Volume 10 Number 3, December 2025, pp. 451~462
P-ISSN:2477-7935
E-ISSN: 2548-6225
DOI: 10.59052/edufisika.v10i3.48191

INSTRUCTIONAL MANAGEMENT OF PROJECT-BASED LEARNING IN PHYSICS TO SUPPORT STUDENT CREATIVITY

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Article Info
Received: 04 September 2025
Accepted: 09 December 2025
Publication: 20 December 2025

Abstract :
The decline in creativity indicators, as evidenced in education reports, indicates the need for improved instructional management of project-based learning (PjBL) to foster student creativity. This study used an explanatory sequential mixed methods design. Quantitative data were collected from 108 students (total sampling) using a creativity questionnaire, followed by a qualitative case study through classroom observations and documentation, and through interviews involving 12 informants. Quantitative findings reveal that student creativity falls within the moderate category (Mean: 87.90), with Originality (19.04%) as the lowest indicator, whereas Flexibility (20.56%) is the highest. Qualitative evidence illustrates how instructional management practices contribute to creativity indicators across four distinct stages. Planning is executed in a structured, goal-based manner, while Organizing establishes collaborative learning environments. Subsequently, Implementation drives project implementation that encourages discovery and reflection, and continuous Monitoring through authentic assessment to strengthen student engagement and develop flexibility, elaboration, and problem-solving competencies. However, the originality component requires further improvement through enhanced teacher facilitation. Recommendations emphasize improving teacher competency in project design and authentic assessment to support the development of sustainable student creativity.

Keywords: Creativity, Instructional Management, Project-Based Learning

INTRODUCTION

Schools are educational institutions that guide students in achieving learning objectives through various teaching and learning activities (Sudiatmika, 2020). The choice of strategies and models of learning competencies that meet the standards is very important because it can encourage higher-order thinking skills, student interest, and active participation in the classroom, thereby improving the quality of learning (Amsikan, 2022). Physics is a science subject; therefore, creative thinking skills are related to strong conceptual mastery of its content and to the ability to relate scientific principles to real-world problem-solving situations. Low student creativity in physics reflects constraints in explaining phenomena and proposing innovative solutions; thus, student creativity in physics learning should be addressed as soon as possible to improve the quality of science learning in schools (Hikmah et al., 2023; Kwon & Lee, 2025).

The quality of learning itself, including its advantages and disadvantages, is reflected in well-run instructional management. To guarantee the accomplishment of educational objectives, this management involves the educator's capacity to select appropriate tactics, create relevant lesson plans, conduct the learning process as effectively as possible, and conduct efficient assessments. Musadad (2015) states that the phases of planning, organizing, carrying out, and assessing make up the learning management process. These four phases determine how well students' creativity is incorporated into learning activities in the context of project-based physics learning. The effectiveness of this process is mainly based on how well the teacher manages student-centered learning and fosters the growth of innovative and cooperative thinking abilities (Fitri et al., 2024).

Physics is often perceived as a complex subject focused on formulas and as less interesting, so their motivation to learn tends to be low (Londa & Kamaruddin, 2023). This phenomenon is evident at SMA Negeri 1 Moga, which, based on the education report, experienced a decline in the character aspect of achievement compared to the previous year, with creativity identified as the lowest-performing indicator. Meanwhile, problems in physics learning at SMA Negeri 1 Moga were identified through the analysis of formative and summative assessment data. The results showed that students had low mastery of concepts and limited application skills. The results of the formative assessment revealed that approximately 60% of students had difficulty understanding basic physics concepts and applying them to problem-solving activities, as indicated by scores below the Learning Objective Achievement Criteria across most assessment indicators. Furthermore, summative assessment data show that only 40% of students successfully achieved the Learning Objective Achievement Criteria. This indicates the need to improve the learning process to achieve the desired learning objectives. Therefore, it is necessary to improve learning methods and models, adopt student-centered approaches such as project-based learning, and implement continuous formative evaluation to enhance students' conceptual understanding and application skills in physics, thereby supporting student creativity.

