GEN BIONIX: JURNAL ILMIAH PENDIDIKAN BIOLOGI
e-ISSN: 2988-716X Volume 4 Issue 1, 47-57

An Analysis of Biology Teachers' Constructivist Teaching Styles at MAS Ummi Kalsum, Gunungsitoli City

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Received: 20 April 2026
Revised: 24 May 2026
Accepted: 18 June 2026
Published: 22 June 2026

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DOI: 10.56207/genbionix.v4i1.909

Abstract: Effective biology learning requires a teaching style that is able to actively build conceptual understanding. However, the reality in many Indonesian schools, including private madrasah schools with limited facilities, is still dominated by a teacher-centered approach that positions students as passive recipients of information, while in-depth qualitative studies on constructivist-based biology teachers' teaching styles in such contexts remain very limited. This study aims to describe the biology teacher's teaching style, identify the learning theories applied, determine the most dominant theory, and analyze its relationship with students' activeness and conceptual understanding at MAS Ummi Kalsum, Gunungsitoli City. The study employed a descriptive qualitative approach of the field research type with one biology teacher as the sole subject selected purposively; data were collected through non-participant observation, semi-structured interviews, a twenty-item Likert-scale questionnaire, and documentation, then analyzed using the Miles and Huberman model and validated through source and method triangulation. The results showed that the teacher applied a student-centered teaching style with the dominance of the Problem-Based Learning method, obtaining an average questionnaire score of 4.70 on a 5-point scale (15 out of 20 indicators were rated strongly agree). Constructivism was proven to be the most dominant foundation, complementarily supported by cognitive, behaviorist, and humanistic theories that were organically integrated and contributed significantly to the high level of student activeness and conceptual understanding.

Keywords: teaching style, constructivism, problem-based learning, student activeness

How to Cite:
Halawa, M. C., Harefa, D. P., Gori, W. D., Telaumbanua, K. M. B., Lase, N. K. (2026). An Analysis of Biology Teachers' Constructivist Teaching Styles at MAS Ummi Kalsum, Gunungsitoli City. *GEN BIONIX: Jurnal Ilmiah Pendidikan Biologi*, *4*(1), 47–57. https://doi.org/10.56207/genbionix.v4i1.909

Introduction

Biology learning at the senior high school level requires an approach that not only transfers knowledge but also develops critical thinking, analytical skills, and contextual problem-solving abilities (Pandia et al., 2025; Agnesa & Rahmadana, 2022; Paidi et al., 2020). Biology materials, which include abstract concepts such as organ systems, ecology, and genetics, require learning strategies capable of connecting scientific knowledge with students' real experiences in their surrounding environment. Without an appropriate approach, students tend to merely memorize biological facts without truly understanding the processes and mechanisms underlying them (Safitri & Setiyawati, 2023; Funa & Talaue, 2021). Therefore, the quality of biology teachers' teaching style becomes a highly strategic determining factor in shaping students' cognitive and affective competencies comprehensively.

Constructivist learning theory has been widely recognized as the most relevant epistemological foundation in science learning, including biology (Bustomi et al., 2024; Nerita et al., 2023; Tegegne et al., 2025). Constructivism, developed by Jean Piaget and Lev Vygotsky, views knowledge as not passively transferred from teacher to student, but actively constructed by students through experience, reflection, and social interaction with their environment (Bustomi et al., 2024). Vygotsky in particular emphasized the role of social mediation in cognitive development, in which teacher guidance and collaboration among students within the zone of proximal development become key to accelerating conceptual understanding (Nerita et al., 2023). Tegegne et al. (2025), in their study at the upper primary school level in Ethiopia, confirmed that a constructivist approach promises real improvements in learning quality, although its implementation still faces various contextual challenges in the field.

One learning model that directly arises from constructivist principles is Problem-Based Learning (PBL), which places real-world problems as the starting point of students' learning activities (Agnesa & Rahmadana, 2022; Pandia et al., 2025; Safitri & Setiyawati, 2023). In PBL, students do not receive material passively; instead, they are confronted with problematic situations that require exploration, discussion, and synthesis of knowledge independently as well as collaboratively. Agnesa and Rahmadana (2022) proved that the PBL model significantly improves students' critical thinking skills in biology learning, far exceeding the effectiveness of conventional lecture methods. Pandia et al.

(2025) also confirmed that the consistent implementation of PBL in biology education results in measurable and sustainable improvements in students' critical thinking skills (Hia et al., 2025).

