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To Link this Article: http://dx.doi.org/10.6007/IJARPED/v9-i2/7734 DOI:10.6007/IJARPED/v9-i2/7734

Received: *18 May 2020,* ***Revised:*** *03 June 2020,* ***Accepted:*** *24 June 2020*

Published Online: 19 July 2020

In-Text Citation: (Girei, Abdullah, and Hammanjoda, 2020)

To Cite this Article: Girei, M. M., Abdullah, Z., and Hammanjoda, B. (2020). Review of related literature on Problem-based Learning and Cognitive Apprenticeship for Instruction in Agriculture as Vocational Education. *International Journal of Academic Research in Progressive Education and Development. 9(2),* 597-612.

Vol. 9(2) 2020, Pg. 597 - 612

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Review of Related literature on Problem-based Learning and Cognitive Apprenticeship for Instruction in Agriculture as Vocational Education

Mohammed Musa Girei[1 & 2], Zaleha Abdullah[1] and Bashiru Hammanjoda[3]

[1]Department of Science, Mathematics Education and Creative Multimedia, School of Education, Universiti Teknologi, Malaysia, [2]Department of Science Education, Faculty of Education, Adamawa State University Mubi, Nigeria, [3]Department of Animal Health and Production Technology, Adamawa State College of Agriculture Ganye, Nigeria

Email: mmgirei2@gmail.com, zac@utm.my, hammajodab44@gmail.com

Abstract

Problem-based learning (PBL) is a student-centered, enabling approach for fostering student's collaboration, self-directed learning, and critical reasoning skills. This paper discussed the previous literature on how components of problem-based learning (PBL) integrates Cognitive apprenticeship (CA) learning principle, considering Scaffolding could benefit vocational learning in the field of Agriculture. These are elements employed to expose students to real-world problem solving, critical thinking skills as well as effective knowledge transfer through active engagement. Results indicate that undertaking on the role of a more specialist as an instructor can take a dynamic role in the problem-based learning strategy, providing the necessary resources to build learners who could address ill-structured problems to use the application of real-life experience and specialist-level strategies to address the cognitive task. This complex skill that cannot be acquired through the traditional teaching, but rather skills that are acquired through the scaffolding of progressive and more stimulating learning opportunities, through guidance and routine exercise, collaborative, and self-reflection. Solving real-world problems entails active collaboration and exploiting the potentials of technologies available for us, and thus instructors need to be contented as facilitators of a learning situation that is often a complex and challenging environment. Thus, it is established that the PBL and Scaffolding have the potentials to enhance student's critical thinking skills but with a careful structure of authentic learning situations.

Keywords: Problem-based Learning, Scaffolding, Agriculture, Secondary School.

Introduction

It is important to identify the best pedagogical methods to trigger student's engagement and desire to study so as to prepare an innovative set of students than those fostered all the way

through (Damianakis et al. 2019; Ginaya, Nyoman, & Astuti 2020). The present review put forward information on issues about the development of an instructional design method of PBL to assist teachers in education to produce an innovative kind of learning environment for students. Basic skills including problem-solving skills, critical thinking, collaborative and self-directed learning, are important in the present society (Ginaya et al. 2020; Nwajiuba, Akinsola-Obatolu, Icha-Ituma, & Binuomote, 2019). To assist exploit the possible cognitive improvement of the students, PBL could be integrated with an emphasis on teachers training to embark on the CA learning approach using scaffolding as its major component.

The style of apprenticeships in training trade skills, which dated back to the earliest manifestation of culture (Hora, Benbow, & Oleson, (2016). Training students as an apprentice to attain to skillful level in practicing a special skill like vocational Agriculture was an important development to preserve educational information of the skills needed by initial societies to function successfully. The traditional mode of imparting knowledge (apprenticeship) elaborates on engaging in a specified field of training individual trainees emulating and being directed by more knowledgeable personnel in the field. It continued as a role model until the time they developed the skills to become experts (Chankseliani & Anuar, 2019).