Implementing a project-based learning model (PjBL) through effective instructional management is one approach to addressing this issue. Defined by Subiyanto (2025) as a learner-centered approach that occurs over a comparatively long period of time and is focused on in-depth research and the creation of tangible products, PjBL positions students as active participants in challenging, real-world projects. This model incorporates formative and summative assessments that emphasize both process and product, and it necessitates group collaboration. PjBL requires structured support in the form of project scenarios, learner worksheets, and assessment rubrics. Operationally, the steps include: (1) mapping learner needs and profiles, (2) determining authentic problems and learning objectives, (3) designing the project, (4) providing mentoring and teaching materials, (5) implementing the project with formative monitoring, (6) completing and presenting the product, and (7) final reflection and evaluation for practice improvement (Subiyanto, 2025; Bistari et al., 2021). Existing literature confirms that this model not only enhances motivation but also fosters essential 21st-century skills, including creativity, critical thinking, independence, and collaboration (Fadilah et al., 2025; Chaniago et al., 2024). PjBL provides various activities requiring problem-solving and decision-making that encourage students to seek information and elaborate on their ideas to produce products as meaningful solutions (Pramesti et al., 2022; Anggiehla & Misdalina, 2019).

Among the various skills fostered by PjBL, creativity plays a pivotal role and requires a comprehensive understanding. Creativity is the cognitive ability to generate new, original, and useful ideas in solving problems, resulting from the creative thinking process that can be trained through learning (Handayani et al., 2021; Yasa et al., 2023). Creativity is measured through four main indicators: (1) Fluency, the ability to generate many relevant ideas in a short time; (2) Flexibility, the ability to shift or organize ideas from different perspectives or approaches; (3) Elaboration, the ability to detail, develop, and elaborate ideas to become more mature solutions; and (4) Originality, the ability to produce answers or solutions that are unusual and rarely appear in other people's answers (Handayani et al., 2021;

Yasa et al., 2023). In addition, problem-solving is often included as an indicator of creativity because it shows how individuals combine original ideas with effective strategies to produce new and useful solutions (Wimmer, 2016; Yasa et al., 2023).

Previous studies have consistently demonstrated the effectiveness of PjBL in enhancing students' creativity, collaboration, and conceptual mastery in STEM subjects, including physics (Saputri et al., 2022; Yanti et al., 2023; Anggiehla & Misdalina, 2019). Specifically in physics topics such as work, energy, and electricity, PjBL has been proven to improve students' conceptual understanding and learning outcomes (Fahrunnisa & Handayani, 2024; Sudiatmika, 2020). However, its contribution is also influenced by contextual factors, such as students' cognitive abilities (Harjono et al., 2024) and the integration of performance assessments (Putri et al., 2020). While these studies confirm that PjBL supports creativity and problem-solving skills, most have focused primarily on the learning outcomes and general classroom activities.

Despite the proven benefits of PjBL, existing literature has not sufficiently explored the role of instructional management in optimizing this model. Most studies predominantly focus on the general implementation of PjBL syntax and its impact on learning outcomes, yet often overlook the critical role of instructional management in optimizing the learning process (Saputri et al., 2022; Yanti et al., 2023; Anggiehla & Misdalina, 2019). Therefore, a study is required to investigate how instructional management, encompassing planning, organizing, implementation, and monitoring, can be systematically applied to foster student creativity. To address this gap, this study examines how instructional management in learning is aligned with student creativity indicators at each managerial stage. The novelty of this research lies in integrating instructional management principles into a PjBL-based physics learning model to foster student creativity. The findings are expected to provide comprehensive insight and theoretically expand the discourse on instructional management within project-based learning contexts to foster student creativity.

RESEARCH METHOD

Research Design

This study employed a mixed-methods design with an explanatory sequential strategy, in which the quantitative phase was conducted first to map student creativity indicators, followed by a qualitative case study to explain and deepen the quantitative findings (Sakir, 2024 ;Saparudin et al., 2022). The qualitative component employed a case study approach to gain an in-depth understanding of physics instructional management using the Project-Based Learning (PjBL) model at SMA Negeri 1 Moga in supporting student creativity. This mixed design was chosen to provide a broad, representative quantitative description while capturing the depth of the instructional management process through an inductive-deductive analysis that encompasses planning, organizing, implementation, and monitoring. The study was conducted from August to September 2025 at SMA Negeri 1 Moga, Pemalang Regency, to capture the dynamics of learning implementation in the natural field context.