Although constructivism and PBL have gained strong theoretical and empirical support, classroom reality shows a significant gap between ideal conditions and actual learning practices (Firmansyah, 2022; Tegegne et al., 2025; Nerita et al., 2023). Firmansyah (2022) found that most teachers in Indonesia still tend to apply teacher-centered learning (TCL) in daily practice, making students passive recipients of information who depend entirely on teacher explanations. Tegegne et al. (2025) identified that although teachers rhetorically claimed to apply constructivism, classroom observations instead showed the dominance of directive learning patterns with minimal meaningful interaction between teachers and students. This gap between pedagogical ideals and classroom realities confirms that transforming teaching styles from teacher-centered to student-centered is a real challenge that requires in-depth, evidence-based study.

Previous studies on biology teachers' teaching styles and the implementation of constructivism in Indonesia are still dominated by research focusing on student learning outcomes as the main dependent variable, with classroom action research (CAR) designs based on quantitative approaches (Safitri & Setiyawati, 2023; Agnesa & Rahmadana, 2022; Pandia et al., 2025). Although rich in numerical data, such approaches tend to overlook the qualitative dimensions of actual teaching practice, including how teachers consciously or intuitively integrate various learning theories into a single learning flow. Firmansyah (2022) highlighted that studies on teachers' tendencies in applying learning approaches are still very limited, especially those using the teacher's perspective as the main research subject rather than merely as an independent variable. In addition, most previous studies were conducted in urban public schools with adequate facilities, so representation from private madrasah schools in areas with limited resources has almost never appeared in the existing literature.

The research gap identified from the literature review above includes three dimensions at once: methodological gap, contextual gap, and subject perspective gap (Bustomi et al., 2024; Tegegne et al., 2025; Firmansyah, 2022). Methodologically, qualitative studies that deeply analyze constructivist-based biology teachers' teaching styles in madrasah schools are still rare in Indonesian science education literature. Contextually, research on the implementation of constructivism in schools with limited facilities in remote areas such as Gunungsitoli City has never been systematically reported in indexed scientific journals. In terms of perspective, placing teachers as the main research subjects rather than students in studies of teaching styles based on learning theory is an approach that has not been widely explored, even though teachers are the key actors who determine the quality of the entire learning ecosystem (Nerita et al., 2023; Paidi et al., 2020).

This study was conducted at MAS Ummi Kalsum, Gunungsitoli City, North Sumatra, by positioning one biology teacher as the sole research subject selected purposively because she demonstrated a dominant use of the PBL method, which is uncommon in the context of private madrasah schools in the region (Agnesa & Rahmadana, 2022; Pandia et al., 2025; Safitri & Setiyawati, 2023). This study employed a descriptive qualitative approach with data collection techniques in the form of observation, semi-structured interviews, questionnaires, and documentation to obtain a holistic picture of the teacher's teaching style. Methodologically, this approach addresses the limitations of previous studies, which generally used quantitative CAR designs that were unable to capture the complexity of pedagogical practices behind the numbers of learning outcomes. This study also pays attention to how the learning theories of constructivism, cognitivism, behaviorism, and humanism are reflected in an integrated manner in the real practices of a teacher teaching amid limited facilities, so that the findings are expected to enrich understanding of the actual conditions of biology learning in Indonesian private madrasah schools (Bustomi et al., 2024; Nerita et al., 2023; Tegegne et al., 2025).

The fundamental question driving this study is: how does the biology teacher's teaching style at MAS Ummi Kalsum, Gunungsitoli City reflect the principles of constructivism in actual classroom practice, and which learning theory is the most dominant in underpinning the overall process? The findings of this study are expected to make an empirical contribution to the development of effective biology pedagogy in schools with similar contexts, while also serving as a reflective mirror for educators regarding how the integration of learning theories in a holistic manner can be realized amid limitations (Firmansyah, 2022; Paidi et al., 2020). This study is also expected to open space for scientific dialogue on the need for a paradigm shift in teaching-style studies, from merely measuring impacts on students toward a deeper understanding of the complexity of teachers' pedagogical practices themselves (Tegegne et al., 2025; Bustomi et al., 2024). The question of whether a teacher in a remote school with limited facilities can authentically implement constructivism is a relevant and urgent question that needs to be answered through strong empirical evidence.

Method

This study employed a qualitative approach with a descriptive field research design. The qualitative approach was chosen because this study aimed to describe and analyze the constructivist-based teaching style of a biology teacher in depth within the context of learning as it naturally occurred in the field. As emphasized by Moleong (2018), qualitative research aims to understand phenomena experienced by research subjects, such as behavior, perceptions, motivations, and actions, holistically through descriptions in the form of words within a specific natural context. A descriptive qualitative approach was used because this study not only aimed to identify surface facts but also to understand the meaning behind the teaching practices applied by the biology teacher in her daily work.

