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PROJECT BASED LEARNING MODEL TO IMPROVE LEARNING OUTCOMES IN HIGHER EDUCATION

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Abstract: Project Based Learning (PjBL) Model believed as a promising approach to improve the quality of student learning in higher education. Empirical studies on the Project Based Learning model have been proven with a focus on student learning outcomes. Affective results based on the perceived benefits of the PjBL model and the perceived experience of the PjBL model were the most widely applied, as measured by questionnaires, interviews, observations, and self-reflection journals. Cognitive outcomes in the form of knowledge and cognitive strategies as well as behavioral outcomes of skills and involvement in groups were measured by questionnaires, rubrics, tests, interviews, observations, self-reflection journals, work results, and log data. Outcomes of skills and involvement in groups are assessed with a rubric. Future research should focus on further investigation of the student learning process and the final product.

I. INTRODUCTION

In recent years higher education institutions have attempted to equip students with hard skills, namely cognitive knowledge and professional skills (Vogler et al., 2018), and soft skills, such as problem solving and work in Group(Casner-Lotto, 2006). However, this skill-related goal is not easy to achieve because traditional learning has defined the role of the lecturer as the "transmitter of knowledge" while the student acts as the "receiver of information".(Alorda et al., 2011). As a result, it is difficult for students to be fully involved in the educational process, which can lead to a shallow understanding of the knowledge of the discipline. In addition, colleges, and research universities in particular, focus more on inculcating research skills in students than on professional skills or transferable skills. As such, this can lead to a gap between what students learn at university and what they need in the workplace(Holmes, 2018). To change this situation, it is suggested that students be given the opportunity to participate in real problem solving and knowledge construction in an authentic professional context. One interesting way to achieve this goal is through the implementation of the Project Based Learning (PjBL) model. Study(Chen & Yang, 2019), the impact of the PjBL model and the direct instruction of educators have an effect on student academic achievement in primary, secondary, and higher education. The PjBL model in this study shows a learning process in which students are involved in working on authentic projects and product development. The results showed that the PjBL model had a more positive impact on student academic achievement than direct teaching. However, only 20% (6 of 30) of the studies reviewed were conducted in universities. Addition,(Lee et al., 2014)States thatcompared to the development of the PjBL model in K-12 education which is more massive, the study of the PjBL model in higher education is lagging behind. Therefore, this study aims to contribute to a better understanding of the PjBL model applied in higher education.

1.1. Project Based Learning Model

The Project Based Learning (PjBL) model refers to an inquiry-based instructional method that involves students in knowledge construction by asking students to complete projects and develop real-world products. (Brundiers & Wiek, 2013).(Krajcik & Blumenfeld, 2006)showing the six advantages of the PjBL model are: (1) initial questions; (2) focus on learning objectives; (3) participation in educational activities; (4) collaboration

between students; (5) use of technology computer; and (6) copyright works. Among all these advantages, the attempt to solve authentic problems is the most important, which distinguishes the PjBL model from other student-centered pedagogies, for example, Problem Based Learning (PBL).(Blumenfeld et al., 1991);(Helle et al., 2007). This creation process requires students to work together to find solutions to authentic problems in the process of integrating knowledge, application, and construction. Instructors and community members (eg clients), usually as facilitators, provide feedback and support for students to assist the student learning process.

Several studies have mostly focused on the PjBL model in post-secondary education.(Helle et al., 2006)discusses the practice of the PjBL model and the impact of the PjBL model on student learning. Regarding practice, the authors found that most of the studies that researched limited to course descriptions in terms of course scope, instructor requirements, and group size. Regarding the impact, study they found that only a few studies examined the effect of the PjBL model on student learning in terms of cognitive (eg knowledge) or affective (eg motivation) outcomes. In another study,(Ralph, 2016)reviewed fourteen studies using the PjBL model in STEM education. It turns out that the PjBL model improves the development of both knowledge and skills of students. Students also feel that the PjBL model encourages student collaboration and negotiation in groups. However, some students reported a lack of motivation for teamwork.(Reis et al., 2017)reviewing PjBL model studies in engineering education using bibliometrics (eg analysis) and classifying the research methods of the reviewed studies. The bibliometric results show that, for example, the top three keywords used are Project Based Learning, engineering education, and problem-based learning. The classification results revealed that more than 70% of the studies focused on undergraduates and case studies were the most frequently used research approach. In addition, several studies showed that students' academic knowledge, skills, and motivation increased after the PjBL model although students also reported difficulties of the PjBL model (eg time consuming). However, this study has significant limitations.

