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Exploring the *Effectiveness* of Project-Based Learning on Students' Motivation in Science: An Action Research Study

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ABSTRAK
Penelitian ini bertujuan untuk mengkaji pengaruh *project-based learning* (PjBL) terhadap motivasi belajar siswa dalam pembelajaran sains. Subjek penelitian terdiri dari 31 siswa kelas VIII di salah satu sekolah negeri di Bandung, Jawa Barat, yang terdiri atas 16 siswa laki-laki dan 15 siswa perempuan. Penelitian ini menggunakan desain *Classroom Action Research*, dengan pengumpulan data melalui angket dan observasi kelas. Motivasi belajar siswa diukur menggunakan angket *Students' Motivation Toward Science Learning* (SMTSL) yang mencakup enam aspek, yaitu efikasi diri, strategi pembelajaran aktif, nilai pembelajaran sains, tujuan performa, tujuan pencapaian, dan stimulasi lingkungan belajar. Hasil analisis data menunjukkan bahwa rata-rata motivasi belajar siswa pada siklus I dan siklus II masing-masing sebesar 69% dan 68%, yang termasuk dalam kategori "baik". Namun demikian, hasil tersebut juga mengindikasikan tidak adanya peningkatan signifikan pada motivasi belajar meskipun pendekatan PjBL telah diterapkan. Kondisi stagnasi ini mendorong perlunya eksplorasi lebih lanjut untuk mengidentifikasi faktor-faktor yang menyebabkan keterbatasan pengaruh PjBL terhadap peningkatan motivasi siswa. Beberapa faktor yang patut ditelaah antara lain kualitas pelaksanaan proyek, dinamika keterlibatan siswa, serta faktor kontekstual dalam lingkungan belajar yang mungkin memengaruhi hasil penelitian.

Kata kunci : Penelitian Aksi, Pembelajaran Berbasis Proyek, Motivasi Siswa, Pembelajaran Sains

ABSTRACT
Exploring the Effectiveness of Project-Based Learning on Students' Motivation in Science: An Action Research Study. This study aims to examine the effect of project-based learning (PjBL) on students' motivation in science learning. The participants consisted of 31 eighth-grade students from a public school in Bandung, West Java, comprising 16 male and 15 female students. The research employed a classroom action research design, with data collected through questionnaires and classroom observations. Specifically, students' motivation was measured using the Students' Motivation Toward Science Learning (SMTSL) questionnaire, which encompasses six dimensions: self-efficacy, active learning strategies, science learning value, performance goal, achievement goal, and learning environment stimulation. The findings revealed that students' motivation levels in science learning during Cycle 1 and Cycle 2 were 69% and 68%, respectively, both categorized as "good." However, the data also indicated a lack of significant improvement in motivation despite the implementation of the PjBL approach. This stagnation suggests that further exploration is needed to understand the underlying factors contributing to the limited impact of PjBL on students' motivational development. Potential areas of inquiry include the quality of project implementation, student engagement dynamics, and contextual factors within the learning environment that may have influenced the outcomes.

Key word: Action Research, Project-Based Learning, Students' Motivation, Science Learning

Introduction

Science education plays a key role in equipping students with the information and skills essential to navigate and contribute to an increasingly complex and technologically driven world. However, students often encounter challenges in grasping scientific concepts due to their abstract and intricate nature, leading to diminished motivation and engagement in science learning (Fatmahanik, 2022). This decline in motivation can adversely affect students' academic presentation and their capability to apply scientific knowledge effectively. therefore, students in science classroom often feel unmotivated to learn and it affects their achievement of science study (Membiela et al., 2023; Prokop et al., 2007). Previous studies have shown that science achievement among junior high school students remains low, largely due to a lack of motivation (Jufrida et al., 2019). Motivation is essential, as it significantly influences students' conceptual change (Anuar et al., 2023), critical thinking, learning strategies (Anuar et al., 2023); Garcia & Pintrich, 1992; Kuyper et al., 2000), and overall science achievement (Ortega-Torrez, 2020; Perdana, 2022).