This study was conducted at MAS Ummi Kalsum, Gunungsitoli City, located on Jalan Pesantren, Mudik Village, Miga Subdistrict, Gunungsitoli District, Gunungsitoli City, North Sumatra. This location was selected purposively because an interesting phenomenon was found that was worthy of scientific investigation, namely the dominant implementation of the Problem-Based Learning (PBL) method by the biology teacher, reflecting a constructivist approach that differs from the more common condition in which lecture methods are still widely used. Data collection was carried out on Friday, May 8, 2026, during the biology learning process in the classroom.

The informant in this study was determined through purposive sampling, based on the consideration that the informant was the most relevant and competent party to provide information in accordance with the research focus (Sugiyono, 2019). The sole informant in this study was the biology teacher at MAS Ummi Kalsum, Gunungsitoli City, namely Mrs. Leny Suryani Telaumbanua, S.Pd., who has taught biology for approximately three years and is the only biology teacher at the school. The selection of a single informant was based on the consideration that all data needed to answer the research objectives could be obtained directly and comprehensively from the subject concerned.

Data collection techniques were carried out through four complementary methods: (1) non-participant observation, in which the researcher directly observed the biology learning process in the classroom without being involved in the learning activities; (2) semi-structured interviews, conducted directly with the biology teacher using a prepared interview guide while still providing space for the informant to explain her answers more broadly and deeply; (3) a questionnaire, designed in the form of closed statements using a Likert scale (SA = 5, A = 4, LA = 3, D = 2, SD = 1) to obtain systematic data regarding the application of aspects of learning theory in the teacher's teaching practice; and (4) documentation, in the form of photographs of learning activities, observation notes, questionnaire sheets, interview guides, and other supporting documents used to strengthen the validity of the research data.

The research instruments used included: (1) an observation guide containing ten aspects of observation, covering the way material was delivered, learning methods, use of media, teacher-student interaction, student activeness, classroom management, provision of motivation, discussion and question-and-answer activities, direct observation or practicum, and the application of learning theory; (2) a semi-structured interview guide containing ten main questions related to the teacher's views on biology learning, method selection, strategies for increasing student activeness, and the learning theories applied; (3) a questionnaire sheet consisting of twenty statements using a Likert scale; and (4) documentation tools in the form of a camera and field note sheets.

Data analysis was carried out using the qualitative data analysis model of Miles and Huberman as cited in Sugiyono (2019), which includes three continuously implemented stages. First, data reduction, namely the process of selecting, simplifying, and focusing relevant data from all observation, interview, questionnaire, and documentation results. Data unrelated to the research focus were set aside so that the analysis became more directed. Second, data display, namely organizing the reduced data into systematic descriptive narratives, including observation and questionnaire result tables, so that the information could be understood and analyzed according to the research objectives. Third, conclusion drawing, namely concluding the research findings based on all analyzed data, including the dominant teaching style applied by the teacher, the learning theory most strongly reflected in teaching practice, and its relationship with student activeness and understanding. The data analysis process was carried out reflectively and repeatedly until data saturation was achieved (Rijali, 2019).

