

Integration of Problem Based Learning and Scaffolding for Educational Purpose: A review

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***ABSTRACT**--Problem-based learning (PBL) is a student-centered approach that has potential to foster independent study and critical thinking skills. This review discusses how PBL incorporates scaffolding that could benefit vocational learning in Education. These are strategies employed to expose students to real-world problem solving, critical thinking skills and effective knowledge transfer through active engagement. This review employed a systematic approach. Eleven (11) research articles were selected and scrutinized. Results indicated that undertaking the role of a specialist as instructor can take a dynamic task in PBL strategy. Provide the necessary resources to build learners who could address ill-structured problems. Be able to use the application of real-life experience and specialist-level strategies to address the cognitive task. This complex skill cannot be acquired through conventional teaching. However, can be acquired through the scaffolding of progressive, stimulating learning opportunities, routine exercise and self-reflection. Solving real-world problems entails active collaboration and exploiting the potentials of technologies available for us. Thus, instructors need to be contented as facilitators of a learning situation that is often complex and challenging task. Consequently, it is established that the PBL and scaffolding have the potentials to enhance students' critical thinking skills. Though, with a careful structure of authentic learning situation. The application of appropriate technology to offer an on-line scaffolding strategy can support student's engagement with the learning activities. Though, if question prompts in PBL is provided in a complicated or difficult manner, the question prompts could be an interruption of learning instead of assistance.*

***Keywords**-- Online scaffolding; Problem-Based Learning; Engagement; Critical thinking skills.*

I. INTRODUCTION

Modern pedagogy needs to prepare an innovative set of students than that fostered all the way through (Ginaya, Nyoman, & Astuti, 2020). The present review put forward information on issues about the development of an instructional method of problem-based learning (PBL) and scaffolding. It assists teachers to produce an innovative kind of learning environment for students. "Generic skills" including critical thinking, collaborative learning, problem-solving skills, and offering concepts are important in present-day society (Ginaya et al. 2020). To assist exploit the possible cognitive improvement of the students in Agricultural education, PBL could be integrated with an emphasis on teacher training to embark on an online scaffolding teaching approach.

Scaffolding as an important component is a learning strategy that seeks to integrate the activity demonstrating a model, planned supervision to guide, collaborative trends of preparation in the area of instructional reasoning (Jamari, Abdullah, Mohamed, Zaid, & Aris, 2018; Neba, Shey, & Bruno 2019). The integration of problem-based learning (PBL) and scaffolding as an important component involved adding more innovative techniques in

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instructional methods. While it could be utilized, not only for merely teaching and surface transfer of information as knowledge; the intent is to serve as an interactive framework for fostering the 21st-century skills among students to become more expertise and function in a specific field (Alger & Kopcha, 2009; Jamari et al. 2018). The combination of these methods is as a result of the anticipated educational outcomes. Devices a reliable and consistent interdisciplinary task, frequently asses and restructure to facilitate student's engagement and academic achievement with everlasting development of education (Evans, 2016). Integrating PBL and Scaffolding generates a conventional learning situation through technology-based scaffolding. It leads to the mastery of critical thinking skills rightly be related to individual students' life after graduation (Loyens, Kirshiner, & Paas, 2011).

1.1 Advantages and Limitation of PBL

Problem-based learning introduces at the commencement of instruction an ill-structured, real-life problem for students to critically assess, collaborate and deliberate on the information. Come to a compromised base on their understanding and build new knowledge to solve the problem in a group (Phungsuk, Viriyavejakul, & Ratanaolarn, 2017; Yew & Goh, 2016). It implies that the ill-structured problem is a deliberate act to trigger learning among students. PBL was pioneered by a school of medicine, modified in related institutions and more. It generated a verity of PBL modifications based on the suitability and existing problem offered by the teacher in accordance with the delivering other academic supports (Servant-Miklos 2019). Problem-based learning works towards improving the satisfaction of students' knowledge, reasoning skills and problem-solving by engaging them with real-life and problems that have no specific answers, inform of ill-structured problems (Fidan & Tuncel, 2019; Thompson, 2019). In PBL, students are required to search for information to study a problem, advance the claims, debate on issues to support these claims (Moallem, Hung, & Dabbagh, 2019).