Assessing whether students have met educational standards—and whether teachers and schools have effectively taught these standards—is essential (Allen et al., 2013). To improve student achievement, it is essential to implement instructional strategies that foster autonomy, competence, relatedness, and relevance—factors known to enhance motivation and engagement (Jenson, 2005; Turner et al., 2014). Research shows that highly motivated students are more committed to school and confident in their academic abilities, driven by goals such as mastery, performance improvement, and social acceptance (Kuyper & van der Werf, 2015). Genuine engagement, according to Antonetti and Garver (2015), requires students to take ownership of their learning, rather than passively observe. Likewise, Ateh and Charpentier (2014) emphasize that student-centered, relevant learning experiences significantly increase engagement. These findings highlight the need for middle school educators to apply strategies that effectively support student motivation and engagement. Project-based learning (PjBL) is widely regarded as an effective student-centered approach to enhance motivation. Rooted in constructivist principles, PjBL emphasizes contextualized knowledge construction, active learner involvement, and the development of understanding through social interaction (Cocco, 2007). Constructivist theory holds that students build new knowledge by integrating it with prior experiences (Jones & Brader-Araje, 2000). When learning tasks are perceived as meaningful and relevant, students are more likely to engage actively using strategies that connect prior and new knowledge (Tuan et al., 2005). PjBL provides a structured yet adaptable framework that engages students in authentic, complex tasks leading to tangible outcomes, thereby fostering academic achievement and essential life skills (Chen & Yang, 2019). Regular engagement in project work not only enhances academic performance but also promotes intrinsic motivation and meaningful learning (Işik & Gücüm, 2013). Moreover, when students view their tasks as real-world problems, this perception can foster a collaborative and motivating classroom climate (Solomon, 2003).

Research on the relationship between project-based learning (PjBL) and student motivation has been conducted across various countries using diverse methodological approaches, including mixed methods, pre-experimental, quasi-experimental, quantitative, qualitative, and action research designs. Mixed-method studies have explored, for example, the impact of PjBL on college students' intrinsic motivation (Ocak & Uluyol, 2010), middle school students' motivation and attitudes toward biology in the Arab sector of Israel (Kortam et al., 2018), and the motivation and problem-solving abilities of vocational students in food and beverage programs (Chiang & Lee, 2016). Quasi-experimental studies have examined the effect of PjBL and work-based learning models on technical achievement and motivation in vocational high schools (Sudjimat & Permadi, 2021), and the role of electronic media-assisted PjBL in enhancing motivation and science process skills (Safaruddin, 2020). Quantitative research has assessed motivation and engagement among middle school students (Carrabba & Farmer, 2018) and preschool motivation through PjBL and cooperative learning (Viñuela & de Caso Fuertes, 2023). Qualitative studies, such as Hilvonen (2010), have explored students' experiences of motivation in PjBL settings, while pre-experimental research has measured changes in motivation among 7th-grade science students (Işik & Gücüm, 2013). Literature reviews have compared the impact of PjBL and problem-based learning on motivation and learning outcomes (Simbolon & Koeswanti, 2020).

Although one action research study has explored student motivation in the context of arts education with varying autonomy levels (Ramos & Nicolás, 2022), there remains a notable gap: no prior research has applied an action research approach to examine the effect of project-based learning (PjBL) on students' motivation in science education. While PjBL is widely recognized as a strategy to enhance student motivation, existing studies have produced mixed results—some report improved engagement and motivation, while others show little to no impact, suggesting inconsistent empirical evidence across educational settings (Herman & Gomez, 2006). Moreover, most of these studies have been conducted in Western or higher education contexts, leaving limited understanding of how PjBL functions within the cultural and curricular frameworks of Indonesian junior high school science classrooms. In addition, prior research tends to emphasize learning outcomes over the process of implementation, often neglecting the iterative nature of instructional refinement in classroom settings (Pearce, 2008).

There is a pressing need for action research that not only evaluates the effectiveness of PjBL but also explores the practical challenges of its integration through cycles of planning, action, observation, and reflection. Furthermore, the long-term impact of PjBL on sustaining student motivation across multiple instructional cycles remains underexplored. Therefore, this study aims to fill these gaps by investigating how PjBL influences student motivation in Indonesian junior high school science learning using a reflective, cyclical action research framework.