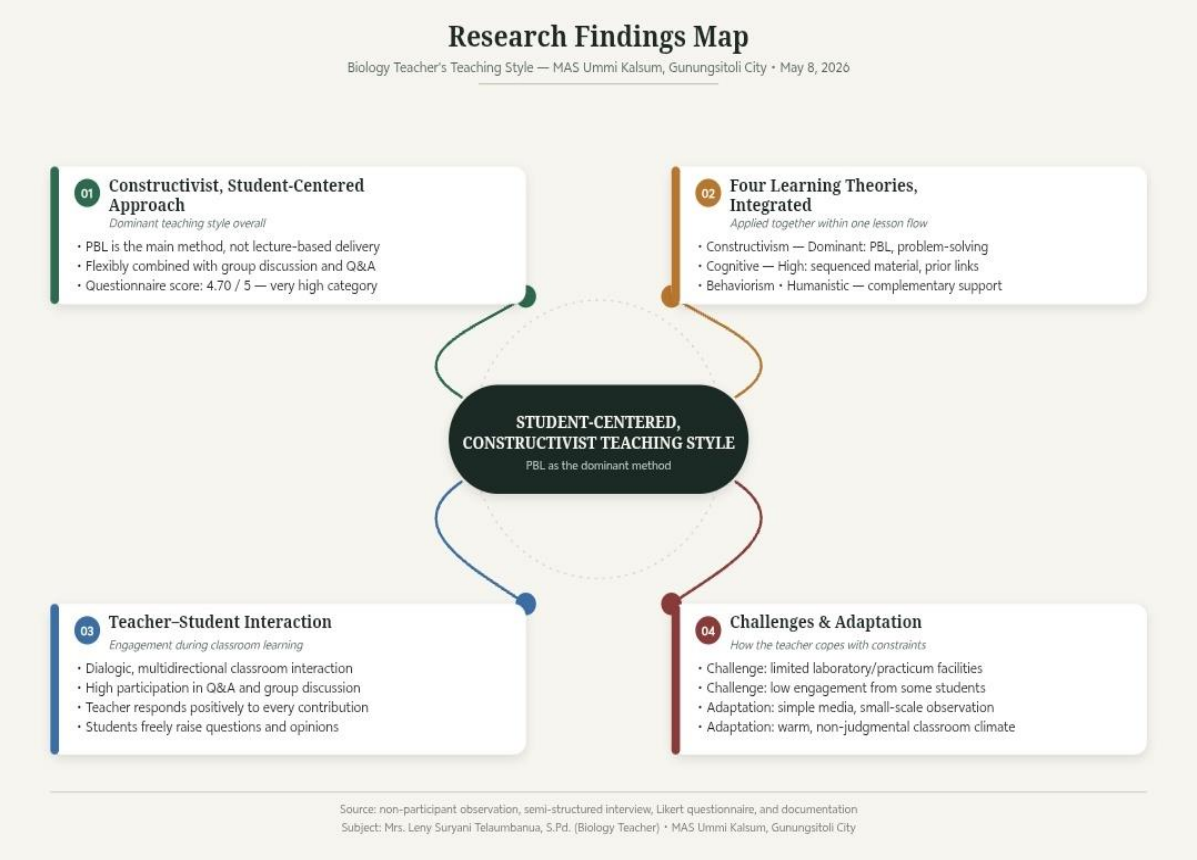
To ensure data validity, source triangulation and method triangulation techniques were used. Source triangulation was conducted by comparing data obtained from observations, interviews, and questionnaires, all of which came from the same informant. Method triangulation was carried out by using various data collection techniques simultaneously so that the truth of the findings could be confirmed from multiple angles (Moleong, 2018). In addition, this study also paid attention to research ethics, including obtaining research permission from the school and the informant's voluntary consent, maintaining the confidentiality of personal data, and presenting the data honestly without manipulating the findings in the field.

Results

This study was conducted at MAS Ummi Kalsum in Gunungsitoli on May 8, 2026, with one research subject: biology teacher Ms. Leny Suryani Telaumbanua, S.Pd. Data were collected through non-participant observation, semi-

structured interviews, a Likert-scale questionnaire, and documentation. The research findings are grouped into four main themes, as described below.

Figure 1. Map of Research Findings on the Teaching Styles of Biology Teachers at MAS Ummi Kalsum in Gunungsitoli City



Constructivism-Based Teaching Styles as the Dominant Approach

The results of the observations revealed that the biology teachers' teaching style is student-centered, with Problem-Based Learning (PBL) being the most dominant approach used in the learning process. Teachers do not rely on lectures as their primary method but rather combine PBL with group discussions and question-and-answer sessions in a flexible manner appropriate to the context of the material. These findings are consistent with the teachers' statements in the interviews:

> *"The most commonly used method is Problem-Based Learning (PBL) because this method helps students think critically and actively solve problems related to biology."*

The survey results also reinforce these findings, as teachers responded "Disagree" to the statement regarding the use of the lecture method (item 1), while responding "Strongly Agree" to all statements related to student engagement. Of the 20 survey statements, 15 received "Strongly Agree" responses, 4 received "Agree" responses, and only 1 received a "Disagree" response, resulting in a total score of 94 out of 100 or an average of 4.70, which falls into the "very high" category. This dominance of PBL aligns with the view of Paidi et al. (2020) that students' cognitive competencies develop optimally when learning is designed around active processes and problem-solving, rather than merely one-way knowledge transfer.

The Integrated Application of the Four Learning Theories

An analysis of all data sources indicates that teachers' teaching styles reflect the integrated application of four learning theories, with constructivism as the most prominent foundation. Table 1 summarizes the findings based on each of the identified learning theories.

Table 1. Application of Learning Theories in the Teaching Practices of Biology Teachers at MAS Ummi Kalsum

Teori Belajar	Indikator yang Ditemukan	Sumber Data	Intensitas
Konstruktivisme	Penggunaan PBL, pemecahan masalah, diskusi, observasi langsung	Observasi, wawancara, angket (butir 11, 12, 18)	Dominan
Kognitif	Penyajian materi runtut-sistematis, pengaitan konsep dengan pengetahuan awal, penggunaan contoh konkret	Observasi, angket (butir 10, 11, 19)	Tinggi
Behaviorisme	Pemberian latihan soal, penguatan verbal (pujian), pemberian motivasi	Observasi, wawancara, angket (butir 8, 9)	Komplementer
Humanistik	Penciptaan suasana nyaman, penghargaan pendapat siswa, perhatian terhadap kebutuhan individual	Observasi, wawancara, angket (butir 5, 13, 14, 15, 16)	Tinggi

Source: Results of observations, interviews, and research questionnaires, May 8, 2026.