Research Target/Subject

The quantitative phase involved 108 students from grade XII (Classes XII A, XII B, and XII C) of SMA Negeri 1 Moga in the 2025/2026 academic year. A total sampling technique was employed to obtain a comprehensive profile of creativity indicators from the entire population who completed a creativity questionnaire. For the qualitative phase, 12 students (four from each class) were selected as informants through purposive sampling based on specific criteria: active engagement in PjBL physics learning, regular attendance, and willingness to engage in comprehensive reflection.

Research Procedure

The research stages proceeded as follows: First, quantitative data were collected using a questionnaire administered to 108 students and analyzed using descriptive statistics to identify indicators of student creativity. Second, 12 students were selected through purposive sampling, based on the survey results and established criteria. Interviews, classroom observations, and document collection were conducted to explain and contextualize the quantitative patterns. Finally, the data were reduced, presented, and integrated for interpretation and reporting. This procedure allowed the qualitative phase to focus on providing a comprehensive overview to explain the quantitative findings.

Instruments and Data Collection Techniques

The primary quantitative instrument was a creativity questionnaire administered to 108 students to measure five indicators: fluency, flexibility, elaboration, originality, and problem-solving. The questionnaire comprised 25 items using a Likert scale. The validity of the creativity questionnaire was tested using Pearson's item–total correlation with a pilot sample of 30 students, and all 25 items exceeded the critical r-value of 0.361. Reliability testing using Cronbach's Alpha yielded a coefficient of 0.969, indicating excellent internal consistency. Together, these results confirm that the instrument is valid and reliable for measuring student creativity. The specific distribution of items for each creativity indicator is presented in Table 1.

Table 1. Student creativity indicators and item distribution

No	Indicator	Questionnaire Statement Number
1	Fluency	1, 2, 3, 4, 5
2	Flexibility	6, 7, 8, 9,10
3	Elaboration	11,12,13,14,15
4	Originality	16, 17, 18, 19, 20
5	Problem Solving	21, 22, 23, 24, 25

Prior to data analysis, the raw scores from the questionnaire were summed up to determine the level of student creativity. To interpret these quantitative findings, the total scores were classified into five categories ranging from 'Very Low' to 'Very High' based on the ideal mean and standard deviation. The criteria for these intervals are outlined in Table 2.

Table 2. Interpretation criteria for student creativity scores

Interval	Category
110 – 125	Very high
97 – 109	High
84 – 96	Moderate
71 – 83	Low
58 – 70	Very Low

In the qualitative instrument, the researcher acted as the key instrument, supported by a semi-structured interview guide, a classroom observation guide, and a document checklist. In-depth interviews were conducted with each informant, lasting 15 to 30 minutes. Additionally, classroom observations were conducted three times during the PjBL session to document student activities and each student's involvement in the group. Document analysis included reviewing the student project plan, project reports, and final project reports.

Data Analysis Technique

Quantitative data were analyzed descriptively, including minimum, maximum, mean, and standard deviation scores to map creativity indicators in the sample. Qualitative data were analyzed using an interactive model, namely collection, reduction, presentation, and conclusion, based on interview transcripts and observations. Open coding was then conducted to identify thematic categories related to planning, organizing, implementation, and monitoring (Miles et al., 2014). The integration of quantitative and qualitative data was conducted through: (1) explanatory sequential integration, where qualitative findings were used to explain and enrich quantitative patterns; and (2) side-by-side comparisons in the presentation of results and through an integration matrix that linked creativity indicators to PjBL management practices. Triangulation among instruments, including observation, interviews, and documentation, was used to strengthen validity and produce a holistic interpretation of how PjBL management was implemented in physics learning to support student creativity.

