Project-Based Learning: A Study of the Effects of PBL in the Classroom

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Introduction

In the general education classroom students are familiar with the standard worksheets and memory-based assignments. These worksheets and other assignments are irrelevant and/or mundane. The students are not allowed to use any creativity or voice. This leads to very little to no interest from students and therefore very little learning. Many students also have a hard time grasping the reasoning behind their objectives. They do not know how the objective will relate to real-world applications. The routine tasks, that are predominately shown in elementary classrooms, do not emphasize the real-world application behind the content. This is why project-based learning would be a valuable and integral addition to the elementary classroom. The Project Based Learning application is an innovative approach that centers on contingent learning through elaborate exercises (Chintya, Haryani, Linuwih, & Marwoto 2023). Project Based Learning (PBL) allows students to further develop collaboration skills, creativity, and problem-solving skills and ultimately leads to higher test scores.

Collaboration in Project-Based Learning

Project Based Learning is rooted in the four c's. Those c's are creativity, communication, critical thinking, and collaboration (Kurniawati, Susanto, Munir 2019). Collaboration is an activity that requires students to work together towards a comparable goal (Kurniawati, Susanto, Munir 2019). During Project Based Learning students are required to share their thoughts and knowledge, therefore requiring students to collaborate (Kurniawati, Susanto, Munir 2019). Learning while using the Project Based Learning method allows students to interact and work well with other

students (Chintya, Haryani, Linuwih, & Marwoto 2023). Learning while employing the Project Based Learning method also permits students to interact and work cohesively with other students (Issa & Khataibeh, 2021). The following studies take a deeper look at the collaboration required and encourage cohesiveness with Project Based Learning activities.

Kediri, East Java Junior High Study

In this study, researchers take a deeper look at the collaboration skills involved in a Project Based Learning environment. The teacher assigned students an assignment that was to be completed in two meetings. Therefore, the researcher observed students in one specific class, but during two different periods. The assignment was to create a wall magazine. The researcher randomly chose a group to observe for both meeting times. The chosen class was in ninth grade and had a class count of thirty-eight students with a ratio of twenty-three girls and fifteen boys. The chosen cluster was a group of five girls. (Kurniawati, Susanto, Munir 2019)

To establish data, the researcher used conversations and body movements/gestures. These verbal and non-verbal communications were used to formulate the data needed to determine the results. The researcher was a non-participant in the classroom, so as not to disrupt the class and construe the results of the investigation. According to Ahmad, there are six indicators to determine if the data results in positive peer collaboration (Ahmad 2018). Those indicators are that

1. Students can give opportunities and motivation to others to express their opinion or ideas.
2. Students can consistently support and respect the effort of others by praising their opinion/ideas, as well as their work.

3. Students can give suggestions politely if someone's idea is not appropriate to the project.

4. Students have the freedom to give their input during the discussion

5. Students can collaborate to decide who is in charge of certain tasks.

6. Students can work together and help each other complete tasks even when they are in charge of different tasks so that they get the project done.

(Ahmad 2018)

The results of this study showed that project-based learning projects could promote collaboration skills. The results showed that through conversations and body gestures, students positively impacted their peers and listened to each other's concerns. In all the conversations that took place in the project meetings, students were very respectful to each other and valued each other's opinions. They frequently encouraged and uplifted each other while working and sharing ideas. The students in the group checked off all of Ahmad's indicators of collaboration skills. (Kurniawati, Susanto, Munir 2019) This shows that Project Based Learning can effectively promote collaboration skills within the classroom.

Creativity in Project-Based Learning

Creativity is the ability of students to create new things in their learning from the information gathered from the teacher, in the process of teaching, and also acquiring information so that they can make new contributions to their learning (Setiawan et al., 2023). Project Based Learning can provide many valuable outcomes if performed correctly and followed through. One of those outcomes is the potential to increase student creativity. Creativity is a skill, a creative operation, and considerations that