Constructivism is most clearly reflected in the use of PBL as the primary method. Teachers consistently encourage students to construct their own knowledge through hands-on experiences, discussions, and contextual problem-solving. Cognitive theory is evident in the way teachers present material in a logical sequence and connect new concepts to students' experiences. Behaviorism is incorporated in a complementary manner through the provision of practice exercises and praise for students who actively participate. Meanwhile, the humanistic approach shapes the entire learning dynamic through the teacher's efforts to foster a conducive, warm, and mutually respectful classroom atmosphere.

Teacher-Student Interaction and Student Engagement in Learning

Observations during the learning process showed that the use of PBL and discussion methods significantly encouraged high levels of student engagement. Most students appeared active in question-and-answer sessions and group discussions. The teacher gave students ample opportunity to express their opinions and ask questions, and responded positively to each student's contribution. In interviews, the teacher described her strategies for increasing student engagement;

> *"Student engagement can be enhanced by using engaging and interactive methods, such as group discussions, group work, educational games, and the use of media such as videos and images."*

> "The interaction patterns observed were dialogic and multidirectional—not only from teacher to student, but also from student to teacher and among students through discussion."

These findings indicate that the teachers' teaching styles positively contribute to student engagement and understanding in biology lessons.

Challenges and Adaptation Strategies for Teachers

Although the teachers' teaching styles were deemed effective, two major obstacles were identified in the learning process: (1) limited practical facilities, which did not always allow for optimal laboratory activities, and (2) a lack of active participation by some students in discussions and problem-solving activities. To address these obstacles, the teacher implemented adaptive strategies by utilizing simple teaching aids, conducting direct observations on a limited scale, and adopting a humanistic approach by creating a comfortable and non-judgmental learning environment. As the teacher explained:

> *"Teachers create a relaxed atmosphere, give students the opportunity to ask questions, and value every student's opinion during class."*

These adaptation strategies demonstrate teachers' pedagogical flexibility in responding to contextual constraints without compromising the principles of student-centered learning.

Discussion

This section discusses the implications of the research findings obtained from observations, semi-structured interviews, questionnaires, and documentation regarding the teaching styles of biology teachers at MAS Ummi Kalsum in Gunungsitoli City. Overall, the findings reveal that biology teachers' teaching styles are student-centered, with constructivism as the dominant foundation implemented through the PBL method, complemented by cognitive, behaviorist, and humanistic theories within an integrated learning process. The following discussion analyzes each finding in depth, relates them to relevant learning theories, compares them with the results of previous studies, and identifies pedagogical implications that can be drawn from the context of private madrasah schools in island regions with limited facilities. This discussion is organized around the main themes emerging from the data, ranging from the dominance of constructivism, the effectiveness of PBL, student engagement, and the integration of multiple theories, to comparisons with previous research and the resulting recommendations.

The Dominance of Constructivism in Biology Teachers' Teaching Styles

The main findings of this study reveal that the teaching style of biology teachers at MAS Ummi Kalsum in Gunungsitoli City is predominantly grounded in constructivist theory, which is implemented through the Problem-Based Learning (PBL) method. In contrast to the general conditions still widely documented in secondary schools across Indonesia, biology teachers at this school have actively moved away from the dominance of the lecture method and shifted to a student-centered approach.

These findings align with the core principle of constructivism, which asserts that knowledge cannot be passively transferred from teacher to student but must be actively constructed by the students themselves through experience, exploration, and interaction with their environment (Bustomi et al., 2024; Nerita et al., 2023). Piaget viewed individuals as constructing knowledge through the processes of assimilation and accommodation in response to new experiences, while Vygotsky emphasized the importance of social interaction and guidance within the zone of proximal development as the driving force behind cognitive development (Bustomi et al., 2024). These two theoretical foundations are clearly reflected in the teachers' observed teaching practices: group discussions reflect Vygotsky's social dimension, while problem-solving tasks promote the processes of assimilation and accommodation à la Piaget. Gulo (2024), in his study at SMP Negeri 3 Mandrehe Barat, also demonstrated that the constructivist approach significantly improved learning outcomes in integrated science, with measurable improvements from cycle to cycle. These findings reinforce the position of the research under discussion, namely that constructivism is not only theoretically relevant but has also proven effective in the context of science learning in schools in the Nias region and its surroundings.