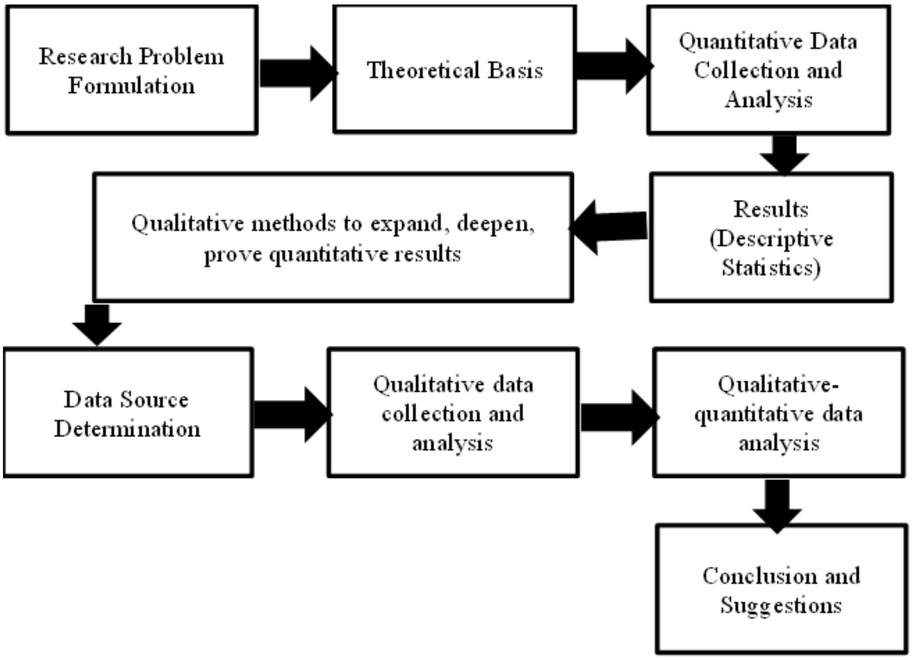

Figure 1. Sequential explanatory model

RESULTS AND DISCUSSION

The data on students' creativity skills in this study were collected using a questionnaire containing 25 statements. The descriptive statistics for the creativity variable are presented in Table 3.

Table 2. Descriptive statistics of student creativity

Variables	N	Min	Max	Mean	Std. deviation	Frequency	Percentage	Category
Creativity	108	58	125	87.90	16.53	11	10.19%	Very high
						24	22.22%	High
						27	25.00%	Moderate
						31	28.70%	Low
						15	13.89%	Very Low

Based on the table above, it can be briefly concluded that the distribution of student creativity shows the most significant proportion in the low category (28.70%), followed by moderate (25.00%), while the average creativity score is 87.90, which falls within the moderate category. The moderate level of student creativity aligns with previous findings by Kurniawati et al. (2024) which stated that physics students often struggle to generate different ideas or solutions to solve problems. This finding also aligns with Wafa et al. (2025) many students struggle to develop their ideas in a detailed and in-depth manner. The analysis used five indicators of creative thinking skills: fluency, flexibility, elaboration, originality, and problem-solving. The detailed findings are presented in the following chart.

