., *Mind in Society: The Development of Higher Psychological Processes*, 1978, London: Harvard University Press. ISBN: 9780674576292
- [13] Howland, J.L., Jonassen, D.H., and Marra, R.M., *Meaningful Learning with Technology*, 4th Ed., 2012, Boston: Pearson. ISBN: 9780132565585
- [14] Engeström, Y., *Learning by expanding: an activity-theoretical approach to developmental research*, 1987, Helsinki: Orienta-Konsultit Oy. ISBN: 9519593322
- [15] Wahono, R.S., A Systematic Literature Review of Software Defect Prediction: Research Trends, Datasets, Methods and Frameworks, *J. Softw. Eng.*, 2015, 1(1), 1–16
- [16] Khan, K.S., Kunz, R., Kleijnen, J., and Antes, G., Five steps to conducting a systematic review, *J. of the Royal Soc. of Med.*, 2003, 96, 118–121
- [17] Friedman Peahl, A., Tarr, E.E., Has, P., and Hampton, B.S., Impact of 4 Components of Instructional Design Video on Medical Student Medical Decision Making During the Inpatient Rounding Experience, *J. Surg. Educ.*, 2019, 76 (5), 1286–1292
- [18] Chuang, H.-H., Leveraging CRT awareness in creating web-based project through use of online collaborative learning for pre-service teachers, *Educ. Technol. Res. Dev.*, 2016, March, 1–20
- [19] Waldman, T. and Harel, E., Getting their feet wet: trainee EFL teachers in Germany and Israel collaborate online to promote their telecollaboration competence through experiential learning, 2016, Dublin: Research-publishing.net. <https://doi.org/10.14705/rpnet.2016.telecollab2016.505>
- [20] Makaramani, R., 21 st Century Learning Design for a Telecollaboration Project, *Procedia Soc. Behav. Sci.*, 2015, 191, 622–627
- [21] Ng, E.M.W., Computers & Education Fostering pre-service teachers' self-regulated learning through self and peer assessment of wiki projects, *Comput. Educ. J.*, 2016, 98, 180–191
- [22] Goldstein, O. and Peled, Y., Pedagogical aspects of integrating wikis in pre-service teacher education, *Technol. Pedagog. Educ.*, 2016, February, 1–19
- [23] Thompson, M. et al., Teacher Moments: A Digital Simulation for Preservice Teachers to Approximate Parent–Teacher Conversations, *J. of Dig. Learn. in Teacher Edu.*, 2019, 35(3), 144–164
- [24] Jordan, M.E., Teaching as designing: Preparing pre-service teachers for adaptive teaching, *Theory Into Pract.*, 2016, May, 1–10
- [25] Park, H., Student perceptions of the benefits of drama projects in university EFL, *English Teach. Pract. Crit.*, 2015, 14(3), 314–334
- [26] P. Chanpet, K. Chomsuwan, and E. Murphy, Online Project-Based Learning and formative assessment, *Technol. Knowl. Learn.*, 2018, April, 1–21
- [27] Dağ, F., Prepare pre-service teachers to teach computer programming skills at K-12 level: experiences in a course,” *J. Comput. Educ.*, 2019, March, 1–37
- [28] Çakiroğlu, U. and Erdemir, T., Online project based learning via cloud computing: exploring roles of instructor and students, *Interact. Learn. Environ.*, 2018, July, 1–19
- [29] Dağ, F. and Durdu, L., Pre-Service Teachers' Experiences and Views on Project-Based Learning Processes, *Int. Edu. Studies*, 2017, 10(7), 18–39
- [30] Avsec, S. and Sajdera, J., Factors influencing pre-service preschool teachers' engineering thinking: model development and test, *Int. J. Technol. Des. Educ.*, 2018, November, 1–28
- [31] Gallagher, C., The use of a multimedia case to prepare classroom teachers of emergent bilinguals, *Teach. & Teach. Educ.*, 2019, 84, 17–29