



A Study on Key Components of Problem-Based Learning through Literature Review

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With problem-solving capacity continuously gathering prominence in professional field, Korean universities are deviating from traditional rote-teaching to a teaching method which ensures development in problem-solving ability among students. As part of several new teaching methods, problem-based learning (PBL) has emerged as an effective means for education. For successful implementation of PBL within university curricula, pinpointing components required for PBL program is necessary, and yet essential components of PBL have not been specifically identified according to studies. Thus, this study conducted a literature review to identify key components which are necessary for effective application of PBL in university courses.

Keywords: Problem-based learning; Component; Korea; University; Education

INTRODUCTION

The World Economic Forum's "The Future of Jobs" (2016) report, states that 'complex problem-solving' has been assessed as the most important competency for future society. In "The Future of Jobs Report 2018," the World Economic Forum continues to highlight complex problem-solving as a skill in demand, along with capacities such as analytical thinking and innovation, critical thinking and analysis, active learning and learning strategies, and reasoning, problem-solving and ideation. The Korean Ministry of Education has suggested that education which i) manifests the learner's potential, creativity, and problem-solving capacity, ii) fully exhibits learner's interest and aptitude, and iii) makes much of mankind and contributes to social unification, as three major directions for Korea's educational development in response to the Fourth Industrial Revolution.

Nowadays, universities within Korea are asked not only to play a role as research centers but are also requested to educate students into professionals equipped with problem-solving capacities well fit for industry within society. However, it is reckoned that rote-teaching has limits in educating present-day students, who differ in approaches to reaching learning capacity and cultural characteristics compared to those of the past. Thus, creative educational attempts to ensure acquisition of specialized knowledge and progress in on-site capability are required now more than ever. Various education methods digressing from the established rote-teaching method have been examined previously, including major-based capstone design, problem-based learning, experimental learning, project-based capstone design, and multi-disciplinary approaches.

Among newly emerging teaching methods receiving attention, problem-based learning (PBL) features as a measure which aims to solve problems through cooperation and discussion in a professor-student or student-student context. PBL has been emphasized by scholars as an effective method to improve the traditional education paradigm and therefore has been selected for further examination. This study aims to conduct a literature review of domestic and foreign academic studies and come up with essential components of PBL, which would provide assistance in devising a model adequate for contemporary situations within universities in Korea. To do so, this study analyzed components of PBL described in existing studies within the literature.

METHODS

Research subject and data collection

The research focused on domestic and foreign qualitative and quantitative studies published in academic journals from January

2015 to December 2020. The search was conducted on primary databases used in the Healthcare field, which included Google Scholar, KISTI, EMBASE, PubMed, KISS, RISS, and KMBASE. Search terms for the studies included “problem-based learning” “PBL,” “PBL education” “PBL university.” Under such conditions, 164 foreign studies have been retrieved primarily through searches in Google Scholar, EMBASE, and PubMed, and 26 domestic articles have been identified through searches in KISTI, KISS, RISS, and KMBASE, resulting in a total of 190 studies. Excluding 37 duplicates, the remaining 153 studies had their abstracts screened and 69 articles were deemed irrelevant to the study and were excluded. With the remaining 84 studies, the full-text was assessed, and those not including PBL components or implementation methods were excluded: 23 studies have remained for qualitative synthesis, 5 which were used for establishing the theoretical background of this study and 18 studies which were included for thorough qualitative analysis (Figure 1 and Supplementary material 1).