Scholars have confirmed the effects of PBL on enriching the students' knowledge construction and critical thinking skills in education (Chung, 2019; Niwa et al. 2016). To reassessed the process of PBL as well as its effectiveness in various studies in Singapore, Yew & Go (2016) inferred that PBL is an eminent technique for teaching and learning especially in terms of higher retention and application of knowledge. PBL when applied in a different field, shows that students gained higher performance than those in a conventional class. However, studies on the process of PBL, are still inconclusive as to which component(s) of PBL most significantly impact students' learning.

Disadvantages of PBL as hypothesized by Narad, Chari, & Gupta (2016), include the perception of students on the complex task involved in PBL activities, and more time-consuming in designing to development. Learners who are unable to link knowledge without specifically defined objectives reveal a justification for another limitation of PBL (Verstegen et al., 2019). In this regard, permitting PBL to be managed by instructors that can mitigate problems, particularly when they have practiced both the PBL and a scaffolding instructional approach. Yet, PBL students find it difficult to adjust as they approach the ill structured-problems presented in PBL the way they can be done in a problem that is well-structured (Tawfik et al. 2019). Therefore, in order to experience a successful PBL learning situation, students required a supportive agent to help initiate a resolution to difficult and ill-structured activities or problems (Kim, Belland, & Walker 2018).

Scaffolding in education is referred to as supportive abilities to assist the student in engaging students to advance in activities and skill gain that cannot be achieved on their own (Kim, Belland, & Axelrod 2019). It is a

guiding support for students to experience an easy and meaningful operation throughout their learning process (Jumaat & Tasir 2016), scaffolding students has been mostly used to overcome the problems as a subject matter. Scaffolding could be a technology-based, teacher based a peer-based scaffolding to support students learning. Scaffolding can also be based on its types such as metacognitive, strategic, procedural and conceptual type (Kim & Lim, 2019). When provided to support students' needs, scaffolding is able to maintain and enhance their engagement by motivating them gradually through the provision of hints as an online environment until they resumed to practice and take responsibility for their learning.

The utilization of scaffolding has been useful in developing a student's critical thinking skills (Kitsantas et al. 2019). Studies recommended for a scaffolding design framework that considers the features of problem PBL. Real ill-structured/real-world problems presented at the commencement of PBL are more often above students' ability without any support, as a result, a negative effect on students' interest and motivation to study (Barrows & Tamblyn 1980). Hence, involvement in activities that could maintain and enhance student's engagement and academic achievement through scaffolding is significant for the students to experience an optimal challenge in the PBL task. (Kim, Belland, Lefler, et al. 2019). It is against this background that this study attempts to reassess the integration of Problem Based Learning and online Scaffolding for Educational purposes.

II. METHODOLOGY/MATERIALS

Problem-Based Learning (PBL) and online scaffolding in combination with technology are widely used in science including agricultural and vocational education (Jabarullah & Iqbal Hussain, 2019; Schwendimann, Kappeler, Mauroux, & Gurtner, 2018; Wahyu, Kurnia, & Syaadah, 2018). The model approach adopted in this review as summarized in Figure 1, has to do with the application of PBL in higher institutions. As a result, difficulties involved in the application of PBL and scaffolding in the educational setting. The model employed a systematic approach to the identification of data sources. The search words applied are PBL, problem-solving, collaboration, self-directed learning, critical thinking skills student engagement, learning outcome (Table 1).

Table 1: Summarized search terms applied in search of the database and corresponding synthesis.