Method

Participants

Thirty-one students in the 8th grade classroom, in one of Public Junior High School in Bandung had participated in the study. The school implements *Kurikulum Merdeka* for 8th grade. *Kurikulum Merdeka* is a curriculum with various intracurricular learning so that students strengthen their competencies based on *Profil Pelajar Pancasila* (Kemendikbudristek, 2022). The selected participants are chosen because they are available to be studied. There are 16 male (51.61%) and 15 female (48.39%) students with an age average of 13-15 years old.

Research Design

This study employed action research as a methodological approach to improve teaching practices within the context of an 8th-grade science classroom. Action research is fundamentally a cyclical process aimed at addressing and resolving specific classroom-based problems (Kemmis et al., 2019). The process involves four key stages: (1) planning, (2) action, (3) observation, and (4) reflection (Kemmis, 2009), as illustrated in Figure 1. It typically begins with the identification of a problem, which is then analyzed using various techniques (Baysal et al., 2022). According to Baysal et al., once the problem is clearly defined, the action phase is initiated. This involves the implementation of a structured intervention; however, it is not assumed that the initial intervention will solve the problem entirely. If the outcomes are unsatisfactory, the plan is revised and re-implemented based on insights gained from the previous cycle. This iterative nature enables the development of increasingly effective strategies over time. The design of this research follows this model, as presented in Figure 1 (Kumdang et al., 2018).

This study employed a classroom action research design consisting of two implementation cycles of project-based learning (PjBL). The decision to conduct only two cycles was based on the practical constraints of the academic calendar and the instructional schedule of the science subject. Each cycle included stages of planning, action, observation, and reflection, allowing the researcher to assess the immediate effects of PjBL on students' motivation and make improvements between cycles. While the two-cycle approach offers valuable insight into the short-term impact and implementation process, it does not capture the long-term sustainability of motivational changes, which is acknowledged as a limitation and a direction for future studies.

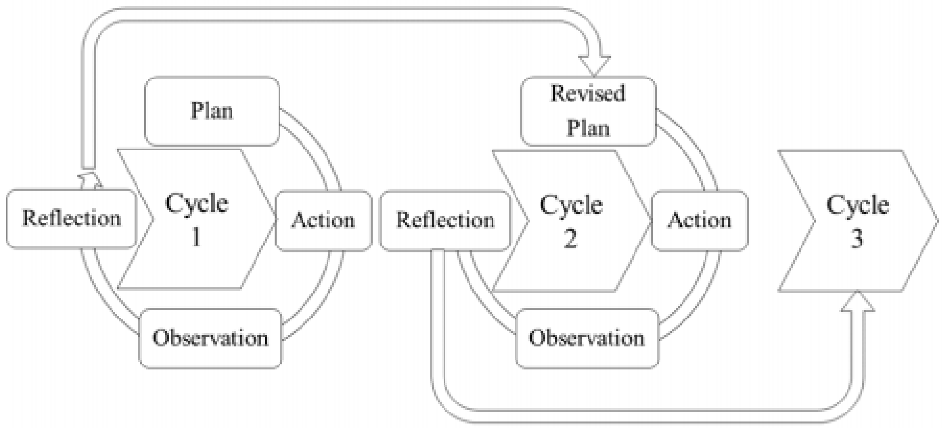

Figure 1. Research process of action research

Research Instruments

In this study, in order to determine students' motivation in science learning, Students' motivation towards science learning (SMTSL) questionnaire has been used. This questionnaire has been developed by Tuan et al. (2005). Six scale were developed: self-efficacy, active learning strategies, science learning value, performance goal, achievement goal, and learning environment stimulation (Tuan et al., 2005). It contains 35 statements (26 positive statements and 9 negative statements) with the choice of strongly disagree, disagree, no opinion, agree, and strongly agree. The instrument was distributed to the students in the class after the one period cycle is done. In addition to questionnaire data, supplementary information was obtained through open classroom observations conducted by another teacher and follow-up reflective discussions with the teacher supervisor after each lesson. These qualitative insights provided valuable context regarding students' engagement, group dynamics, and observable behaviors during project implementation. This approach is consistent with accepted practices in action research, where collaborative reflection and peer observation are recognized as valid means of triangulating data and enhancing the trustworthiness of findings (Kemmis et al., 2014; Zeichner, 2003).