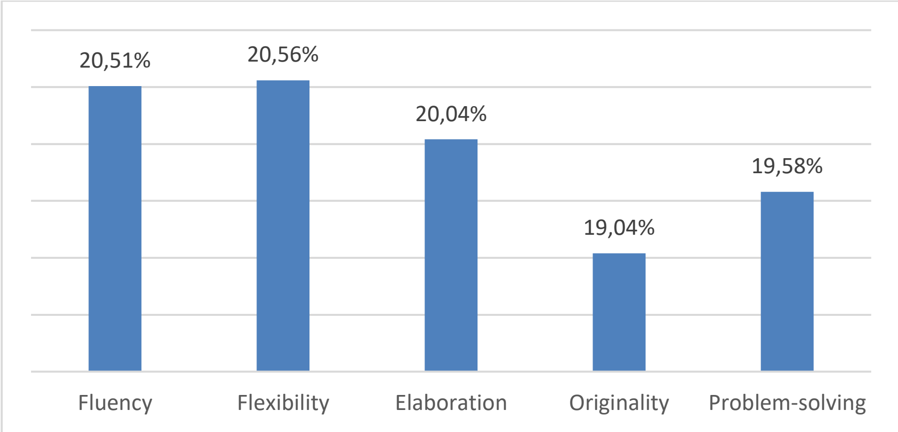

Figure 2. Results of the student creativity indicator

The findings of this study indicate that students' creative thinking skills still need to be strengthened, particularly in originality and problem-solving, which show lower scores than the other indicators. Meanwhile, flexibility and fluency have the highest scores. This pattern indicates that students tend to generate ideas and approach problems from various perspectives, but these ideas are less novel and do not continually develop into in-depth or applicable solutions (Wafa et al., 2025). Conceptually, this finding indicates that students can organize ideas from various approaches, but the answers or solutions are not yet out of the box, or that students do not yet exist (Firdaus et al., 2022). Students prefer to imitate existing products rather than develop new ones, indicating the need to transform ideas into innovative products. Practical implications include strengthening project-based learning designs that demand originality and concrete applications that emphasize novelty and elaboration in project prototyping.

Before PjBL planning, teachers must map the students' learning needs, for example, their learning styles (Jihadah Gaffar et al., 2023). This aligns with the demands of differentiated learning, in which learning differences among students must be understood to plan effective instruction. Komalasari (2023) also emphasized that identifying students' readiness and learning profiles is an important foundation for relevant differentiated learning in project-based learning. Furthermore, Suwidagdho et al. (2024) demonstrated that learning style mapping enables teachers to design more meaningful projects, while Saputri et al. (2022) demonstrated that the effectiveness of PjBL depends heavily on teachers being capable of project design matching for students' interests and needs. Yu, (2024) demonstrated that PjBL student-based designs according to cognitive abilities and motivation are associated with higher idea elaboration and fluency. In this study, mapping students' learning styles at SMA Negeri 1 Moga serves as the basis for designing projects to make learning more meaningful. Therefore, instructional management in physics learning based on student profiles can support student creativity.

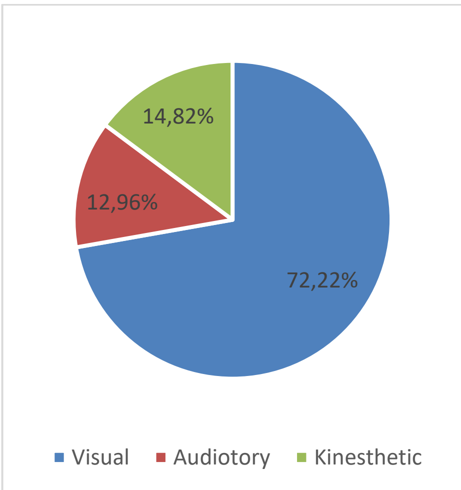

Figure 3. Mapping of student learning style

The mapping results showed a dominance of visual learning styles at 72.2%, followed by auditory and kinesthetic styles. Based on these data, learning plans are designed to accommodate the dominant characteristics of students. Teachers prepare student worksheets, modules, project flows, and schedules that include visual components (diagrams, videos, prototype sketches) and activities that require the creation of visual or conceptual products. This strategy is supported by Qasserras (2024), who argues that visual aids significantly enhance engagement, comprehension, and critical thinking, making them an especially appropriate and effective medium for students. Planning documents and informant recognition indicate that these visual scaffolds are intended to facilitate students in formulating many ideas and developing project details, processes directly related to increasing fluency and elaboration.