Source	Search terms
Model	PBL, problem-solving, collaboration, self-directed learning, critical thinking skills student engagement, learning outcome.
Pathways	Scaffolding, technical and vocational education, higher education
Type of studies	All studies on PBL, problem-solving, collaboration, self-directed learning, critical thinking skills student engagement, learning outcome.

A total of 8916 potential articles were identified in the Scopus database, Science Direct and other databases. Completing the review processes summarized in Figure 2, eleven (11) papers/articles were selected and employed in the review. These studies present approaches relating to PBL and online Scaffolding. Apart from two studies

(Garren 2018 & Fernando 2018), the remaining studies have some analyses on PBL and scaffolding. This demonstrated the relevance of PBL and scaffolding in interdisciplinary education and agriculture.

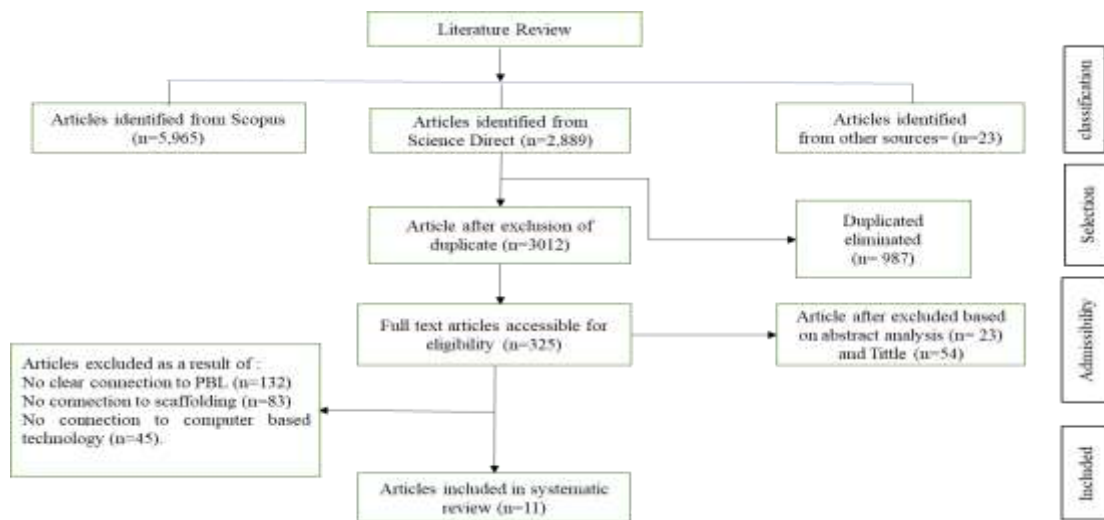


Figure 2: A systematic procedure utilized for the present review comprising the result from documentation of literature evaluation, accessibility, and inclusion of the final study.

III. RESULTS AND FINDINGS

Table 2: summarized the studies employed in this review based on online scaffolding to support the PBL learning environment. In that regards, Kim, Belland, & Walker (2018) reviewed the effects technology-based scaffolding in a problem-based learning setting in science education. The review employed a Meta-analysis. Results indicate that online scaffolding has a significant impact on PBL students’ knowledge construction and academic outcome. Although, question prompts to commence in PBL is provided in a difficult manner, the question could be a hinderance to learning instead of assistance. This calls for a reassessment of the theoretical basis of implementation of PBL, reasons for its failure to prosper as expected to provide a remedy. As a student-centered strategy, Tawfik (2016) revealed that there is a great amount of inconsistency in the implementation of PBL leading to failure and criticisms of the instructional approach. Nevertheless, the need to further explore how to incorporate technology tools to ease managing a PBL approach for students’ engagement for the benefit of maximum learning outcome is an important task in education.

Based on the forgoing, from the table above, (Serife 2016) examined the effectiveness of online scaffolding using the stages in the PBL learning strategy through technology as a mediator of the learning process to construct new knowledge. The study used two groups (i) experimental and (ii) control groups. Results revealed that Scaffolding problem-based in online discussion increase students’ activities in the learning process. Thus, the use of suitable technology like social media to provide on-line scaffolding in the PBL learning environment can support student engagement with the learning activities.