The significance of these findings is consistent with previous studies, which have consistently identified teachers' teaching styles as one of the key factors determining the quality of learning and the level of student engagement in the classroom. Suciyati et al. (2023), for example, found that teachers' teaching styles are closely related to students' motivation to learn, with teachers who are able to adapt their teaching styles to students' needs tending to encourage more active participation compared to teachers who stick to a single, rigid teaching style. This is reinforced by Sukandi and Susilawati (2023), who demonstrated that teachers' teaching styles, along with their classroom attitudes, have a significant impact on students' academic achievement; thus, the choice of teaching style is not merely a matter of personal preference but a pedagogical decision that directly affects learning outcomes. Furthermore, Budianty et al. (2022) observed that variations in teachers' teaching styles—particularly in how they present material and interact with students—play a crucial role in fostering students' sustained interest and motivation to learn. These three findings provide a broader context for the results of this study: biology teacher MAS Ummi Kalsum's shift from lecturing to constructivism-based PBL is not merely a technical change in the delivery of material but a pedagogical decision consistent with empirical findings that adaptive, student-centered teaching styles significantly promote student engagement and conceptual understanding.

The Effectiveness of PBL in Developing Critical Thinking Skills

The use of PBL as a preferred method by biology teachers at MAS Ummi Kalsum has found strong empirical support from various previous studies. Laoli (2024) demonstrated that implementing the PBL model with high school students significantly improved both learning outcomes and biology problem-solving skills, with students' average scores increasing and their problem-solving abilities reaching a high level. Meanwhile, Agnesa and Rahmadana (2022) emphasize that the PBL model is one of the most effective strategies for developing critical thinking skills in biology education, as this model inherently requires students to analyze, evaluate, and synthesize information in order to find solutions to the problems presented. Similar findings were reported by Pandia et al. (2025), who concluded that the

consistent implementation of PBL has been proven to enhance students' critical thinking skills in biology education, making it a highly recommended instructional model for subjects requiring deep conceptual understanding, such as biology.

Biology teachers at MAS Ummi Kalsum have successfully implemented PBL consistently despite facing significant limitations in laboratory facilities. The teacher was able to present problem contexts relevant to students' daily lives as the substance of PBL, so that the lack of complete laboratory equipment did not diminish the essence of problem-based learning itself. Agnesa and Rahmadana (2022) emphasize that the success of PBL does not depend solely on the completeness of facilities, but rather on the quality of the problem design presented by the teacher and the teacher's ability to actively facilitate students' thinking processes. This aligns with the findings of Pandia et al. (2025), which show that effective PBL implementation can occur in various contextual conditions as long as teachers possess a strong pedagogical commitment, and is further supported by Paidi et al. (2020), who assert that the primary determinants of successful science learning are the quality of instructional design and the teacher's orientation, not merely the availability of physical resources.

Student Engagement as an Implication of the Student-Centered Approach

The results of the observations showed that most students actively participated in question-and-answer sessions and discussions throughout the learning process. This high level of student engagement was a direct result of the teacher's decision to implement a student-centered approach through PBL and group discussions. Firmansyah (2022) asserts that teachers' tendency to implement student-centered learning (SCL) has positive implications for students' active participation, self-confidence, and ability to think independently; conversely, the dominance of teacher-centered learning (TCL) tends to produce passive students who are entirely dependent on the teacher. The findings of this study reinforce this argument, as the minimal use of lectures by teachers (reflected in the "Disagree" responses to questionnaire items related to the lecture method) is directly proportional to the high level of student engagement in meaningful learning activities.

Safitri and Setiyawati (2023) empirically demonstrated that the impact of the PBL model on student engagement in science learning is significant and consistent, with students learning through PBL showing a much higher level of participation compared to classes using conventional methods. These findings correspond directly with the observational data in this study, in which the use of PBL and group discussions clearly encouraged the active involvement of most students in the question-and-answer process and problem-solving. Firmansyah (2022) adds that a consistent student-centered approach implemented by teachers fosters the development of independent and critical learning dispositions in students, as students become accustomed to actively processing information rather than passively receiving explanations (Gulo et al.,2025). This finding confirms that the teaching style of biology teachers at MAS Ummi Kalsum has successfully created a learning ecosystem conducive to fostering student engagement, in line with the principles of constructivism, which emphasize the active role of learners in constructing their own knowledge (Nerita et al., 2023; Bustomi et al., 2024; Paidi et al., 2020).

The debate between SCL and TCL is not a phenomenon unique to the Indonesian educational context, but rather a pedagogical issue that has also been extensively studied in the international literature. Altun (2023) asserts that although the teacher-centered approach may be more efficient in conveying information in a short period of time, the student-centered approach has consistently proven to be more effective in fostering critical thinking skills, problem-solving, as well as student engagement and motivation, in line with the high levels of student activity observed at MAS Ummi Kalsum. These findings are also consistent with the results of Keiler's (2018) qualitative study of science and mathematics teachers in student-centered classrooms, which showed that the transition of teachers from the role of content deliverers to learning facilitators is key to the successful implementation of SCL, a role shift that was also clearly evident among the biology teachers in this study, who spent more time guiding discussions and providing reinforcement rather than dominating the classroom with lectures. The convergence of findings across geographical contexts and educational levels—ranging from secondary schools in Indonesia and the Middle East to urban schools in the United States—strengthens the argument that the shift from TCL to SCL is a global pedagogical trend relevant for implementation across contexts, including in schools with limited facilities such as MAS Ummi Kalsum.