In this trend, society would continue to sustain and expand on the system of that philosophy. Among the main feature of the learning style of apprenticeship continue to be a real-world application of knowledge that will be communicated, with emphasis on instructors' level of presenting authentic learning scenarios (Lyons, McLaughlin, Khanova, & Roth 2017). Cognitive Apprenticeship is a learning strategy that seeks to integrate the activity demonstrating a model, planned supervision to guide, collaborative trends of apprenticeship in the area of instructional reasoning (Neba, Shey, & Bruno, 2019). The utilization of PBL and scaffolding take into consideration more innovative techniques in 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 for the graduates to become more expertise and function well after graduation (Alger & Kopcha, 2009; Scott, 2015). The combination of these methods are as a result of the anticipated educational outcomes, devices a reliable and consistent interdisciplinary task, and frequently assess and restructure to facilitate student's engagement and academic achievement as an everlasting development of education (Lee & Hannafin, 2016; Niwa, Saiki, Fujisaki, Suzuki, & Evans, 2016). Incorporating PBL and CA models ensure an interactive learning environment through scaffolding to mastery of problem-solving, collaborative, and self-directed learning skills rightly be related to individual students' life (Ismail, Harun, Zakaria, & Salleh, 2018). The objectives of this paper were to:

- Discussed how PBL integrates Cognitive apprenticeship learning principles considering scaffolding as a major component
- Review information on issues about the development of an instructional design method of PBL to assist teachers in education to set an innovative kind of learning environment for students

Review of Literature

PBL is an activity-based learning strategy in which students are allowed to play major roles in the learning through solving an ill-structured problem in effective collaboration with self-directed learning and activities under the guidance of their instructor as a facilitator. It introduces

at the commencement of instruction a real-world, 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 problem presented is a deliberate act to trigger students learning. PBL was pioneered by a school of medicine, modified in related institutions and more, generating a verity of PBL modification based on the suitability and existing problem offered by the teacher in accordance with the delivering other academic supports (Servant-Miklos, 2019). Table 1 summarized some studies on problem-based learning.

The process of PBL and its contribution to training students in the field of fisheries according to Lopes et al. (2020), indicated that PBL components encourage students to develop through the utilization of authentic problems presented as a stimulating factor. However, involvement in PBL studies is important to provide information for teachers and researchers in educational institutions. To assess precisely the possibility of change in the teaching methods of institutions. in the teaching methods of institutions.

Table **Error! No text of specified style in document.**.1 Summaries of studies on the effectiveness of problem-based learning across the world

S/No	Study	Country/region	Objectives of the study	Methodology	Results/findings	Remarks
1	(Lopes et al., 2020)	Brazil	Investigate and provide information about the process of PBL and its contribution to training students in the field of fisheries.	Experimental study	Components of PBL encourage students to develop skills through the utilization of authentic and real-world problems as a stimulating factor.	Involvement in PBL studies is important to provide information for teachers and researchers in the educational institutions to assess precisely the possibility for change in the institutions
2	(Nursa'ban, Masykuri, & Yamtinah, 2019)	Indonesia	To reconsider the effectiveness of the implementation of PBL Module on student's achievement in Science subjects	Quasi-Experimental	PBL module significantly affects Science student's learning outcome, its utilization in teaching ensures optimal learning abilities and academic achievement.	The need to extend further the study to analyze students' critical thinking skills in a PBL setting.
3	(Loyens, Jones, Mikkers, & van Gog, 2015)	Netherland	To examine whether the use of PBL strategy to influence student's abstract knowledge compare to traditional and self-learning method of teaching.	Experimental	Students in the PBL group performed better and improved theoretical changes in knowledge.	Understanding whether some procedures in present in the PBL processes have more potentials in encouraging theoretical changes than others is an important task.

4	(Chibueze & Theresa, 2018)	Nigeria	To investigate the effects of PBL and conventional learning settings on students' academic achievement	Experimental	Teaching with PBL ensured students' high academic achievement.	To explore PBL interventions, regarding technical/vocational programs, ought to be organized in such a way as to reflect the advancement of group coordination in the PBL study.
5	(Sunar & Shaari, 2017)	Malaysia	To study the effectiveness of PBL using Facebook as a mediator for student interaction and learning approach and academic achievement.	Experimental	Students' learning style through the interaction with PBL and Facebook approach learning has yielded a significant effect on students' achievement.	Implementation to conduct a similar study on PBL in the earlier level of students learning and academic programs will assist students to be acquainted with the application of skills and knowledge learned to a higher level.

Effectiveness of the implementation of the PBL Module on student's achievement in Science subjects was examined by (Nursa'ban et al. 2019). The study revealed that the PBL module has a significant effect on science student's learning outcomes, its utilization in teaching ensures an optimal learning ability, maximum learning outcome, and academic achievement. Therefore, there is a need to further the study to analyze students' critical thinking skills in a PBL setting in vocational disciplines like Agriculture.