In the same development, Garren & Skylstad (2016) attempted to increase student learning through the utilization of an online scaffolding environment using learning modules. Although he did not utilize PBL in the learning scenario, the outcome indicated that the use of online scaffolding with modules significantly improved

students' performance in exams than students who did not use the module. However, implementation also experienced some little challenges in the design of the Moodle as a viable tool and these include ways images can be presented and linked. Thus scaffolding students through social media can facilitate the process of instructional design and ease students access resource materials as well.

To support students in the PBL learning situation, Haruehansawasin & Kiattikomol (2018) investigated the approaches in scaffolding. Results showed that the use of computer spreadsheets as online scaffolding significantly affects the learning outcome of the students. Nevertheless, teachers' use of a suitable scaffolding strategy can improve student's achievement and encourage active deliberation in a PBL context. To compare the effectiveness of different types of scaffolding, Kim & Lim (2019) used reflective and supportive scaffolding on student's problem solving and academic achievement in an online learning system. The study revealed that students supported with a reflective type of scaffolding experienced higher achievement than their counterparts with supportive scaffolding. Yet, addressing which type of scaffolding that effectively encourages student-centered and online team collaboration is of great importance. This will aid in understanding to support agricultural technology, student's engagement and academic achievement.

Table 2: Example of studies on problem-based learning and online scaffolding

S / N	Study	PB L	Scaffolding	Objectives	Area	Methods	Result	Remark
1	Kim, Belland, & Walker (2018)		✓	To study the effects technology-based scaffolding in problem-based learning (PBL) in the learning environment in science education.	STEM Education Mathematics	Review (Meta-analysis)	Technology-based scaffolding has a significant impact on PBL students' knowledge construction and academic performance.	Though, if question prompts in PBL is provided in a complicated or difficult manner, the question prompts could be an interruption of learning instead of assistance.
2	Tawfik & Kolodner (2016)		✓	To reassess the theoretical basics of implementation of PBL reasons for its failure to prosper as expected to provide a remedy.	Disciplinary subjects	Review	There is a great amount of inconsistency in the implementation of PBL leading to failure and criticisms of the instructional approach.	The need to further explore how to incorporate technology tools to ease managing a PBL approach for students' engagement for maximum learning outcome is an important task.

3	Serife (2016)		✓	studied the effectiveness of online scaffolding using technology in the PBL process to conduct new knowledge.	Instruc tional technol ogy design.	Quasi - exper iment al	Scaffolding problem-based in online discussion increase students' engagement in the learning process.	The use of social media to provide an on-line scaffolding can support student engagement with the learning activities.
4	Garren & Skystad (2016)	No	✓	To increase student learning in mathematics through the utilization of an online scaffolding environment using learning modules.	Medica l	Exper iment al	The use of the online scaffolding of modules significantly improved students' performance in exams than students who did not use the module.	The implement also experienced some little challenges confines in the design of the Moodle as a viable tool and these include ways images can be presented and linked.
5	Haruehan & Kiattikomol (2018)		✓	Investigated the approaches in scaffolding to support students in the PBL learning situation.	Compu ter educati on	Exper iment al	The use of computer spreadsheets as online scaffolding significantly affects the learning outcome of the students.	Teachers' use of a suitable scaffolding can improve student's achievement and will encourage active deliberation in a PBL context.
6	Kim & Lim, (2019)		✓	To compare the effectiveness of two different types of scaffolding ((reflective or supportive), Problem-solving skills on student's	Instruc tional design	Exper iment al	Students supported with a reflective type of scaffolding experience higher achievement than their counterparts with supportive scaffolding.	Addressing which type of scaffolding most effectively encourage student-centered and online team collaboration is of great importance.