influence behavior and create originality (Hasanah, Desniarti, & Siregar 2022). When students are permitted to be involved and have a voice in their learning, they are more motivated, therefore enhancing their creativity (Cahyani 2021). Creative thinking enables students to evaluate their thoughts in making decisions and drawing conclusions wisely (Tamba, Motlin & Turnip 2017). Expanding student learning creativity is the basis of Project Based Learning (PBL), which includes students in the learning process, while students work collaboratively and solve problems to create a project. (Chintya, Haryani, Linuwih, & Marwoto 2023). Project Based Learning is more student-centered rather than teacher-centered, therefore increasing students' participation because most of the projects and activities are facilitated by the students (m & Esche, 2002). The students will engagingly partake in the classroom and show their creativity because they have to do the bulk of the activities unaccompanied by the teacher's ongoing input (Praba, Artini, & Ramendra, 2018). The following studies show the correlation between Project Based Learning and creativity.

SDN 143 Ge'tengan Inpres. 4th Grade Study

In this study, a class of fourth-grade students was researched to show the correlation between Project Based Learning and the increase in creativity among students. The first step was for the teacher to alter her assignments to allow for student creativity to be exposed. Student engagement will appear if the teacher supplies occasions for students to want to grow their mindset, and want to expand their ideas (Sumarmin & Victorina, 2015). After the teacher developed activities to allow for creativity, the researcher was able to describe the level of student creativity.

Data was collected by the researcher through observations, interviews, documentation, and questionnaires. The interviews were collected from the

fourth-grade teachers. The means employed are based on the Miles and Huberman model. These include data reduction and display, including data presentation and verification (Chintya, Haryani, Linuwih, & Marwoto 2023). After determining how data would be collected, the researcher performed prior research to obtain data related to issues in learning in elementary schools. The researcher also determined the learning model being used and the opinions of said model. This stage also determines the competency standards to be attained and establishes the learning model to be used to teach the standards (Chintya, Haryani, Linuwih, & Marwoto 2023). The next step was to design the learning videos, practice questions, and tests for the Project Based Learning model (Chintya, Haryani, Linuwih, & Marwoto 2023).

The results of this study showed a definite correlation between the Project Based Learning model and increased student creativity. In the examination of the results of the data, it was found that students were more inclined to be lively and eager in the activities of PBL, especially in creating and constructing activities. This is sustained by a student observation sheet, in the form of a questionnaire. The questionnaire showed that all in all, students are more intrigued by PBL activities. The use of PBL requires students to think more creatively. This is signified by the growing number of students inquiring and communicating their opinions while also answering teacher queries (Chintya, Haryani, Linuwih, & Marwoto 2023).

Development of Problem-Solving Skills in PBL

Project Based Learning is a learner-centered approach, which is well-known as one of the ways that promote the growth of competencies and advance learners' problem-solving skills (Junisbayeva 2020). According to the study of the definitions

linked to critical thinking skills, it can be said that the subsequent statement “the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action” superbly defines critical thinking skills (Scriven & Paul, 2007 as cited in Snyder & Snyder,2008). Project Based Learning is an inventive learning model that teaches problem-solving mastery in authentic situations, persistent with the growth of students' people skills (Vogler et al., 2018). The PBL learning model includes a complex set of initiatives that help students to master an assortment of 21st-century skills or 4c skills (Dewi et al., 2017). These four C’s are collaboration, communication, creativity, and critical thinking (Amelia & Santoso, 2021; Hakim et al., 2019; Musa et al., 2012). Students must develop problem-solving skills in this day and age. Students need to have problem-solving skills to be prepared for the endeavors of the 21st century to keep up with the world (Putri & Dwikoranto 2022). Problem-solving is identified as one of the chief skills that students must have when participating in the real world (Mabilangan 2012). The following study takes a deeper look at the development of problem-solving skills when engaging in the Project Based Learning model.