The reliability of each scale in SMTSL was assessed using Cronbach's alpha, with values ranging from 0.70 to 0.87 when individual students were treated as the unit of analysis. Discriminant validity was evaluated to determine the extent to which each scale measured a unique construct distinct from the others. In the SMTSL instrument, discriminant validity coefficients ranged from 0.09 to 0.51, indicating that while the scales were generally independent, there was some degree of overlap among them.

Data Analysis

In the research, student data is processed by using Microsoft excel. The items were established using five-point Likert-type scales. Items on the scales are anchored at 1 = strongly disagree, 2 = disagree, 3 = no opinion, 4 = agree and 5 = strongly agree for positive statements and vice versa for negative statments (Tuan et al., 2005). In order to reveal the students' motivation towards project-based learning applications, mean and percentage values from descriptive statistics were used. Furthermore, the observation gathered and analyzed focused on general indicators of student motivation, such as task completion, participation in project activities, collaboration, and visible enthusiasm during lessons. These observations were not systematically coded but served as supporting evidence for the questionnaire results. After each lesson, informal reflective discussions were held with a teacher supervisor to gain further insights and cross-check the consistency of classroom impressions. This triangulation between observation and post-lesson reflection is acceptable in classroom-based action research, especially when aiming to understand instructional impact in real teaching contexts (Kemmis et al., 2014)

Research Procedure

This study consisted of two cycles of classroom action research, initiated by the identification of a key problem: low student motivation in science learning. In Cycle 1, the planning phase involved a literature review, consultation with experts, analysis of classroom conditions, and the design of a project-based learning (PjBL) strategy tailored to the identified issue. The selected project theme for Cycle 1 was earthquake mitigation, which spanned three meetings (each 2 x 40 minutes). During this cycle, students were asked to form groups and design a product that could represent an earthquake preparedness or mitigation tool, such as an emergency kit or a model of an earthquake-resistant building. The teacher facilitated learning by guiding problem identification, planning, scheduling, and overseeing the hands-on work phase. Observation was conducted throughout the three meetings, and at the end of the cycle, students completed the SMTSL questionnaire to assess their motivation.

The results of the questionnaire and observational feedback were then analyzed and used during the reflection phase to revise and improve the implementation for Cycle 2. In the second cycle, the same PjBL framework was applied, but with refined procedures based on the challenges identified in Cycle 1. The project theme was shifted to wave and vibration, and students were asked to design a musical instrument inspired by the traditional bamboo flute (suling) using common materials. This cycle also lasted the same meeting duration and structure. Greater emphasis was placed on clearer project guidelines, more structured group formation, and integration of culturally responsive elements to better align the learning experience with students' backgrounds. Observations and questionnaire data from Cycle 2 were collected similarly and used to evaluate the progression in student motivation and engagement.

Results and Discussion

The analysis and discussion of the result will be presented as percentages of students' motivation. The students' motivation in cycle 1 and cycle 2 can be seen in Figure 2.