				problem solving and academic achievement in an online learning environment.				
7	Peng, Wang & Sampson (2017)		✓	To readdress problem facing instruction in computer programing, through design and evaluation of web-based structure to engage students in realistic complex tasks through the aid of computer-based scaffolding	Computer programming	Quantitative survey	Students perceived that using a web-based computer in scaffolding PBL structure can provide a promising result on their efforts in constructing new knowledge and achievement, as a rationale to learn their course in computer programing.	On the contrary view, students offered their suggestions on the improvement of the entire learning approach on its interface, learning resources, and further support to students throughout the learning process.
8	Fernando (2018)	No	✓	To explore the effectiveness of online scaffolding in assisting student's engagement through abstract knowledge assessment.	Writing	Mix-method Questionnaire & Interview	Online scaffolding enhances students' engagement and boosts understanding of the abstract concept in learning.	undertaking an online learning environment is worthy of the creation of innovative exercise in other academic disciplines like Agriculture.
9	(Kim, Belland, & Axelrod, 2019b)		✓	Explore student's perception of the use of a student-centered scaffolding to address challenges in	STEM Education	Review	Multiple types of scaffolding in PBL increase students' experience in independent learning and skills development.	The selection of the type and quantity of help they need when confronted by challenges beyond their abilities remained an issue.

				PBL for optimal engagement in learning.				
10	Lauerer et al. (2017)		✓	To describe a model of online medical course program utilized a constructivist idea to innovatively combine online problem-based learning and scaffolding student learning.	Medical	quantitative	Online scaffolding in PBL improved student's experience, knowledge and ease in dealing with communication of problems in a medical care setting.	Therefore, a similar study using social media should be undertaken as a guide for other instructional programs like Agriculture to improve student's abilities through active engagement in the learning situation.
11	Belland (2016)		✓	To redresses the process of PBL and way students learn through problem solving with the support of a change in online scaffolded technology and PBL.	STEM Education	Review	Online scaffolding is an important structure that assists students to succeed in PBL and scaffolding has a reasonable effect on engaging students.	However, conducting the study in other field of education like Agriculture through utilization of social media as a considerable scaffolding effort to aid learning activities will yield a significant impact on student activities.

Building on the above, Peng et al. (2017) surveyed the problems facing instruction in computer programming, through the design and evaluation of web-based structure to engage students in realistic complex tasks through the aid of computer-based scaffolding. Students perceived that using a web-based computer in scaffolding PBL structure can provide a promising result on their efforts in constructing new knowledge and achievement, as a rationale to learn their course in computer programming. On the contrary view, students offered their suggestions on the improvement of the entire learning approach on its interface, learning resources, and further support to students throughout the learning process.

Moreover, Fernando (2018) explore the effectiveness of online scaffolding in assisting student's engagement through abstract knowledge assessment. The study discovered that online scaffolding enhances students' engagement and boosts understanding of the abstract concept in learning. Conversely, undertaking to an online scaffolded learning environment is worthy in education for the creation of innovative assessment exercises in other academic disciplines like Agriculture where students' progress and effective completion of their learning outcome is determined by their skills and achievement. To support the concept, Kim et al. (2018) explored student's perception of the use of a student-centered scaffolding to address challenges in PBL for optimal engagement in learning. It indicates that multiple types of scaffolding in PBL increases students' experience in independent learning and skills development. However, selection of type and amount of support needed by the students when confronted challenges beyond their abilities remained an issue. Thus, it is important to use an online and interactive scaffolding to give an optimal challenge to encourage student's engagement through innovative and creative activities towards fostering and nurturing the 21st-century skills.

A quantitative survey conducted by Lauerer et al. (2017) described a model of the online medical course program. It utilized a constructivist idea that innovatively combines online problem-based learning and scaffolding student learning. Although study indicates that online scaffolding in PBL improved student's experience, knowledge and ease in dealing with communication of problems in a medical care setting. The researcher would have use PBL and online scaffolding as an innovative framework to assist student's engagement for effective knowledge construction. Therefore, a similar study using social media should be undertaken as a guide for other instructional programs like Agriculture to improve student's abilities through active engagement in the learning situation.