To compare the use of the PBL strategy to influence student's abstract knowledge with traditional and self-learning methods of teaching, Loyens et al. (2015) found that students exposed to PBL activities performed better and improved their theoretical changes in knowledge than their counterpart in the traditional class. Yet, understanding whether some procedures present in the PBL processes have more potentials in encouraging theoretical changes than others is an important task.

A similar study was carryout by Sunar & Shaari (2017) to study the effectiveness of PBL using Facebook as a mediator for effective interaction and academic achievement among Malaysian students. Results indicate that students' learning styles through the interaction with PBL and Facebook approach to learning has yielded a significant effect on students' achievement. However, implementation to conduct a similar study on PBL in the earlier level of students learning and academic programs in colleges of Agriculture in Nigeria will assist students to be acquainted with the application of skills and knowledge learned to a higher level.

In this regard, Bhattacharjee & College, (2015) reveal that a typical Constructivist learning situation usually pursues students begins with a question, a case, or an ill-structured problem. As they engage in a problem, the teachers only serve as supervisors when required to guide students in the right direction. Moreover, advantages of PBL over traditional approaches according to Alrahlah (2016) include improved and continuous use of basic skills, perfect communication through teamwork within a specified group, advance in motivation, and engagement for working together to solve a particular problem.

This review has modeled an improved PBL and online scaffolding (PBLS) that represents instruction that integrates an instructor producing notes and improvised teaching script to assist his/her students to discuss a detailed problem intentionally prepared for learners to search for a lasting solution. The initial PBL denotes to McMaster's approach whereby education was solely through problem-solving (Servant-Miklos, 2019). The fundamentals of the cognitive apprenticeship model are in agreement with the idea of situated learning, which suggests that to have a competent and effective transfer of knowledge, it must be situated in an authentic framework (Sant'Anna, Patrus, & Andrade, 2019).

The cognitive apprenticeship (CA) was planned by the group of scientists (cognitive) comprising Collins and his associates in 1989. It focuses on evolving the academic models and skills that are essentials for novice/students to accomplish a particular task in more professional conduct, with a focus on teaching by guided practice (Lockwood, 2017). The primary objective of cognitive apprenticeship was training those intricate courses and activities handled by professionals so that the skills and attitude of those fields are coached using ill-defined and problem-solving. The socio-cultural and knowledge-based cognitive learning standpoint is consistent with the views of teacher learning and practical knowledge of teachers. However, the cognitive apprenticeship model has been identified as a teaching strategy that relates to a

student-centered approach (Hedges & Cullen, 2005), it has been tested and trusted in different fields of study as a virtual learning environment like online vocational education (Abukhousa & Bataineh, 2018).

Another significant feature of CA is the idea of "making thinking noticeable" (Gomillion, George, Becker, & Scialdone, 2019). The final product for learning efforts in a cognitive field usually in abstract unlike the physical objects formed in trained craft, cognitive apprenticeship entails teachers to facilitate and supervise the learning process while students performing the tasks (Shaw, Gordon, Xing, & Carroll, 2017). An instructor in mathematics might articulate the choices available at a complex situation, or an instructor in reading might think aloud as reading and interpreting a sentence from narratives (Kim, 2019). By so doing, Learners can be introduced to actually discuss what transpires the attention of the instructor's level of solving the problem, gaining a deeper understanding of how to approach authentic problems by a qualified professional of a specific field.

Scaffolding is a learning model that demonstrates Vygotsky's theories on social constructivism which believe that social interactions could enhance learning, and also the incapability of students to advance from what they can do on their own knowledge to a more complex stage of understanding or capability without assistance from an instructor. The constructivist philosophies on CA to be specific on scaffolding, where assistance is maximum at the time students are about to be ineffectual of accomplishing learning activity on their own and gradually withdraw as soon as the students resume to a rational practice situation, also paves the way for a vital role in CA. The scaffolds are gradually withdrawn, systematically as the students resume practice and positive exercise permitting the learning situation in such a way of probing to stimulate students' feedback (Hoidn, 2017). Instructors' role in the Scaffolding method in combination with the PBL framework ensures that teachers facilitate learning instead of tutors whereas learners in this scenario are active to construct new knowledge base on their experience as a result of active engagement in the real-life activities (Ak, 2015).