The Integration of Learning Theories as a Holistic Pedagogical Practice

One of the most interesting and unexpected findings of this study is the fact that teachers do not apply just one learning theory, but rather organically integrate four learning theories simultaneously into a seamless learning process.

The teacher did not mention in the interview that she explicitly designed instruction based on the four learning theories, but observational data and questionnaire responses consistently revealed traces of constructivism, cognitivism, behaviorism, and humanism in every observed learning session. This finding aligns with recent trends in learning theory research, which no longer views these four theories in isolation but rather as an integrated and mutually complementary conceptual model supporting the development of effective learning (Hartono & Wahyunuringtyas, 2026; Kurniawan & Darmawan, 2024). Bustomi et al. (2024) emphasize that constructivism and cognitivism are in fact complementary in good teaching practice: constructivism provides a philosophical framework for how knowledge is constructed, while cognitivism offers guidance on how information is mentally processed and organized by students. Nerita et al. (2023) add that the authentic implementation of constructivism in the classroom is almost always accompanied by elements from other theories implicitly, because meaningful learning is inherently multidimensional and cannot be reduced to a single theoretical framework, while Tegegne et al. (2025) confirm that effective teachers in various contexts demonstrate flexibility in combining different approaches according to the actual needs of the classroom (Waruwu et al., 2025).

The cognitive aspect of teachers' instructional practices is evident in the presentation of material in a logical sequence and the linking of new concepts to students' prior knowledge, while the behaviorist aspect is evident through the provision of practice problems and verbal reinforcement in the form of praise for students who actively participate. The humanistic aspect shapes the entire classroom dynamic through the creation of a warm, inclusive learning environment that respects every student's opinion without exception, in line with the view that the application of humanistic theory in learning leads to the establishment of humane teacher-student relationships and a non-coercive learning atmosphere (Chailani et al., 2024). This kind of multi-theoretical integration reflects what is referred to in pedagogical studies as the eclectic teaching approach—that is, a teacher's ability to reflectively select and combine various strategies based on students' actual needs and the learning context (Firmansyah, 2022; Nerita et al., 2023). This situation also underscores that the dichotomy between various learning theories is, in fact, artificial in effective classroom practice, as emphasized in the discourse on the major schools of learning theory, which shows that behaviorism, cognitivism/constructivism, and humanism, in practice, overlap and rarely stand as entirely separate entities (Komarudin et al., 2023). A professionally mature teacher moves flexibly among various theoretical frameworks to respond to students' complex and dynamic needs, as empirically confirmed by Bustomi et al. (2024), Paidi et al. (2020), and Tegegne et al. (2025) in diverse educational contexts

Similarities and Differences with Previous Research

In general, the findings of this study share several similarities with previous studies, particularly regarding the effectiveness of PBL and constructivism on student learning outcomes and engagement. These similarities further reinforce the ecological validity of the constructivist approach in biology education in Indonesia. However, there are significant differences worth highlighting. Most previous studies, such as those by Laoli (2024), Agnesa and Rahmadana (2022), and Gulo (2024), employed a classroom action research (CAR) design with a quantitative or mixed-methods approach that measured the effectiveness of PBL by comparing pretest and posttest scores. Meanwhile, this study employs a descriptive qualitative approach that focuses on an in-depth analysis of a single teacher's teaching practices, thereby revealing pedagogical nuances that are not captured by quantitative designs.

Another important difference is the context of the research subjects. Most previous studies have focused on students as the primary unit of analysis, whereas this study specifically focuses on teachers as the research subjects. This teacher-centric inquiry fills a research gap that is still relatively rare in the literature on biology education in Indonesia, particularly in the context of madrasah-based private schools in remote areas.

Findings, Generalizations, and Recommendations

This study has limitations in terms of generalizability because it involved a single research subject at a single school; therefore, the findings cannot be readily generalized to the entire population of biology teachers in Gunungsitoli City or a broader region. Nevertheless, this study makes a meaningful contribution as a rich case study on how constructivist-based teaching styles can be brought to life in the real-world practice of a biology teacher amidst contextual limitations (Moleong, 2018; Sugiyono, 2019). Firmansyah (2022) emphasizes that qualitative studies on teachers' teaching approach tendencies hold high value precisely because of the depth of their descriptions, not because of the breadth of statistical generalizations; thus, the transferability of findings can be assessed by readers based on contextual similarity. Several recommendations are formulated based on these limitations: future research should involve a larger sample of teachers from diverse school backgrounds, integrate student perspectives as a source of triangulation, employ a mixed-methods design to strengthen validity, and conduct longitudinal studies on the long-

term impact of constructivist-based teaching styles on students' cognitive competencies (Paidi et al., 2020; Tegegne et al., 2025; Nerita et al., 2023).