Theoretical and methodological frameworks presented by Sim-

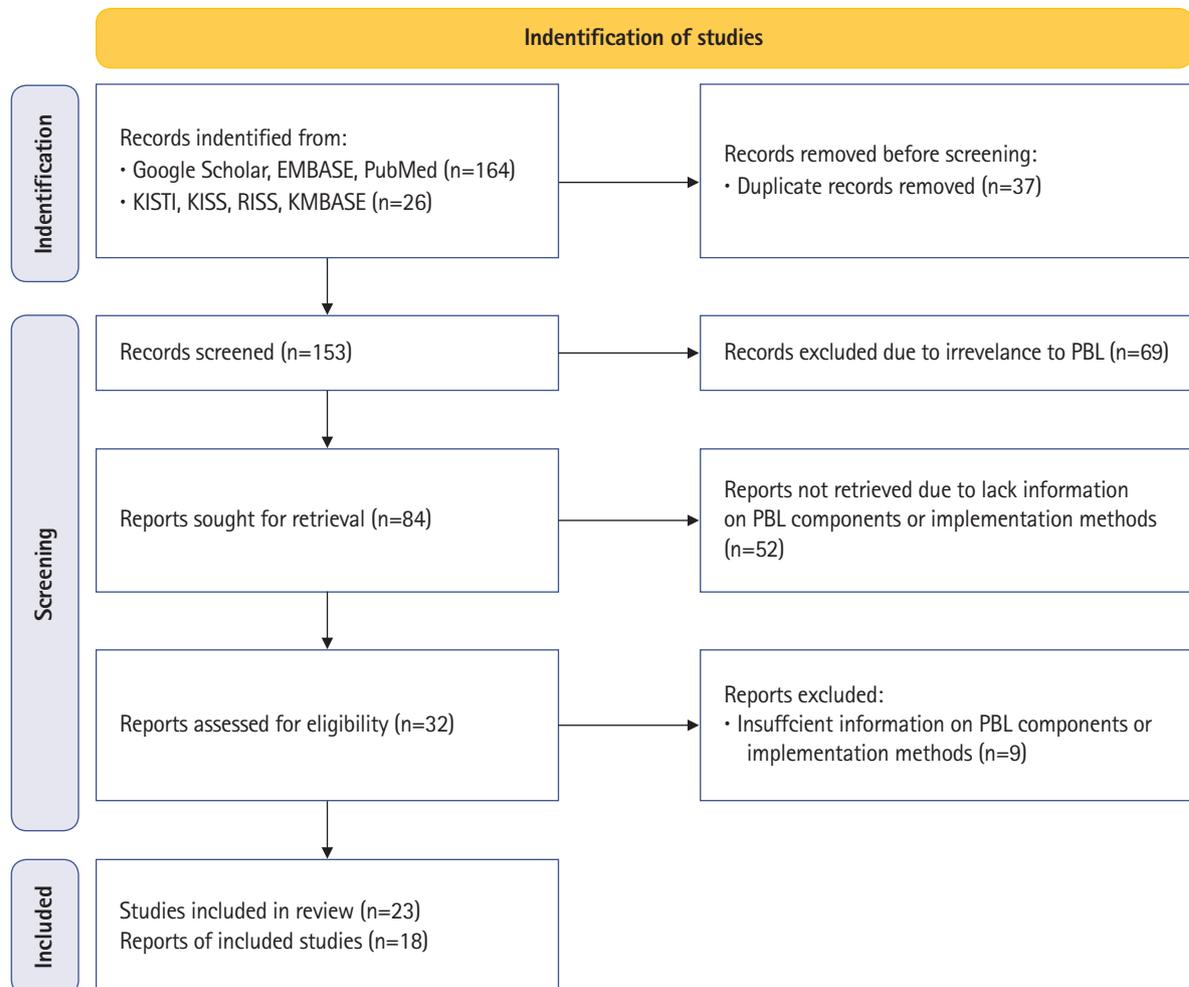


Figure 1. PRISMA flow diagram for inclusion of studies

one C. dos Santos in her 2017 piece “PBL-SEE: An Authentic Assessment Model for PBL-Based Software Engineering Education” were used as reference for coming up with key components of PBL. The framework has been selected for this study because of the relevance and expertise dos Santos has in the PBL field, having published more than 20 articles on PBL since the year 2000. In the article, dos Santos mentions five elements of the PBL approach:

- 1) Problem, selecting actual problems, whose complexity is treated as a significant aspect;
- 2) Environment, creating an actual real-world work environment;
- 3) Human Capital, having professional experts as teachers and tutors, with the students as actors and real clients involved in the teaching process;
- 4) Content, compiling an innovative syllabus whose content closely reflects actual problems;
- 5) Process, implementing an authentic assessment process based on the teams’ results and the students’ knowledge, and, from a technical and market perspective, a tight control enforced by monitors. (p. 121)

With these elements in mind, key components of PBL have been perused in the selected eighteen articles.

RESULTS

Through analysis, certain elements of PBL have been highlighted within the studies. The selected studies were examined again to determine whether the highlighted elements were included in each piece. After analysis, the final selection of PBL components includes 1) incorporation of real-life problem, 2) collectiveness, 3) solution formulation, 4) learner proactiveness, 5) evaluation by the learner, 6) integration of a planning process, and 7) facilitation by the instructor. While 8) efficient time management was included in three articles as another component of PBL, it was excluded for further discussion because it was deemed irrelevant or with minor importance. Supplementary material 2 provides an overview of each article and the components of PBL that the article incorporates.

1. Incorporation of real-life problem

Incorporation of real-life problem places emphasis on the characteristics of the problem; problems presented in PBL must be challenging, and yet should also be pragmatic and applicable to actual situations. Hallinger and Bridges (2017) highlight that in PBL, “learning is stimulated by and organized around a high impact problem that students are apt to face in the workplace.” As Rodríguez González and Fernández Batanero (2016) recom-

mend, a realistic problem is essential because “the work is seen to be relevant and is infused with an intrinsic motivation” for the student. In other words, because the problem is relevant to students’ interests and provides functional knowledge in a field of interest, students are likely to become immersed in the learning process and thus acquire better understanding of the course and subject (dos Santos, 2015).

2. Collectiveness

All studies included collectiveness as an essential element of PBL. Hung and Lin (2015) in their version of PBL curriculum, required students to participate in group discussion for them to systematize new information into acquired knowledge. Based on social constructivism, students obtain knowledge better in a collective setting, and they tend to display better motivation and greater confidence in doing so (Jaleniauskiene, 2016). Study results also show that through team discussions, “students become more capable of recognizing problems and enable themselves to seek appropriate solutions for those problems,” naturally leading to the actual problem-solving process itself (Huang & Wang, 2020). Thus, Rodríguez González and Fernández Batanero (2016) describe collectiveness as an element of PBL which offers great improvement in problem-solving capacity as well as guaranteeing professional development among students.

3. Solution formation

Solution formation involves formulating a feasible resolution to the problem provided. Perhaps solution formation is the most crucial element of PBL, as it is one feature differentiating PBL from traditional rote learning. Kim (2018) accentuates that PBL emerged because rote-teaching failed to stimulate connection between new and existing knowledge within students. Hence, as Hallinger and Bridges (2017) claim, students should “demonstrate’ simulated solutions to the problem (rather than just analyses) and receive formative feedback on their efforts.” It is through this conversion of fundamental information to demonstration where higher levels of expertise can be accomplished by the learner (Hung & Lin, 2015). In short, students have to come up with a solution by merging new knowledge with prior knowledge, and such exercise acts as an effective measure for securing freshly learned information (Huang & Wang, 2020).

4. Learner proactiveness

Learner proactiveness is another component of PBL which explains that students should feel responsible for their learning and accordingly act constructively. Students, as Tortorella et al. (2017) describes, “must be conscious of what information is already

known about the problem, which information they need to know to solve it and possible strategies to apply.” Another study places high emphasis on learner proactiveness, in that “intrinsic motivation is of utmost importance in students’ learning in blended learning events, and students who are motivated intrinsically are more prone to finish tasks, and perform better in comparison with the extrinsically motivated pupils” (Almulla, 2019). Alrahlah (2016) also states, due to learner proactiveness, students are likely to gain expertise, as they are attaining knowledge in the similar manner that professionals do.