In the planning stage, authentic problem selection, project scheduling, and structured learning guides, such as worksheets, encouraged students to generate a variety of relevant ideas (fluency) and elaborate on them into more detailed project designs (elaboration). During the planning phase, student participation fostered collaboration and creative exploration. As student S3 stated, "*When the teacher explained the real-world problem and gave us guidance on the project, we were able to come up with multiple ways to complete it, not just one idea*." Similarly, student S5 stated, "*During thematic discussions, we shared ideas and then combined them until we found the most appropriate plan to implement*." These qualitative findings corroborate observational data (O1) and documentation (D1), confirming that most groups outlined multiple project options from sources like YouTube. This finding suggests that collaborative planning supports idea generation and refinement, which are fundamental aspects of creative fluency and elaboration. Collaboration between teachers and students in defining real-world problems fosters cooperation and motivation (Widyaningsih & Yusuf, 2020; Zuhdi et al., 2023), making students active participants and leading to innovative works (Al-Kamzari & Alias, 2025; Chistyakov et al., 2023). In SMA Negeri 1 Moga, this planning facilitates making students become active participants in learning, enhancing creativity, particularly in creating and producing many solutions. Therefore, instructional management in the planning process is said to lead to innovative work.

The organizing phase encouraged flexibility and teamwork among students through well-structured group projects and clear role assignments. The organized project structure helped students adapt their strategies when faced with challenges and learn together. Student S2 said, "*When our plan did not work, we discussed it again and changed the method until we found a better way*." Student S6 said, "*The teacher divided the groups evenly based on ability, so we could help each other and learn new things in solving problems*." Evidence from classroom observations (O2) confirmed that students were grouped based on ability to balance participation and peer guidance. Documentation (D1), such as project planning notes, demonstrated thorough preparation for completing the project, supporting the finding that the organization encouraged flexible thinking and collaboration, indicators of creativity in PjBL.

The organizing stage helps ensure that each student in the group has a clear role and task. Group collaboration with a clear division of roles and tasks for each group member will strengthen each student's flexibility and critical thinking. Organizing students in structured groups, facilitated by the teacher, and assigning responsibilities to each student in the project, will encourage flexibility because students are required to adapt strategies and problem-solving skills in completing the project (Yanti et al., 2023; Darmilah et al., 2023). These findings show that organizational structure in instructional management supports creativity and productive collaboration.

During the implementation phase, students create their planned projects. Teachers facilitate problem-solving and refinement through repeated testing. Students apply physics concepts to project creation from various literacy resources through trial and error. Student S4 stated, "*When creating projects and final products, we have to try several times until the tools we create work. Each failure encourages us to find new solutions*." Similarly, Student S8 added, "*If our first design fails, the teacher guides us to find another way*." Observation results (O2) confirm that students independently revise their prototypes in their respective groups to solve problems under teacher guidance. Documentation (D2) in the form of project progress notes, photos, and videos of project creation demonstrates how project-based learning builds persistence and encourages creative problem-solving in physics projects.

In the implementation stage, the contextual integration of projects and the inquiry process students conduct demonstrate that creativity emerges when students apply physics concepts to real product contexts (Harjono et al., 2024; Devanda et al., 2023). Findings from SMA Negeri 1 Moga show that students who are actively and collaboratively involved in conducting project testing contribute to problem-solving and elaboration skills. According to Sudiatmika (2020) and Hikmah et al. (2023), student originality remains relatively low, partly due to limited variation in project design and time constraints. This suggests that instructional management in physics learning must allocate flexible project time and provide students with broad exploration space to support originality in their projects. Therefore, constraints such as time and resource allocation contribute to student creative outcomes.

The monitoring phase encourages reflection that supports continuous improvement and problem-solving. Teacher feedback and guidance enable students to improve their work more effectively. As Student S7 stated, "*Every time we report our progress, the teacher gives clear suggestions on what needs to be fixed and how to fix it so that the project continues to progress*." However, Student S9 observed, "*In making projects, we mostly copy existing projects, for example, from YouTube*." This is reinforced by observation notes (O3) indicating that students create projects that only copy existing projects and show minimal project development. Based on documentation (D3), student project reports are mostly copied and pasted from internet sources, with little to no in-depth discussion of the final product that has been created and tested. This indicates a lack of student innovation in project completion, both in final products and reports. This triangulation finding emphasizes the importance of reflection and evaluation processes in project-based learning to foster innovation and continuous improvement, encouraging student creativity.