In a similar but different study, Kim, Belland, Lefler et al. (2019) readdressed the process of PBL and the way medical students learn through problem solving with the support of online scaffolded technology and PBL. The study inferred that computer-based scaffolding is an important structure that assists students to succeed. The study further documented that PBL and technology-based scaffolding has a reasonable effect on improving student's reasoning skills and yield better learning outcomes of students. However, conducting the study in other field of education like Agriculture through utilization of social media as a considerable scaffolding effort to aid learning activities. Studies have indicated PBL and scaffolding able to advance engagement and achievement in learning setting. Nevertheless, without proper structuring, taking the suitable technology into consideration the outcome will not be achieved. It thus significant to understand the need and utilization of social media as online technology to support PBL to enhance an effective students' engagement and better learning outcome.

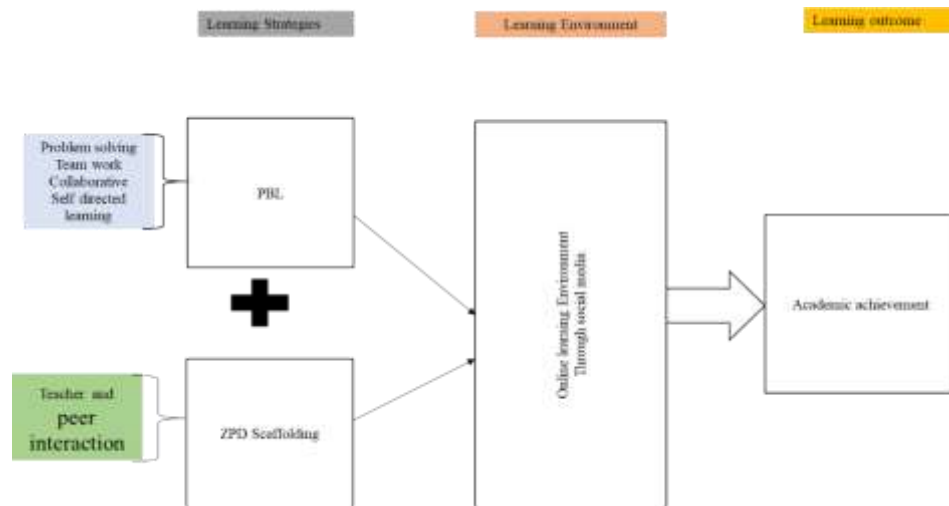


Figure 2: Concept of PBL and Scaffolding of student for optimal engagement and academic achievement.

IV. CONCLUSION

Literature is almost unanimous about the need for understanding problem-based learning practices. Though the debate relating to the application of problem-based learning approaches is still going on, PBL and technology-based scaffolding framework can be jointly utilized through diverse learning situations for the purpose of attending to certain needs of students in the field of Agricultural education. Based on this review, the following remarks can be made:

1. Scaffolding problem-based learning in educational practice ensures that student's independence is balanced and working together in teamwork, with their teachers as facilitators;
2. This would help to perceive what would be learned, while online scaffolding approach in PBL nurtures skills development instantly in a more professional method;
3. Scaffolding of students intended for more real-world problems can promote the integration of hybrid PBL that address the needs of these students; and
4. A transition towards placing students at the central heart of their own learning situation can encourage greater engagement and academic achievement.

Therefore, implementation of interactive student-centered learning such as integration of problem-based learning and online scaffolding is able to provide a source for engaging students, improve critical thinking, training them on how to analyze and resolve authentic problems, through active collaboration, peer interaction, problem-solving and self-directed learning with instructors as a facilitator of learning process which prepares the students to face the challenges of the 21st century.

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