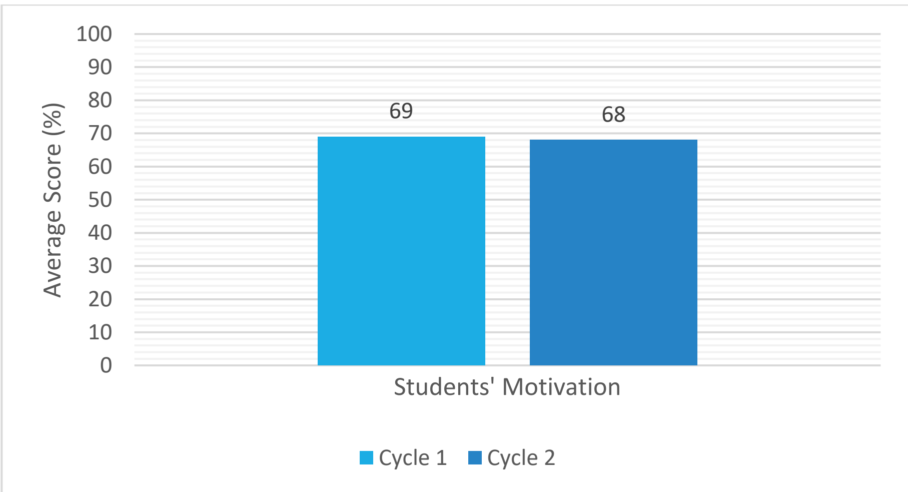

Figure 2. Students' Motivation in Cycle 1 and Cycle 2

As illustrated in Figure 2, students' motivation in Cycle 1 was recorded at 69%, while in Cycle 2 it slightly decreased to 68%, indicating a marginal difference of 1% in favor of Cycle 1. Although the difference is minimal, it suggests either a slight decline or a relatively stable level of student motivation across the two cycles. To further analyze these outcomes, student motivation was examined based on six specific dimensions, as proposed by Tuan et al. (2005). As the previous data, the results also presented in percentage to represent the average score of each aspect that included in the questionnaire. The results of the students' motivation between cycle 1 and cycle 2 are presented in Figure 3 as it can be seen below.

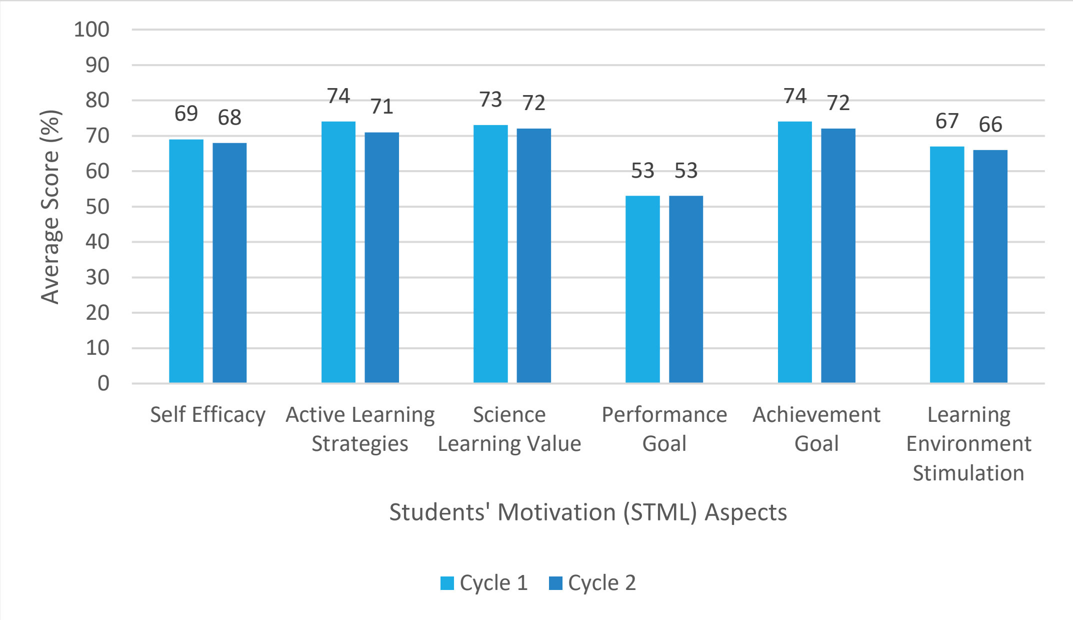

Figure 3. Students' Motivation factors in Cycle 1 and Cycle 2

The Figure 3 shows that there are five aspects that undergo a decline from cycle 1 to cycle 2, while one aspect remains unchanged. The aspects that having a decline are Self Efficacy (69% to 68%), Active Learning Strategies (74% to 71%), Achievement Goal (74% to 72%), and Learning Environment Stimulation (67% to 66%). While the aspect that remains unchanged is Performance Goal (53% still). Overall. The range of the difference between the aspects is about 1%-3%, with the highest change on the Active Learning Strategies Aspects (3% difference) and the lowest change (beside the unchanged) are Self Efficacy, Science Learning Value, and Learning Environment Stimulation (each 1% difference).