1.2. Previous research

Although this study has mentioned student learning outcomes to some extent, there is no comprehensive picture of learning outcomes that can be attributed to the PjBL model, especially in universities. Therefore, in this study, it will provide an overview of the student learning outcomes of the PjBL model in higher education based on study empirical studies. In order to fully understand student outcomes, two research questions will be answered in this study:

1. What are the results of the evaluation of the PjBL model for students in higher education?
2. What instruments are used to measure student learning outcomes?

II. Method

Based on the articles that have been reviewed, the researcher has prepared a matrix involving the research design, learning outcomes, measurement instruments, findings, and limitations of the studies reviewed. Based on this matrix, researcher summarizes the results measured and the instruments used to measure those results based on the grouping of learning outcomes and commonly used research methods (such as those used in (Brinson, 2015)and (Post et al., 2019). Researcher divided the results into four categories, namely cognitive, affective, behavioral outcomes, and work results. Five categories of instruments were revealed, including questionnaires, rubrics and taxonomies, interviews, tests, and self-reflection journals.

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III. Results

More than half of the studies studied involved one group. In addition, learning outcomes and measuring instruments that were and were measured externally were reported in the 75 reviewed studies. This study will present findings for each learning outcome and for each type of learning outcome researcher will present the instruments used to measure the learning outcomes.

3.1. Cognitive results

3.1.1. Knowledge

In 17 studies, student knowledge, conceptual understanding, and course achievement were reported as results of the PjBL model. For example, biological knowledge, such as DNA cloning and isolation(Regassa & Morrison-

Seatlar, 2009), psychological knowledge relevant to healthy living habits and stress management(Lucas & Goodman, 2015), and technical knowledge related to aerospace engineering(Rodríguez et al., 2015), researched. Student academic achievement, programming courses are measured in(Çelik et al., 2018). Four types of instruments (ie self-reported questionnaires, tests, rubrics, and work results) were used to measure students' knowledge, of which self-reported questionnaires were mostly applied. The two Likert scales for example(Lucas & Goodman, 2015);(Rodríguez et al., 2015);(Torres et al., 2019) and qualitative questionnaires with open-ended questions for example (García, 2016); (Luo & Wu, 2015)used. As an example,(Katsanos et al., 2012)requires students to evaluate knowledge of web accessibility on a Likert scale from 1 (very low) to 5 (very high). The test is the second tool that is often used to assess students' academic knowledge for example(Çelik et al., 2018);(Katsanos et al., 2012); (Mohamadi, 2018). For example, student self-knowledge is measured by written tests with knowledge-based, application-based, analysis-based, and synthesis-based questions.(Chu, 2014);(Chua et al., 2014). In the(Regassa & Morrison-Seatlar, 2009), the concept of biology is examined by a three-choice test and seven open-ended questions.

Only one study (Kettanun, 2015)measure student course performance with rubrics. In this study, the presentation of English learners was evaluated through six criteria, such as how authentic the words were and how well they organized facts and opinions. In another study,(Usher & Barak, 2018)evaluate students' understanding of chemistry through project analysis.

3.1.2. Cognitive strategy

Nine studies measure the cognitive learning strategies used by students in the PjBL model. For example, students at(Hou et al., 2007)using seven strategies, including remembering, understanding, applying, analyzing, evaluating, creating, and deviating from the topic. Likewise, students in(Stozhko et al., 2015)also uses seven strategies, which are divided into four levels, namely the lower level (identification), the basic level (knowledge and understanding), the intermediate level (application and analysis), and the upper level (synthesis and evaluation). Both of them(Heo et al., 2010)and (Hou et al., 2007)identify five phases of student knowledge construction, namely (1) information sharing; (2) detection of disagreements; (3) negotiation of meaning; (4) modification of new ideas; and (5) a statement of agreement. In the study of(Helle et al., 2007), two cognitive processing strategies of students were investigated, namely linking (relationship of new knowledge with previous information) and structuring (outline of a set of ideas).

Five types of instruments (ie rubrics/taxonomies, questionnaires, interviews, observations, and work results) were used to assess student learning strategies, of which rubrics and taxonomies were most often used, for example (Hou et al., 2007); (Usher & Barak, 2018). As an example ,(Heo et al., 2010)develop and use an assessment rubric with several criteria, such as students' understanding of the value of design and creativity. Both of them (Stozhko et al., 2015)and (SY Wu et al., 2013)used Bloom's revised Taxonomy to assess students' cognitive strategies. However, students use different taxonomy operations. Other studies use a questionnaire as an assessment tool (Biasutti & EL-Deghaidy, 2015). (Stefanou et al., 2013)using Likert scale 7 study which focuses on the development of the PjBL model curriculum/activities/technology and the implementation/practice of the PjBL model, studies that measure the effect of tools/frameworks on the PjBL model, and studies that do not have clear reports of work results.