5. Evaluation

Evaluation implies assessment of solutions or procedures incorporated during the learning process. Dos Santos (2017) stresses a need for frequent evaluation to determine if the actions are in agreement with the learning objective and to see whether improvements can be made for future reference. According to Tortorella et al. (2017), “the reflective components of PBL can also contribute to higher levels of individual interest in helping students explicitly articulate their growing comprehension of the real work,” indicating a potential positive connection between evaluation and learner proactiveness, the 4th component of PBL. Furthermore, Almulla (2019) states that progress in reflective skills through PBL also results in improvement of research skills on the course subject.

6. Involvement of planning process

As explained by Kang et al. (2019), problem-solving involves a self-planned process where the learner selects adequate resources with respect to the learning objective and executes a strategy for learning achievement. In essence, a major difference between PBL and other forms of learning is that it relies, not on the evaluation of the learning result, but predominantly on the acquisition of knowledge through the learning process (Shin & Kim, 2019). It is through such process where focused thinking occurs, as Wosinski et al. (2018) describes, where students devise a periodical plan for research to solve the problem and act accordingly. Dos Santos (2015) elaborates further when she describes “the essence of PBL is that it is process-oriented,” and that “it is important to maintain alignment between the stages of the PBL process to ensure its effectiveness.”

7. Facilitation by instructor

Facilitation by the instructor is another unique component of PBL when compared to other learning methods in that it becomes the major, perhaps the only, role of the instructor. According to Jaleniauskiene (2016), “the role of a tutor or an instructor

changes into a facilitator of students’ learning,” and so “students have to become self-directed and self-regulated in the process of learning.” Instructors, based on their experience and knowledge of the actual professional environment, hold significant roles in providing guidance and assessing the practicality of solutions given by students (Salinitri et al., 2015). The importance of such roles is highlighted through metacognitive communication, where the instructor provides students with questions on how to improve their thoughts regarding the course subject (Alrahlah, 2016). Moreover, Kim (2018) asserts that facilitation by the instructors is significant because under poor assistance, students may not acquire essential learning resources at appropriate times, establish inapt hypotheses, and have low learning interest due to unnecessary wasting of time.

DISCUSSION

While variables do exist among essential factors of successful PBL implementation, a thorough literature review of 18 domestic and foreign academic studies in this study provides a list of major components required for PBL learning which could be utilized for the development of curriculum design that is adequate for implementing PBL within Korean universities. The study has identified seven elements as essential factors of successful PBL application in university courses -incorporation of real-life problem, collectiveness, solution formulation, learner proactiveness, evaluation by the learner, integration of a planning process, and facilitation by the instructor. While efficient time management has been highlighted in several studies, there was not sufficient data to confirm its importance.

CONCLUSION

This study has provided evidence of reports on the elements necessary for successful implementation of PBL methodology. Once these elements are all considered in the design and implementation of a university curriculum, the following results are anticipated:

- 1) Improvement of self-directed problem-solving capacity through learners’ proactive involvement in learning.
- 2) Enhancement of learners’ integrated thinking and creative aptitude.
- 3) Augmentation of learners’ communication skills and presentation skills
- 4) Development of learners’ strategic thinking proficiencies.

Thus, it is recommended that Korean universities, divert away from the traditional rote-teaching method to provide a more effi-

cient and meaningful means to assist students with meaningful knowledge acquisition and application; employing PBL methods in their curriculum will achieve the learning outcomes listed above. When doing so, the incorporation of key PBL components as highlighted in this study is necessary for successful implementation.

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SUPPLEMENTARY MATERIALS

Further details on supplementary materials are presented online (available at <https://doi.org/10.24313/jpbl.2021.00045>).

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