Based on the description above, generally the cycle 1 (69%) resulted better performance than cycle 2 (68%) with only 1% decline. It may be inferred that there is a slight decline in the general students' motivation score. While according to the aspects' score, the decline can be seen in five aspects while the other one remains unchanged. The highest decline is resulted on the Active Learning Strategies aspect (3%), continue by Achievement Goal (2%), and Self-Efficacy, Science Learning Value, and Learning Environment Stimulation by 1%. Performance Goal is the only aspect that remains unchanged. Cycle 1 implemented project-based learning. The George Lucas Educational Foundation (2007) stated that there are six steps of project-based learning; (1) Start with the essential question; (2) Design a plan for the project; (3) Create a schedule; (4) Monitor the students and the progress of the project; (5) Asses the outcome; (6) Evaluate the experience. On the first meeting of cycle 1, students were asked to do the discussion stage of analyzing the problem, planning the design to the problem (in this case earthquake mitigation) and scheduling. The next meeting students are asked to complete their project, and the last meeting for assessing and evaluating the product. Along the activity, students were observed to gather more relevant information about how students' motivation during the activity. Figure 4 and Figure 5 shows the products' example of earthquake mitigation that made by the students.

Figure 4. The earthquake resistant building

Figure 5. Emergency bag

Figures 4 and 5 present examples of student products developed during Cycle 1 of the project-based learning (PjBL) activity, which focused on disaster mitigation. In Figure 4, a group of students constructed a scaled model of a BPBD (*Badan Penanggulangan Bencana Daerah*) emergency response building, demonstrating thoughtful engagement with real-world applications of science and civic awareness. In Figure 5, another group designed a mobile emergency unit prototype, incorporating storage compartments and wheels using recycled materials, which reflects creative problem-solving and a high degree of task ownership. These products indicate that, despite some groups failing to complete their projects on time in Cycle 1, the students who did finish their work displayed motivation in terms of meaningful task interpretation and collaboration. Their ability to connect scientific content to societal challenges and to deliver physical models suggests moderate-to-high engagement, particularly in the science learning value and active learning strategies aspects of motivation (Tuan et al., 2005). On the first cycle, the group was made by the idea of the project that they will make. The students tend to choose the group member that is their close friends. The students are expected to be actively involved and participate in this project. In the first meeting, students seemed excited to plan the earthquake mitigation project that they will make. However, in the second meeting, some of the groups did not bring or prepare the tools and materials that needed to make the project. This may be caused by the students' readiness in making the project, the number of tools and materials that must be prepared, or the time that is given to prepare the materials. In this cycle, students were less motivated to complete the project. Figure 3 shows that the lowest aspect is performance goal which student's goals in science are to compete with other students and get attention from the teacher. It may explain that some of the students do not bother to prepare the materials nor actively join the discussion in the group.

Through a mindful analysis of the progression and result of cycle 1, a few points were noted to be regarded in the next cycle. The points are the group formation is not effective, the project option is too broad, so the students are confused and need more time to determine the project that they want to make. The attempt to evaluate cycle 1 and foster cycle 2 was then initiated. In cycle 1, there is a problem when the group formation is not effective so then an attempt as the researcher chooses the leaders of the group and the other students can choose their leader. This way is employed to resolve the issue. The other problem is the project option is too broad also fixed by limiting the product that students can make. In the implementation of cycle 2, students were given more time in the explanation of the concept related. The concept within cycle 2 is "Wave and Motion" that exclusively studied in the first meeting. The second meeting is where the Questioning, Designing, and Scheduling. They were challenged to make a musical instrument that inspired by the traditional music instrument called "suling", a flute originally made of a bamboo commonly found/originated from West Java. Students were asked to replicate the musical instrument using household items that are commonly found around us. On the third meeting, students were engaged in the Monitor, Assess, and Evaluate stage. During the third meeting students were demanded to consider their evaluation from the cycle 1. In the end of the learning session of the third meeting, students still asked to evaluate the whole process of the cycle 2 to be considered for their next school progress. The example of *suling* product that students made can be seen in Figure 6 and Figure 7.