3.2. Affective result

Affective results are divided into evaluations by students about what they have learned (whether the PjBL model is effective) and how students feel about the learning experience.

3.2.1. Perceptions About the Benefits of the PjBL Model

Thirty-seven studies reported on student evaluations of what they learned from the PjBL model. A number of studies explore students' perceptions of improving content knowledge and skills, for example (Affandi & Sukyadi, 2016); (Botha, 2010); (Costa-Silva et al., 2018); (Cudney & Kanigolla, 2014); (Mou, 2020); (Rodríguez et al., 2015). Several studies report student attitudes, for example (Genc, 2015), motivation for example (Terrón-López et al., 2017), and self-efficacy towards the subject, for example (Bilgin et al., 2015); (Brennan et al., 2013); (Costa-Silva et al., 2018); (Tseng et al., 2013); (T.-T. Wu et al., 2018). As an example, (Assaf, 2018)examines the impact of the PjBL model through making videos on student attitudes towards English courses. (Belagra & Draoui, 2018)measuring the orientation of students' mastery of electrical power courses after three months of the PjBL model being implemented. (Beier et al., 2019)assessing students' abilities, skills, and perceived motivation to master STEM areas. (Helle et al., 2007) explores the impact of the PjBL model on learners' intrinsic motivation. Other benefits of the PjBL model that are felt by students, such as increasing insight (Çelik et al., 2018) and career after completing education (Beier et al., 2019); (Papastergiou, 2005), is also reported.

Three types of instruments (ie questionnaire, interview, and observation) were used, of which questionnaires were most frequently used. Both Likert scales, for example (Assaf, 2018); (Beier et al., 2019);

(Cudney & Kanigolla, 2014); (Helle et al., 2007); (T.-T. Wu et al., 2018) and a questionnaire with open-ended questions (Çelik et al., 2018); (Genc, 2015); (Karaman & Celik, 2008) used. Interviews, including unstructured interviews (Kettanun, 2015), semi-structured interview (Frank et al., 2003); (Genc, 2015); (Helle et al., 2007), and focus groups (Okudan & Rzasa, 2006); (Regassa & Morrison-Seatlar, 2009), is also used. In addition to the questionnaire, class observations were also used (Wildermoth & Rowlands, 2012).

3.2.2. Perceptions of the PjBL Model experience

Several studies reported students' general feelings about the PjBL model, for example (Assaf, 2018); (Başbay & Ateş, 2009); (Botha, 2010); (Mahendran, 1995); (Frank et al., 2003); (Hall et al., 2012); (Ngai, 2007); (Thomas & MacGregor, 2005); (Vogler et al., 2018); (Yang et al., 2012). Several studies have evaluated student attitudes towards the PjBL model, for example (Usher & Barak, 2018); (Frank & Barzilia, 2004); (Lee et al., 2014); (Musa et al., 2011); (Raycheva et al., 2017) and satisfaction with the use of PjBL, for example (Dehdashti et al., 2013); (Gülbahar & Tinmaz, 2006); (Okudan & Rzasa, 2006). Several studies reported difficulties faced by students during the learning process, for example (Dauletova, 2014); (Davenport, 2000); (Gülbahar & Tinmaz, 2006); (Karaman & Celik, 2008); (Lima et al., 2007); (Mysorewala & Cheded, 2013); (Papastergiou, 2005); (Zhang et al., 2009). As an example, (T.-T. Wu et al., 2018)explores whether using an e-book system results in the mental endurance and effort of nursing students during coursework. (Yam & Rossini, 2010)research on the challenges felt by students during the learning process in courses that are integrated with the PjBL model. One study explored whether the PjBL model supports student autonomy during learning activities (Stefanou et al., 2013).

Likewise, the two questionnaires, for example(Dauletova, 2014); (Stefanou et al., 2013) and interviews, for example (Dehdashti et al., 2013); (Zhang et al., 2009)used to measure student experience. In addition, the experience of students is also measured by reflective journals in(Frank & Barzilia, 2004)and (Vogler et al., 2018).

