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EVALUATION OF THE IMPLEMENTATION OF PROCESS STANDARDS IN THE 2013 CURRICULUM IN BIOLOGY LEARNING AT SENIOR HIGH SCHOOLS IN KUNINGAN REGENCY

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ABSTRACT

This study aims to evaluate the implementation of process standards in the 2013 Curriculum in Biology learning at the senior high school level in Kuningan Regency. This research employs a qualitative descriptive approach with a purposive sampling technique, involving six schools with one Biology teacher representing each school as respondents. Data were collected through observations, interviews, documentation, and questionnaires. The findings indicate that most schools have developed lesson plans (RPP) following Circular Letter No. 14 of 2019, yet the actual implementation in the learning process does not fully align with the initial planning. The scientific approach has not been optimally applied, particularly in questioning and developing students' critical thinking skills. The primary challenges faced by teachers include limited learning media, difficulties in implementing scientific-based methods, and low student engagement in online learning. Additionally, the introductory and closing activities need improvement, particularly in terms of student motivation, reflection, and feedback. Therefore, strengthening scientific-based learning strategies, utilizing technology more effectively, and providing teacher training are essential to enhancing the effectiveness of Biology learning under the 2013 Curriculum.

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Introduction

Education is the foundation for developing quality human resources. The curriculum, as a guideline for learning, continues to evolve to adapt to changing times and societal needs (Lubis et al., 2022). The 2013 Curriculum (K-13) was introduced as an improvement over the previous curriculum, emphasizing character development, 21st-century competencies, and the integration of a scientific approach in learning (Kasman & Lubis, 2022). However, various challenges arise in its implementation, particularly in Biology at the senior high school level.

Previous studies indicate that the scientific approach and the use of technology in Biology learning have not been optimally implemented. Research has revealed that experiment-based learning and laboratory use remain limited, especially during online learning amid the COVID-19 pandemic (Darici et al., 2021; Jiang & Ning, 2021). Even under normal conditions, innovative teaching methods such as blended learning and flipped classrooms are still underutilized in Biology instruction (Adnyana & Sudaryati, 2022; Agustian et al., 2022).

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Furthermore, challenges in implementing K-13 also include teachers' limited readiness to adapt to more interactive teaching methods. Studies show that many teachers still rely heavily on lecture-based methods rather than problem-based or project-based approaches (Fradila et al., 2021; Muji et al., 2021). This reliance contributes to poor student performance in science subjects, as reflected in Indonesia's low scores in the Programme for International Student Assessment (PISA) (Hartono et al., 2022). Therefore, an in-depth study is needed to examine how process standards in K-13 are applied in Biology learning at the senior high school level.

Some previous studies have highlighted various approaches to implementing the 2013 Curriculum (K-13) in Biology learning. One proven effective approach is blended learning and gamification, which can enhance student engagement in Biology learning (Alt & Naamati-Schneider, 2021; Dustman et al., 2021). Moreover, the use of virtual laboratories has emerged as a solution to address the limitations of physical laboratory facilities, particularly in Biology learning, which requires direct experimentation. Studies have shown that virtual laboratories support students' understanding of complex biological concepts (Alam & Mohanty, 2023; Hudha et al., 2023).

On the other hand, improving teacher competency is also a crucial factor in the successful implementation of K-13. Several studies emphasize the importance of teacher training in adapting the scientific approach and utilizing digital learning technology to enhance Biology instruction effectiveness (Greene et al., 2021; Kotzebue et al., 2021). These findings suggest that the success of K-13 implementation in Biology learning greatly depends on innovative teaching strategies and teachers' readiness to integrate technology and teaching methods aligned with students' needs.

Despite these insights, there remains a research gap concerning how process standards in K-13 are truly implemented in schools, particularly in the context of online learning. Many studies focus on general curriculum implementation rather than in-depth evaluations of process standards in Biology learning. Additionally, studies evaluating the challenges faced by teachers in applying the scientific approach in K-13 are still limited. This aspect is crucial, as the scientific approach plays a fundamental role in K-13 and significantly impacts the quality of Biology learning. Moreover, few studies have comprehensively measured the impact of K-13 implementation on student learning outcomes in Biology.

Based on these research gaps, the research questions in this study are:

1. How is the implementation of process standards in the 2013 Curriculum in Biology learning at the senior high school level in Kuningan Regency?
2. What challenges do teachers face in implementing the scientific approach in Biology learning?
3. How effective is K-13 implementation in improving student learning outcomes in Biology?