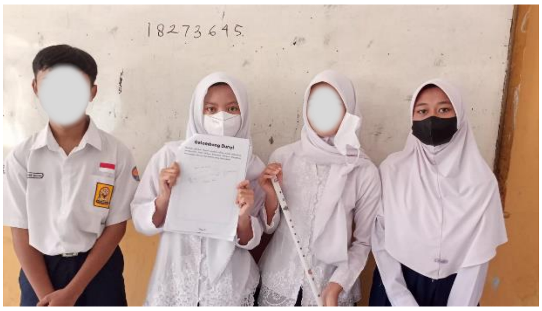

Figure 6. *Suling* product 1

Figure 7. *Suling* product 2

Figures 6 and 7 display examples of student projects developed during Cycle 2, in which students were tasked with creating musical instruments inspired by the traditional suling (bamboo flute) using household materials. The students in these groups successfully produced functional wind instruments using repurposed items such as PVC pipes and household things. Although simpler in form than some of the more elaborate Cycle 1 outputs, these projects reflect students' ability to apply scientific concepts (e.g., sound, vibration, and air flow) in a creative and accessible way. The completion of these products by nearly all groups in Cycle 2 is notable, as it contrasts with the lower completion rate in Cycle 1. This suggests an increase in task engagement, possibly influenced by improved clarity in project instructions and better group management. However, the slight decrease in overall motivation implies that creative expression and content integration may have been more constrained due to the narrower project scope. While the performance goal aspect remained unchanged, students appeared more focused on completion and collaboration, as reflected in their effective use of simple tools and division of roles. Thus, these products, while less complex, still demonstrate effort and engagement, supporting the idea that students were motivated by clear expectations and culturally relevant content—especially when aligned with their local context and familiar objects.

During Cycle 2, students appeared to demonstrate greater awareness and consideration of the reflections and evaluations from Cycle 1. This was evident in the improved rate of project completion. In Cycle 1, only 3 out of 7 groups successfully completed their projects within the given time frame, while the remaining 4 groups failed to do so. However, in Cycle 2, project completion increased notably, with 7 out of 8 groups completing their projects on time. This improvement suggests that students applied lessons learned from the first cycle and showed increased responsibility and collaboration. Despite this progress, several weaknesses were still observed during Cycle 2. One key issue was the shorter duration allotted for project completion compared to Cycle 1, which may have limited students' ability to explore the topic in greater depth or refine their final outputs. Additionally, while the number of completed projects increased, the overall quality of engagement and depth of learning varied between groups, indicating the need for more structured guidance and clearer success criteria. These findings suggest that while students became more productively engaged, further refinement of the PjBL design is needed to ensure both completion and meaningful learning.

Considering the result, which fall into the "good" category (Arikunto, 2014). Despite the expectation that cycle 2 will score a higher result than cycle 1, the result shows a contrary presentation. The expectation comes from the believe that students may learn or improve themselves by the evaluation of the cycle 1. The score of students' motivation on cycle 2 is turns out to be slightly declined even by just 1%. It applies to the aspects of the most students' motivation. There are a few possibilities that may affect this outcome. Based on the circumstances in the classroom and also the school, the collection of the data may be flawed. The reason for the flaw is that the students were on the end of a lesson they tend to hurry up going home. The second reason, the type of project work on cycle 1 may promote more motivation than the cycle 2. The possibility comes up from the fact that in cycle one, students were given wider chance in the project that they may engaged into a lot of variety of projects about disaster mitigation that may prompt their certain interest. On the other hand, cycle 2 has limited option that they may only create a "suling". The next reason, the duration of the first cycle is in point of fact, longer than the second cycle. That may prompt the students to be well-engaged in the project without being hurried. Nonetheless, both of the cycle resulted good category of students' motivation that was in line with other studies (Shin, 2018; Kortam et al., 2018; Filippatou & Kaldi, 2010). In addition, most studies validate the students' high motivation and their positive attitudes towards PBL (Filippatou & Kaldi, 2010; Kaldi et al., 2011).