Magelang, Central Java. 5th Grade Study

In this study, fifth-grade students were examined to show the correlation between Project Based Learning and the development of problem-solving skills. In Indonesia, there are certain skills listed in the Regulation of the Minister of Education and Culture Number 21 of 2016. These skills are considered to be necessary for students to obtain, for them to be successful in the 21st century. The skills listed are communication, problem-solving, critical thinking, creativity/innovation, and

collaboration (Sarwi, Baihaqi & Ellianawati 2021). In this study, researchers were faced with another obstacle, Covid-19. With Covid-19 making physical interaction impossible, the Project Based Learning model with the STEM approach must be presented by distance learning (Sarwi, Baihaqi & Ellianawati 2021). Starting, problem-solving skills in this group were considerably low (Sarwi, Baihaqi & Ellianawati 2021). In this study, students will partake in small groups and find solutions while the teacher acts as only a facilitator (Luo, So, Li, & Yao 2020). Incorporating STEM in the PBL learning model can enhance problem-solving skills in the real world (Luo, So, Li, & Yao 2020). Therefore, this study will focus on merging STEM into the Project Based Learning method to elevate learning outcomes and critical thinking. In this particular study, the researcher made all of the instruments for testing and learning so that they were conducive to distance learning as well as Project Based Learning (Luo, So, Li, & Yao 2020).

The students selected for this study were from 4 schools in Magelang City, Central Java. The selected students were all in grade 5 and the sampling was random. In total, there were 78 students selected. The way the researcher set up the study was by providing the sampled students with a pre-test, followed by the teacher providing the students with instruction through PBL that focused on STEM. After the instruction, the students were evaluated with a post-test to determine the results (Luo, So, Li, & Yao 2020). Both the pre-test and post-test consisted of five indicators to determine the problem-solving skills obtained. Those indicators included (1) define, (2) assess, (3) plan, (4) implement and (5) communicate (Sarwi, Baihaqi & Ellianawati 2021). Before the researcher carried out the study, the validity of the testing instruments was evaluated by three experts in the field of study (Luo, So, Li, & Yao 2020).

The results of the study showed a definite and strong correlation between PBL and strengthened problem-solving skills among the sampled students. Each of the five indicators was compared from the pretest to the post-test. The “define” indicator pretest had a score of 75% and jumped to 88% on the post-test. The next indicator, “assess”, had a score of 68% on the pretest, while the post-test had a score of 80%. Indicator three, “plan”, went from 66% on the pretest to 79% on the post-test. Indicator four, “implement”, had a score of 62% on the pretest and jumped to 75% on the post-test. The last indicator, “communicate” had a score of 61% on the pretest and elevated to 80% on the post-test (Luo, So, Li, & Yao 2020). These results show the strengthening of problem-solving skills when PBL is implemented in the classroom, even through unforeseen difficulties, such as distance learning.

PBL and Test Scores

With the positive correlation between PBL and strengthened collaboration, creativity, and problem-solving skills, it would be conducive to assume that students would be more equipped to perform higher on standardized tests. From the examination of the results of the PBL learning method and research on student learning outcomes, it is revealed that the average student score has improved (Chintya, Haryani, Linuwih, & Marwoto 2023). Lessons based on attentive student involvement in the learning process, activities that encourage students to investigate, collaborate, and solve real-life issues, and are cross-curricular attain superior outcomes (Lazić, Maričić & Milinković, 2015). Research reveals that when the Project Based Learning model is used in the classroom it helps enhance academic achievement in mathematics (Ali, Hukamdad, Akhter & Khan, 2010). This enhanced achievement is largely attributed to the student being actively involved in the learning process, therefore making them more

accountable and invested in their learning. In the following study, we will take a more in-depth look at how PBL increases student achievement and scores.

Serbia, 3rd Grade Study

In this study, the focus was on third-grade students in Serbia. The study was conducted over three months during the 2017 to 2018 school year. The content and objectives were centered on measurement, which readily pertains to real-life experiences, making it easily adapted to the Project Based Learning model. All of the activities within the experiment were designed in the form of projects and were closely associated with students' daily lives and real-life dilemmas pertaining to measurement (Lazic, Knezevic, & Maricic 2021). While partaking in this PBL experiment, these 3rd graders had a chance to solve real-life problems, making their understanding more lasting and more relevant in occurrences outside the school environment (Lazic, Knezevic, & Maricic 2021). Due to the activities being relevant and interesting to the students, they were more engaged in the project causing a deeper and more meaningful mastery. The focus of this particular experiment was to establish the efficacy of applying the Project Based Learning model on student mastery in lower elementary mathematics education (Lazic, Knezevic, & Maricic 2021).