This study offers novelty in several aspects that have not been extensively explored in previous research. First, it specifically analyzes the implementation of process standards in the 2013 Curriculum (K-13) in Biology learning at the senior high school level, which is still rarely the primary focus of research. Second, the research combines quantitative and qualitative methods (mixed-method), providing a more comprehensive picture of the effectiveness of K-13 implementation in Biology learning. This approach enables a deeper analysis of quantitative data while also offering qualitative insights into experiences and challenges encountered in implementing this curriculum. Third, this study integrates teachers' and students' perspectives in evaluating the effectiveness of K-13 implementation in Biology classrooms. By involving both parties, the research can identify gaps between the teaching strategies applied by teachers and students' learning experiences, resulting in more holistic recommendations for improving

K-13 implementation in Biology learning.

Practically, the study results can provide recommendations for teachers, schools, and policymakers to enhance the effectiveness of process standards in K-13. Additionally, the study can serve as a basis for developing teacher training programs that align better with the needs of Biology learning in the digital era. By considering the challenges and opportunities in implementing process standards in K-13, this research aims to examine how the curriculum is applied in Biology learning at senior high schools. Through a systematic and data-driven approach, this study seeks to contribute significantly to improving the quality of Biology education in Indonesia.

Methods

This study employs a qualitative descriptive approach to analyze the implementation of process standards in the 2013 Curriculum for Biology learning in senior high schools in Kuningan Regency. This approach was chosen to gain an in-depth understanding of the dynamics of process standard implementation based on teachers' and students' experiences (Muji et al., 2021). Data were collected from six public schools selected using purposive sampling, with one Biology teacher representing each school (Hartono et al., 2022).

Observations were conducted to examine the Biology learning process in the classroom, covering the introductory, core, and closing stages. The primary focus was on the implementation of the scientific approach by teachers in online learning, aligning with blended learning approaches in science education (Adnyana & Sudaryati, 2022). The observation also assessed the integration of technology-based strategies in learning (Kasman & Lubis, 2022), which remains a key challenge in online learning (Darici et al., 2021).

Collected documents include Lesson Plans (RPP) developed by teachers. The lesson plans were analyzed using observation sheets to evaluate their alignment with the 2013 Curriculum standards and competency-based approaches (Roehrig et al., 2021). Previous studies indicate that curriculum designs based on the scientific approach need to be supported by hands-on activities and exploratory learning materials (Momsen et al., 2022).

Interviews were conducted with both teachers and students to gather additional information about the planning and implementation of learning, as well as the challenges encountered during the 2013 Curriculum implementation. The interviews focused on teachers' experiences in applying scientific teaching methods and students' preparedness to comprehend Biology concepts deeply (Humphrey & Wiles, 2021; Jiang & Ning, 2021).

Questionnaires were distributed to teachers and students to collect data on lesson planning, instructional execution, and the effectiveness of the scientific approach in learning. Previous studies highlight that students' perceptions of teaching methods significantly impact the effectiveness of curriculum implementation (Greene et al., 2021). Furthermore, integrating technology into Biology teaching has also been identified as a key factor in enhancing student comprehension (Lubis et al., 2022; Susanto et al., 2022).

The data were analyzed in three main stages:

1. *Data Reduction* – Filtering relevant data to answer research questions, as suggested in studies on curriculum evaluation based on the scientific approach (Muji et al., 2021).
2. *Data Presentation* – Presenting data in narrative and tabular forms to facilitate interpretation, following approaches used in education policy evaluation research (Kasman & Lubis, 2022).
3. *Verification and Conclusion Drawing* – Analyzing the compiled data to obtain valid and applicable conclusions regarding the implementation of the 2013 Curriculum in Biology classrooms (Momsen et al., 2022).

To ensure data validity, the study employed:

1. *Triangulation Technique*: Comparing data from multiple sources (observations, interviews, documentation, and questionnaires) to enhance the credibility of research findings. This approach has been widely used in curriculum evaluation research to ensure the objectivity of the findings (Roehrig et al., 2021).
2. *Dependability Testing:* Conducted to verify that the research findings are reliable and meet qualitative research standards in science education (Bawaneh, 2021).

This study aims to provide a comprehensive understanding of the implementation of process standards in the 2013 Curriculum, specifically in Biology learning at the senior high school level, as well as the challenges faced by teachers in applying the scientific approach in classrooms. The findings of this research are expected to offer recommendations for enhancing scientific-based learning effectiveness within the science education curriculum (Hartono et al., 2022).