Apart from internal school-related factors, several studies have suggested that project-based learning (PjBL) may not always lead to increased student motivation. For instance, Kaldi et al. (2011) reported that students exhibited minimal change in motivation following the implementation of PjBL. Although students gained content knowledge and collaborative skills, they did not express particular enthusiasm for the method. Similarly, Skaalvik and Skaalvik (2004) found that students with initially low motivation who studied mathematics through PjBL did not show improvement; in fact, they continued to express a dislike for the subject. The researchers attributed this outcome to a tendency among students to avoid tasks in which they feel less competent. Likewise, Lam et al. (2009) concluded that student motivation remained largely unchanged after project work. A study conducted in Taiwan by Tseng et al. (2013) also found no significant shift in students' attitudes toward the subject matter despite the use of PjBL. The researchers suggested that such attitudes might be culturally influenced and dependent on the teacher's expertise. In a similar vein, Kanter (2010) observed no notable change in students' attitudes toward science or their interest in pursuing it further after experiencing PjBL. Karacalli and Korur (2014) argued that any potential shift in students' attitudes—whether in PjBL or traditional methods—depends heavily on the duration of exposure. They noted that attitudinal change does not occur rapidly and requires sustained experience with the learning approach. Since their study involved a relatively short application of PjBL, and it was the students' first encounter with this method, attitude change was unlikely. In contrast, Hugerat (2016) found that students exposed to PjBL in science classrooms perceived their learning environment more positively, reporting higher satisfaction, stronger teacher support, and better teacher-student relationships.

Although some studies have demonstrated that project-based learning (PjBL) may not significantly enhance student motivation, especially when internal school conditions are excluded (Kaldi et al., 2011; Skaalvik & Skaalvik, 2004; Lam et al., 2009), this study contributes uniquely to the growing body of literature by adopting an action research approach—an approach that remains relatively uncommon in investigations of PjBL and student motivation. While prior findings often attribute limited motivational gains to factors such as lack of prior competence or insufficient exposure to PjBL methods, this study highlights additional limitations, particularly the short implementation period across only two cycles and the constraints of conducting the research near the end of the academic term. These factors may have influenced the outcomes. Importantly, a distinguishing feature of this study lies in its integration of culturally responsive teaching (CRT) elements during the second cycle of PjBL implementation. Embedding CRT within PjBL offers a novel approach that aligns learning activities with students' cultural backgrounds and lived experiences, which has the potential to deepen engagement and motivation. Future research should consider longer implementation periods, earlier integration in the academic calendar, and the systematic exploration of culturally responsive strategies within PjBL to better understand their synergistic effects on student motivation.

Conclusion

This classroom action research examined the effect of project-based learning (PjBL) on students' motivation in science learning over two implementation cycles. The findings showed that students' motivation remained in the "good" category across both cycles—69% in Cycle 1 and 68% in Cycle 2. While project completion and participation improved in Cycle 2, the slight decrease in motivation indicates that short-term implementations may be insufficient to generate consistent motivational growth. These results align with previous research suggesting that motivation is influenced not only by instructional models like PjBL but also by learners' prior experiences, self-efficacy, and contextual factors (Anuar et al., 2023). Several challenges—such as limited implementation time, restricted project choices, and the pressures of end-of-term scheduling—likely affected students' motivational outcomes. In light of this, practical implications for educators include the importance of allocating sufficient time, offering culturally meaningful project topics, and initiating PjBL earlier in the academic term. Moreover, while this study incorporated elements of culturally responsive teaching (CRT) in Cycle 2—aligning learning tasks with students' cultural contexts—its impact could not be fully assessed due to time constraints. Future research should explore CRT more systematically within the PjBL framework, particularly in science classrooms serving diverse student populations. This study is one of the few to integrate action research with culturally responsive pedagogy in the context of science learning and PjBL, offering insights into both the possibilities and challenges of such an approach. Although limited by a small sample size and short implementation duration, the research contributes a novel perspective on how culturally attuned, reflective teaching practices can possibly support student motivation. Longer-term studies with iterative refinements and expanded classroom settings are recommended to deepen understanding and broaden the application of these strategies.

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