Conclusion

This study successfully addressed all of its objectives through an in-depth analysis of the teaching styles of biology teachers at MAS Ummi Kalsum in Gunungsitoli. Based on data obtained through non-participant observation, semi-structured interviews, Likert-scale questionnaires, and documentation, it was found that the biology teachers' teaching styles are student-centered and predominantly grounded in constructivist theory, which is implemented through Problem-Based Learning (PBL). Teachers do not rely on lectures as their primary approach but instead flexibly combine PBL with group discussions, question-and-answer sessions, and simple observations, tailored to the context of the material and students' needs. These findings confirm that a pedagogical shift from a teacher-centered to a constructivist-based student-centered approach can be effectively realized even in the context of a private madrasah with limited facilities in an island region.

Constructivism was identified as the most dominant foundation in the overall teaching practices of biology teachers at MAS Ummi Kalsum in Gunungsitoli City. The dominance of constructivism was consistently reflected in the use of PBL as the primary method, the assignment of contextual problem-solving tasks, the involvement of students in active group discussions, and the encouragement of students to discover and construct their own knowledge through direct experience. In addition to constructivism, three other learning theories were also found to be integrated into the teachers' teaching practices: cognitive theory is reflected in the presentation of material in a coherent and systematic manner; behaviorist theory is present through the provision of practice problems, structured assignments, and verbal reinforcement in the form of praise; and humanistic theory is manifested through the creation of a warm, inclusive learning atmosphere that values every student's contribution. Teachers' ability to naturally integrate these four learning theories into a single learning sequence reflects true professional maturity and constitutes one of the main contributions of this study to our understanding of the pedagogical practices of biology teachers in schools with limited facilities.

Biology teachers' varied and student-centered teaching styles have been shown to positively contribute to student engagement and active participation during the learning process. Observation results indicate that the use of PBL and discussions significantly encourages students to participate more actively, express their opinions more confidently, and understand biological concepts more easily compared to learning that relies solely on lectures. The average questionnaire score of 4.70 on a 5-point scale indicates that the teacher was highly consistent in implementing student-centered, interactive, and meaningful learning aspects in every class session. The main challenges faced—limited laboratory facilities and a lack of engagement among some students—were successfully overcome through creative pedagogical adaptation strategies, including the use of simple teaching aids and a warm, humanistic approach to classroom management.

Based on the findings and limitations of this study, several recommendations are formulated for future research. First, future research should expand the scope of the study by involving more biology teachers from various madrasahs and public schools in Gunungsitoli City and the surrounding areas, thereby significantly enhancing the generalizability and comparability of the findings. Second, interview and questionnaire instruments should be administered not only to teachers but also to students as a source of triangulated data, so that findings regarding student engagement and conceptual understanding are not based solely on teachers' perceptions and the researcher's observations. Third, future research is advised to combine qualitative and quantitative approaches in a mixed-methods design so that the resulting findings are more comprehensive, measurable, and can be generalized more broadly to a larger population of biology teachers. Fourth, a longitudinal study is needed to examine the consistency of constructivist-based teaching styles and their long-term impact on students' cognitive, affective, and psychomotor competencies in biology learning, given that this study was conducted in a single observation session. Fifth, research on professional development strategies that specifically encourage the implementation of constructivist-based teaching styles in schools with limited facilities in remote areas is urgently needed as a follow-up to the findings of this study.

Acknowledgments

The author would like to express his deepest gratitude to MAS Ummi Kalsum in Gunungsitoli for granting permission to conduct this research and for facilitating access during the fieldwork. Special thanks are also extended to Ms. Leny Suryani Telaumbanua, S.Pd., a biology teacher at MAS Ummi Kalsum in Gunungsitoli, for her willingness to serve as the primary informant for this study and for her openness in allowing classroom observations and direct interviews. The author would also like to thank all parties who provided support, feedback, and motivation, enabling this field research to be successfully completed.

Declaration on the Use of AI

The authors state that an artificial intelligence (AI)-based tool, namely Claude AI (Anthropic), was used in the preparation of this manuscript, specifically to assist with language editing and refining the writing structure to conform to the GEN BIONIX journal template. The entire process of data collection, conducting observations, interviews, and questionnaire administration, as well as data analysis and interpretation of findings, was carried out entirely by the author team directly in the field. All authors take full responsibility for the entire content of this manuscript and have critically reviewed and validated all content based on research data obtained directly in the field.

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