Models Integration

In a proposed plan for integration cognitive apprenticeship model and problem base interactive learning situation (PBLS), the educational goal could be a focus to five important motives as presented by Santriono Refki in (2019). These include the ability to knowledge construction, expert performance, curriculum, learning approach, and learners' ability. In addition to that, if the learning objectives are to develop skilled problem solving of different practical circumstances which are interdisciplinary and ill-structured, an improved PBL and Scaffolding (PBLS) can be designed to generate inspiration from the authentic learning situation experience by the students to engage in a process for constructing their knowledge in a group as peers. When learning and the environment change, the position for the learners expected to stay flexible by the changing skills, which appears to be more appropriate to the information as knowledge. Teaching and learning are expected to be standardized from the conventional mode of imparting knowledge (Ma, 2019), to improve student-centered, collaborative, and self-directed learning.

There are possibilities to generate interactive communication from Scaffolding through the idea of collaboration as a group. Villeneuve et al. (2019) acknowledged that to add more

value to a real-world situation for practice, students that are set under a genuine practice develop a sort of diverse culture, with distinctive skills, backgrounds, and worldviews that are necessary for the students to admit to being successful. This kind of implementation remains different from the cultural type of class activity, where efforts in setting all information is a sole impression, to that of college (Dincer, Yesilyurt, Noels, & Vargas Lascano 2019). A similar instance is an expression of Mathematics problems, by Rao, Slovin, Zenigami, & Black (2017). They observed that mathematics explanation is among the background in which problems necessitating mathematics explanations are expressed in this method. A trainee who understands the sentence structure and ways of resolving these authentic problems are no willing to learn outside the capability resolve the same problem in Mathematics, an action that has a little comparison. Students who master the syntax and patterns of solving these Mathematics word problems may not learn much beyond the ability to solve similar Mathematics problems (Capraro & Joffrion, 2006).

Studies on PBL models from various perspectives (Hmelo-Silver & Eberbach, 2012), including application, approach to student-centered learning, towards engagement and motivation, utilization of technology, and characteristics of instructors. Respective studies contributed to the development of knowledge towards designing a structure for efficient problem-based learning or the PBLS learning situation (Enkenberg 2001; Stinson & Milter 1996; Tiantong & Teemuangsai 2013). Studying a comprehensive field of educations can generate a framework for the execution of improving Problem-based learning (Sherwood 2004).

Existing studies on instructors

In a plan to implement improved problem based assisted learning (PBLS), the implementing instructors are very significant factors to consider. A research conducted by (Al said, du, Al khatib, Romanowski, & Barham, 2019), using instructor in their first year of implementation of PBL. As a beginner, the implication of PBL will be tough for instructors during their first year of executing, since the problem presented has no correct answer. While the instructors value PBL as an active approach to benefit students, they showed a sense of responding to changes of roles to move from teachers to facilitators while ample control of learning is no longer with the teachers. A facilitator has no total influence on the response during the learning situation (Fanning & Gaba 2007). This inconsistency might be credited to some obstacles, such as instructors' self-doubt and lack of self-confidence, struggle to facilitates peers to collaborate, operational limitations, and overwork since preparation for PBL and scaffolding is too demanding (Al Said et al., 2019).

Improve problem-based learning has more recognition in science particularly in the field of agriculture as vocational/technical subjects, where learners have the basic as previous knowledge (Amro, 2019). In problem-based learning, the structure and nature of the learning environment and the instructor to be in charge should be taken into consideration to ensure effective implementation and its success as well. Instructors are expected to show a kind of willingness to simplify, adjust with their learning strategies, and advance it to create liberation among learners towards ensuring that the improved strategy in PBLS works effectively for learners.

A study conducted by (Cheek, Jones, Holden, & Holden, 2019) on pre-service teacher training using the cognitive apprenticeship model with an emphasis on the incorporation of scaffolding, and real problem solving to present pre-service teacher to a method of teaching authentic practice. The findings showed that most of the students and teachers enjoyed the straightforward presentation as a way out for other more abstract lessons, that they had previously taken (Cheek et al., 2019). The result also ascertained that Scaffolding as a stimulation element of cognitive apprenticeship, often encourage student teachers to think about what was presented concerning the topic on their level of improvement.

Implementation

Assessments of the implementation of an improved problem-based learning environment in higher education, throughout the day's learners, are being introduced to ill-structured and information to support their learning task (Savery, 2006). The issues presented varies and ranges from a real-world problem and a stimulating structured problem, contrary to inferential, as the year progressed, it grew in complicity. Group approaches where team dialogs and conversations strengthen to readdress students. Assessment is done through a variety of measuring tools such as verbal demonstration based on the title, group assessment, and reflection for student's folio (McConnell, Parker, & Eberhardt, 2019). It was concluded that students' views on problem-based leading PBL are an active structure for professional development. Providing information to teachers of PBL to adopt the use of a logical pinpointing method to pedagogical problems (Valtonen, Pontinen, Kukkonen, Vaisanen, & Hacklin, 2011; Zeng et al. 2015). The majority of students developed a notion that Problem based learning offers a substantial structure that present suggestion to group search and instructors led-inquiry during the class session. Thus, student independence is the major assistance of PBL (McConnell et al., 2019).