3.3. Behavioral results

3.3.1. Skills

Nine studies were conducted to explore the hard skills and soft skills of students in the PjBL model. Hard skills, such as marketing skills for hotel administration students (Vogler et al., 2018), general nursing skills for nursing students (T.-T. Wu et al., 2018), writing skills of EFL students (Sadeghi et al., 2016), and the skills of engineering management students to decide where to place public services in real-life situations (Berbegal-Miraben et al., 2017), reported. Apart from hard skills, several soft skills were reported, such as problem solving and critical thinking skills (Vogler et al., 2018); (T.-T. Wu et al., 2018); (Wurdinger & Qureshi, 2015), collaboration and teamwork skills (Berbegal-Miraben et al., 2017); (Rodríguez et al., 2015); (Vogler et al., 2018), and lifelong learning skills (Vogler et al., 2018); (T.-T. Wu et al., 2018). As an example, (Brassler & Jan Dettmers, 2017)emphasizes student problem solving skills from three interdisciplinary perspectives: (a) considering and applying different views, (b) reconsidering the strategies used, and (c) using discipline-based methods. Several phases for scenario-based problem solving, such as problem identification, data collection and analysis, and design of alternative plans, were investigated by (Chu, 2014)and (Chua et al., 2014).

Five types of instruments (i.e. questionnaires, tests, rubrics, interviews, and reflective journals) were used to assess student skills, of which questionnaires were the most widely used for example. (Rodríguez et al., 2015); (T.-T. Wu et al., 2018); (Wurdinger & Qureshi, 2015). As an example, (Brassler & Jan Dettmers, 2017)using a self-reported scale adapted from previous research. Several development steps, including literature research, concept identification, group interview, item creation, pilot study, and revision, were used to revise the scale. Scenario-based tests were developed by instructors and used in (Chu, 2014)and (Chua et al., 2014). In this study, students' performance in implementing strategies to solve problems related to programming was assessed by means of a test. Rubrics to assess students' technical skills through presentations are used from (Berbegal-Miraben et al., 2017). Students' abilities are evaluated by scoring on content, comprehension, and presentation style and are ranked on four levels (from advanced to inadequate). Then, (Vogler et al., 2018)using the journal how to assess skills through self-reflection journals and interviews.

3.3.2. Engagement

Four studies focused on the student learning process in the PjBL model. Students feel involved in the process poran study (Cudney & Kanigolla, 2014). Three aspects of student involvement, namely the level of general involvement in semester projects, the level of participation in class discussions, and whether students apply course concepts to practice need to be investigated. In the(Fujimura, 2016), the educational activities that students participate in during the entire project, such as making a research plan and collecting and analyzing data, are explored. In addition, the process of how students learn knowledge is also examined. In the(Hou, 2010), seven patterns of learner behavior, including project topic analysis, data collection, data evaluation, project content analysis, comprehensive analysis, comment proposal, and discussion of irrelevant information were explored. In

the(Koh et al., 2010) the five levels of student knowledge construction, namely sharing, triggering, exploration, integration, and resolution, were well examined in PjBL and non-PjBL model activities.

Likert scale 5 (from strongly agree to strongly disagree) with 23 questions adapted from: (Yadav et al., 1999)and used to assess the level of student involvement in semester projects (Cudney & Kanigolla, 2014). Student online interviews are recorded to gain insight into their learning process at (Hou, 2010)and (Koh et al., 2010). In (Fujimura, 2016), both student reflection journals and audio recordings, discussions were used to determine their learning activities. In addition to these two instruments, three other instruments, namely the work made by students, student reflection journals, and focus group interviews with students, were also used to examine student learning processes.

3.4. Student Work Result

Three types of work outcomes, namely physical objects, documents, and multimedia were most frequently measured in the ten studies reviewed. All products are graded with a rubric. As an example, (Chu, 2014)and (Chua et al., 2014) assessing student-made dryers with a 5-point rubric created by the instructor. Assessment criteria include, for example, original design and product quality. (Papastergiou, 2005)evaluates student-generated websites against five criteria, including topic, content and aesthetics, pedagogy, technology, and usability. (Rajan et al., 2019)graded student project reports with a 5-point rubric (from very good to poor) for several writing assignments, such as literature review, analysis, and presentation. (Torres et al., 2019)evaluate student offer reports based on three aspects, namely report accuracy (40%), report completeness (40%), and report neatness (20%).