In the monitoring and evaluation stage, instructional management plays a vital role in ensuring quality. Monitoring mechanisms, such as project assessment rubrics, observation sheets, and project progress checklists, enable teachers to monitor and provide continuous feedback for improvement (Al-Kamzari & Alias, 2025); Rukmi & Perdana, 2023). At SMA Negeri 1 Moga, the role of monitoring and evaluation, in the form of joint reflection, supports problem-solving abilities, flexibility, and learning discipline. However, to address the lack of innovation found, the assessment must be more targeted. This aligns with Putri et al. (2020) and Lichtenberger et al. (2025), who argue that performance assessment must explicitly evaluate new ideas. Therefore, instructional management in physics learning must utilize these monitoring tools not just for progress checks but also to drive innovation and unique ideas from students.

Instructional management in physics learning can spur creativity in PjBL students. Data-based, interest-driven learning styles planning, based on student learning profiles, can help ensure the flow and elaboration of ideas among students in groups without interruption. Teacher monitoring will facilitate learning, improve problem-solving, and support continuous improvement through collaborative reflection. Thus, instructional management for PjBL-based physics learning contributes to all the signs of students' creativity (Tain et al., 2024; Nilsook et al., 2021; Fitri et al., 2024)

In the context of SMA Negeri 1 Moga, where creativity indicators had previously declined, implementing PjBL-based instruction requires a strategic plan. This plan must be capable of fostering student creativity while guaranteeing coordination within groups, ensuring that project goals align seamlessly with learning objectives (Utama et al., 2021; Sumo et al., 2024). Consequently, PjBL-based instructional management offers a model that synthesizes PjBL with a specific emphasis on student creativity. Overall, this study broadens the understanding of PjBL by examining the management phases. The findings suggest that creativity development results from the planning, organizing, implementing, and monitoring processes. Connecting these elements of instructional management will contribute to student creativity and provide practical insights for school policymakers in designing creative and contextual learning environments.

This study has several contextual and methodological limitations that need to be acknowledged. First, the study was conducted in a single school, SMA Negeri 1 Moga, over a relatively short period (August–September 2025). Second, the quantitative phase utilized a total sampling of 108 students, while the qualitative phase relied on a case study of 12 purposively selected informants. Although the data triangulation (observations, interviews, documents) provides in-depth insights into instructional management practices at this specific site, these limitations restrict the generalizability of the findings to broader educational contexts. Furthermore, the explanatory nature of the design prevents drawing definitive causal conclusions about the relationship between management practices and creativity outcomes. Therefore, future research should expand this instructional management model to diverse schools and regions, involve a wider range of teachers, and conduct longitudinal studies to observe long-term effects. Crucially, future studies should develop and validate more robust assessment instruments specifically designed to mitigate plagiarism and accurately measure originality, addressing the low scores identified in this research.

CONCLUSION

The quantitative findings of this study show an average student creativity score of 87.90 in the moderate category, with flexibility as the highest indicator and originality as the lowest. These quantitative data are supported by qualitative findings that explain the mechanisms by which managerial practices in physics learning support students' creativity. Overall, this study addresses the research objective of analyzing how instructional management supports the implementation of Project-Based Learning (PjBL). The findings confirm that project planning aligned with learning objectives, organization through clear division of roles and tasks for each group member, active teacher facilitation, exploration, and continuous monitoring through constructive feedback collectively ensure the sustainability of PjBL and contribute to indicators of creativity. The novelty of this study lies in integrating instructional management principles into PjBL to support student creativity specifically.

The study recommends developing a structured yet adaptive instructional management system. This includes prioritizing mapping students' needs and learning styles, effective project scheduling, forming small groups with clear roles, and revising assessment rubrics to explicitly evaluate originality as well as product functionality. Furthermore, strengthening teacher capacity through training in project design and authentic assessment is essential. These steps are expected to not only maintain PjBL practices but also specifically target improvements in weaker aspects of creativity, especially originality, ensuring that PjBL can be developed sustainably at the school level.

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