The experiment was conducted on a total of 147 third-grade students. The researchers formed two different parallel groups, with the experiment group being 77 students from three different 3rd-grade classes from one particular elementary school and the control group being made up of 70 students from three different classes at another elementary school. The teachers of the control groups were not aware of the content or given any instructions on how to teach the content, although they were to

teach the same material. (Lazic, Knezevic, & Maricic 2021) A pilot test was performed on 43 different students to test the validity and accuracy. However, these students did not participate in the experiment. A pretest was given to both the experimental and the control group. Following the pretest, teachers taught the content and the experiment teacher facilitated the PBL method using various real-life problems and projects. After the completion of the projects, a post-test was given (Lazic, Knezevic, & Maricic 2021). The same 10 measurement concepts were tested on both the pretest and the post-test but in different questions (Lazic, Knezevic, & Maricic 2021).

The results of the study showed a direct correlation between Project Based Learning and student test scores. Analyzing the results, we can determine that the Project Based Learning model assisted students from the experimental group to score higher on the post-test (M = 69.34, SD = 17.893) as opposed to students from the control group (M = 63.14, SD = 19.744). Variance on the post-test shows the occurrence of an empirically notable difference in the achievement of students on the test, with the experimental group surpassing the control group. According to Lazic, Knezevic, and Maricic, "Levene's test shows that the assumption of the equality of variances has not been violated (p = 1.119, p = .275) and that the result is reliable" (Lazic, Knezevic, & Maricic 2021).

Table 1 Descriptive statistics of the experimental and control group at the pre-test and post-test

Test/Group		*N*	*M*	*SD*	*SE*	95% CI for mean Lower bound	95% CI for mean Upper bound	Minimum (Min)	Maximum (Max)
Pre-test	Experimental	77	63.01	19.626	2.237	58.56	67.47	5	93
	Control	70	62.84	21.489	2.568	57.72	67.97	5	100
	Total	147	62.93	20.463	1.688	59.60	66.27	5	100
Post-test	Experimental	77	69.34	17.893	2.039	65.28	73.40	16	97
	Control	70	63.14	19.744	2.360	58.44	67.85	12	92
	Total	147	66.39	18.988	1.566	63.29	69.48	12	97

Table from Lazic, Knezevic, & Maricic 2021.

To relieve any concerns that the deviation was because of a deficiency of consistency between the experimental and the control group, researchers computed the ANCOVA. The outcome of the first calculation was taken as the initial measurement. The conclusion ($F = 39.686$, $p < .001$) proves that the dissimilarities were not due to a deficiency of consistency between the experimental and the control group, but because of the Project Based Learning model (Lazic, Knezevic, & Maricic 2021). Results of further testing have depicted that students from the experimental group have achieved better scores on other tests in comparison to the students from the control group. Due to these results, we can conclude that students who partake in PBL outperform their counterparts in testing scores and achievement (Lazic, Knezevic, & Maricic 2021).

Conclusion

In this literature review, we have taken a deep dive into the outcomes of student performance when Project Based Learning is implemented in the classroom. We can conclude that overall PBL leads to greater enjoyment and engagement from students. This, therefore, leads students to gain a deeper understanding and more meaningful connections. It is likely that creativity, collaboration, problem-solving skills, and ultimately test scores will be increased when the Project Based Learning model is implemented in the classroom. Upon my research, I noticed that additional research could be beneficial to determine overall student achievement and how the learning will be transferred to the following year. Will the dreaded “summer slide” occur, where students forget what they learn like with the standard conventional “sit and get” learning model or will students be able to hold onto their knowledge since they made meaningful connections with the Project Based Learning Model? This is why I am

proposing to further this research by implementing the PBL model in my classroom this coming year. Upon the completion of the school year, I will determine if students held onto their knowledge by comparing their beginning-of-year MAP scores to their end-of-year MAP scores. There is also a deficit in long-term research on the implementation of Project Based Learning. The longest study I found was for three months. I am curious to compile the results of a Project Based Learning model being implemented over a full school year. The results will be valuable in determining the overall effectiveness of providing this particular learning model for the long term or even indefinitely. Overall, we can determine that Project Based Learning can provide many beneficial qualities to the academic world and students.

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