IV. Discussion

Knowledge, strategies, and skills of learners are often measured by most of the instruments, namely questionnaires, rubrics, tests, interviews, observations, and self-reflection journals. This learning outcome received a lot of attention perhaps because the business world reported that basic knowledge and skills were very important for students' readiness for work (Casner-Lotto, 2006). The benefits and experiences felt by students from the PjBL model were measured by questionnaires, interviews, observations, and self-reflection journals. However, although these two results differ from each other, in many studies reviewed they are interrelated, which makes it difficult to interpret the findings. Student engagement was evaluated by questionnaires, interviews, self-reflection journals, work results, and recorded student discussions in only four studies. It is necessary to examine the special learning process of students during the study period. All work is assessed with a rubric. However, product evaluation has not received much attention in the studies analyzed despite the creation of products that distinguish the PjBL model from other forms of learning. Product creation is important because it helps learners to integrate and reconstruct their knowledge, discover and improve their professional skills, and increase their interest in learning the discipline and ability to work with others. In other words, the final product is a concentrated expression of various competencies that students can develop during the PjBL model. Thus, further research is recommended to investigate further about the performance of students' final products. the final product is a concentrated expression of the various competencies that students can develop during the PjBL model. Thus, further research is recommended to investigate further about the performance of students' final products. the final product is a concentrated expression of the various competencies that students can develop during the PjBL model. Thus, further research is recommended to investigate further about the performance of students' final products.

Many of the studies reviewed did not have clear descriptions of the measurement instruments and data analysis. Although questionnaires are most frequently used, some studies do not report on questionnaire items, for example (Costa-Silva et al., 2018); (Davenport, 2000); (Ngai, 2007); (Seo et al., 2008). There is also a lack of clear reports on the reliability and validity of the scale, for example (Dehdashti et al., 2013); (Sababha et al., 2016); (Thomas & MacGregor, 2005); (Yam & Rossini, 2010). This limitation is also found in self-reported questionnaires used in other studies such as clinical research (Kosowski et al., 2009).

Providing information about psychometric instruments is useful for researchers to use high-quality tools and quality study results. Subsequent research should report on the items, reliability, and validity of the instruments used. As for qualitative data analysis, some studies do not have quality validity. Standard audit procedures are recommended to be used to ensure quality study results. In addition, the field of computer technology is often used in the PjBL model, the use of log data as a data collection method, should be further considered. A more comprehensive picture of student learning can be provided by data logs(Deane et al., 1998)based on various behaviors, such as browsing, time, frequency, that are recorded. In addition, log files are suitable for finding and analyzing student learning strategies and patterns in complex cognitive learning processes such as complex problem solving (Greiff et al., 2016). Then, this additional information helps teachers and researchers better understand student profiles (student interest and engagement) and improve future curriculum (Bunderson & Olsen, 1988).

Although this study did not intend to focus on the impact of the PjBL model on student learning, the small number of studies reviewed have proven that the PjBL model is beneficial to student knowledge, e.g. (Mohamadi, 2018), learning strategies, for example (Stefanou et al., 2013), skills, for example (T.-T. Wu et al., 2018), motivation, for example (Helle et al., 2007); (T.-T. Wu et al., 2018), and product quality, for example (Affandi & Sukyadi, 2016); (Torres et al., 2019). However, it is difficult to determine the effect of the PjBL model on student learning because most of the studies analyzed did not apply research designs that allow claims about effects on learning outcomes. Therefore, for further research, more experimental research should be conducted to determine the benefits of the PjBL model on heterogeneous student learning outcomes.

V. Implications

Since the Project Based Learning and Problem Based Solving models are similar and there is still debate about their effect on student learning, it is necessary to distinguish between the two, especially in higher education. An important task of higher education is to provide innovative education for students entering the labor market in the future as it increases their competitiveness and promotes the long-term development of society. (Crosling et al., 2015). Research has suggested encouraging student innovation by supporting autonomy during tasks in the learning process (Martín et al., 2017). The Project Based Learning model can meet these needs. Although some studies, for example (Helle et al., 2006) have shown the difference between project-based and problem-based learning, such as different types of assignments and instructor roles, however, how to process knowledge is key. The focus of problem-based learning lies in the application of knowledge while project-based learning, which is based on active construction science learning (Krajcik & Blumenfeld, 2006), emphasizing the construction of knowledge. This new knowledge creation process allows students to test and achieve their ideas in the way they want, which promotes students' innovation competence. Therefore, the researcher believes that it is necessary to encourage lecturers in higher education to use project-based learning. In addition, although the disciplines were not analyzed in this study, there are many applications of the Project Based Learning model in the STEM. Future research should consider applying the Project Based Learning model more in the humanities and social sciences.

VI. Conclusion

This article has found four categories and seven subcategories of student learning outcomes in the PjBL model in universities and eight appropriate measurement instruments. Further studies should be conducted to evaluate student learning processes and student work results. The quality of the measurement instruments should be reported and the way of data analysis should be improved. In addition, more experimental research should be conducted to determine the effect of the PjBL model on student learning.

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