Chethana & Menezes, (2017) evaluated the effectiveness of the cognitive apprenticeship model using students in a public secondary school studying science subject. Using two groups, the first group (control) was taught through the conventional way of the traditional mode of teaching while the other group (experimental) being thought using a real-world instance as situate learning, illustrating trial modeling, coaching, and scaffolding as elements of CA model to support students. Results revealed that the outcome on the post-test of the situated learning in the experimental group was significantly high, indicating that the results obtained did not suggest that neither group could use the information if it were put in an authentic learning situation Chethana & Menezes (2017). Further acknowledge that if not because of the scaffolding strategy applied in the study, the classroom environment would have been out of a true estimation of the real-world experience.

Models to Practice Exercise

The philosophy behind the problem-based learning model is focused on the problems solved by students (Hung 2016). The problem in PBL should be addressed through different media, based on an objective situation in the real-life. An ideal problem should contain other problems that are directly concerned with the targeted goals and learning objectives of a course. Dividing the mini-lessons and lecture sessions, transitory, and weakened to fill the knowledge

gap while promoting student's individuality (Hung, 2019; Imandala et al. 2019). Some factors to be considered in designing an effective PBL as follows:

- Identifying appropriate learning goal;
- Scaffolding to facilitate learning for both students and teachers;
- Creating various chances to recall learning as self-assessment and revision resources; and
- Creation of common structures that encourage learners' participation and a sense of intervention (Hung, 2019).

During the entire process of learning, learners would be denoting back to directives that define achievement factors (Tsai, Perrotta, & Gasevic, 2019). In PBL Responses and comments from group peers and instructors, should be understood in conjunction with the learner's independent reflection (Hung, 2016). An important factor of problem-based learning (PBL) design which is often ignored is the creation of time for instructors to work together in the development of collaborative issues and the mentorships of new teachers (Goodin, Caukin, & Dillard, 2019).

The handling of new instructors could be adopted through the principles of cognitive apprenticeship that assist instructors to be capable of planning out the way a considerable time should be allocated for a respective task and establishing effective response from the teacher or well-informed peers (Lopez-Alcarria, Olivares-Vicente, & Poza-Vilches 2019), a unique way to learn this is through following a professional in the subject area. Both teachers and their students require ample time to change and improve PBL as a novel practice in teaching and undergo a diverse learning experience (Belland, 2019). To assist in the transition from the traditional mode of teaching to improve PBL, recognizing the advantages and limitations of the PBL model could be of great importance.

Conclusion

Literature is almost unanimous about the need for understanding problem-based learning practices. Though the discussion relating to the application of PBL approaches is still going on, PBL and Scaffolding (PBLS) can be jointly utilized through diverse learning situations to attend to student's needs in the field of Agriculture as vocational education. Based on this review, the following remarks can be made:

PBL as an eminent approach in educational practice ensures that students' effective communication and independence are balanced and working together in teamwork, with their instructors as facilitators. Consequently, this would help to perceive what would be learned, while the Scaffolding approach nurtures skills development instantly in a more professional method. Related studies revealed that Scaffolding of students with meaningful content intended for more real-world problems can promote the integration of hybrid PBLS that address the needs of these students and a transition towards placing the students at the central heart of their learning situation.

It is thus important to note that, utilization of a student-centered approach to creating an interactive learning environment such as integration of PBL and Scaffolding (PBLS) can provide a source for engaging students with collaborative and self-directed learning activities, improve critical thinking skills, training them on how to analyze and resolve authentic problems, and inspiring the students with the necessary skills required to face the challenges of the 21st century.

Teaching and learning to improve agriculture and vocational education training requires a universal change to widely deal with structural barriers to desired outcomes. This review provided important learning outcomes that could contribute to the improvement of vocational pedagogy, benefit teachers in the understanding of method and practice that can be used to advocate on active teaching and learning based on the social constructivism concept. Teachers can make a difference when they can deliver content effectively and encourage active participation among their students. Students could also be actively explored, inculcating values, acquiring skills, knowledge, and attitudes to be competent as humans.

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