Results

The evaluation of Lesson Plans (RPP) in several Senior High Schools (SMA) in Kuningan Regency showed varying levels of achievement. School SK2 reached 97%, classified as good, while School SJ1 achieved 84%, also categorized as good. Likewise, School SCG1 obtained 92%, maintaining its position in the good category. In contrast, School SG1 had a lower achievement rate of 53%, placing it in the moderate category. Meanwhile, School SL1 recorded 75%, and School SCN1 attained 81%, both falling into the good category. These results highlight differences in lesson planning implementation across schools, as shown in Figure 1.

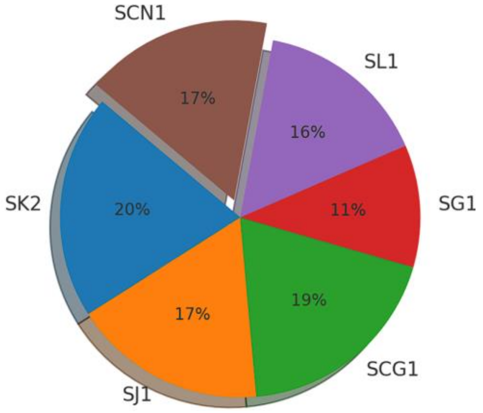

Figure 1. Percentage of Lesson Plan (RPP) Analysis Results for Biology Teachers

Figure 2 presents a summary of the lesson plan (RPP) analysis results for Biology teachers in senior high schools across Kuningan Regency. The figure highlights variations in lesson plan quality and completeness, reflecting differences in how teachers design and implement instructional planning based on the 2013 Curriculum guidelines. These results provide a comparative overview of the extent to which each school adheres to curriculum standards, offering valuable insights into areas that require further development to optimize lesson planning and delivery.

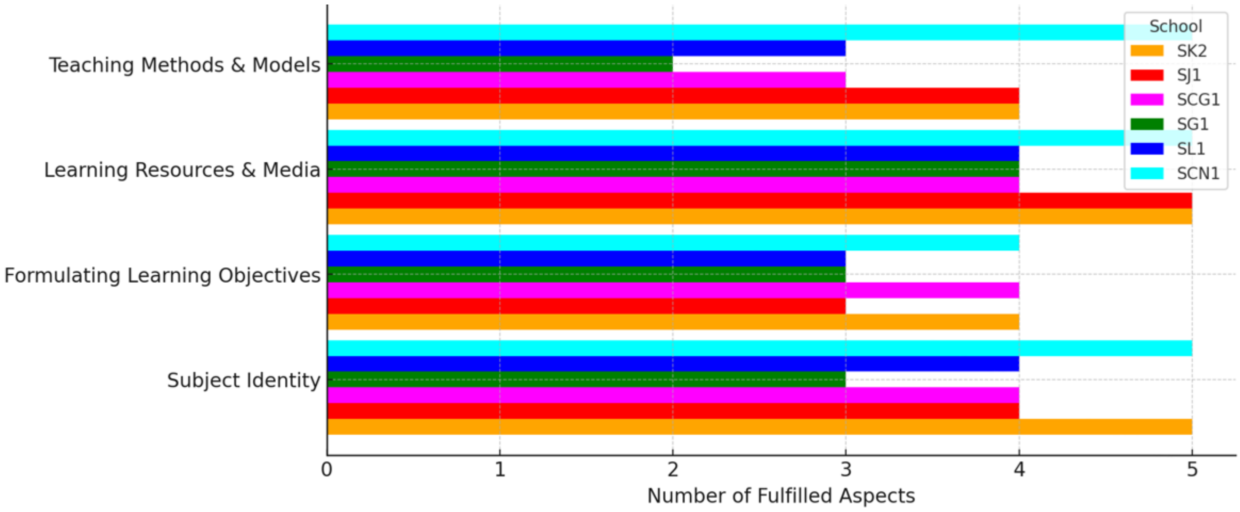

Figure 2. Summary of Lesson Plan (RPP) Analysis Results for Biology Teachers in Senior High Schools across Kuningan Regency

Figure 3 illustrates the results of learning implementation observations conducted across six senior high schools in Kuningan Regency. The figure provides a visual representation of how effectively teachers applied instructional strategies during the learning process, including the introduction, core activities, and closure stages. These results highlight variations in the implementation of the scientific approach, student engagement levels, and the overall effectiveness of lesson delivery, offering insights into areas that require improvement for more effective Biology instruction.

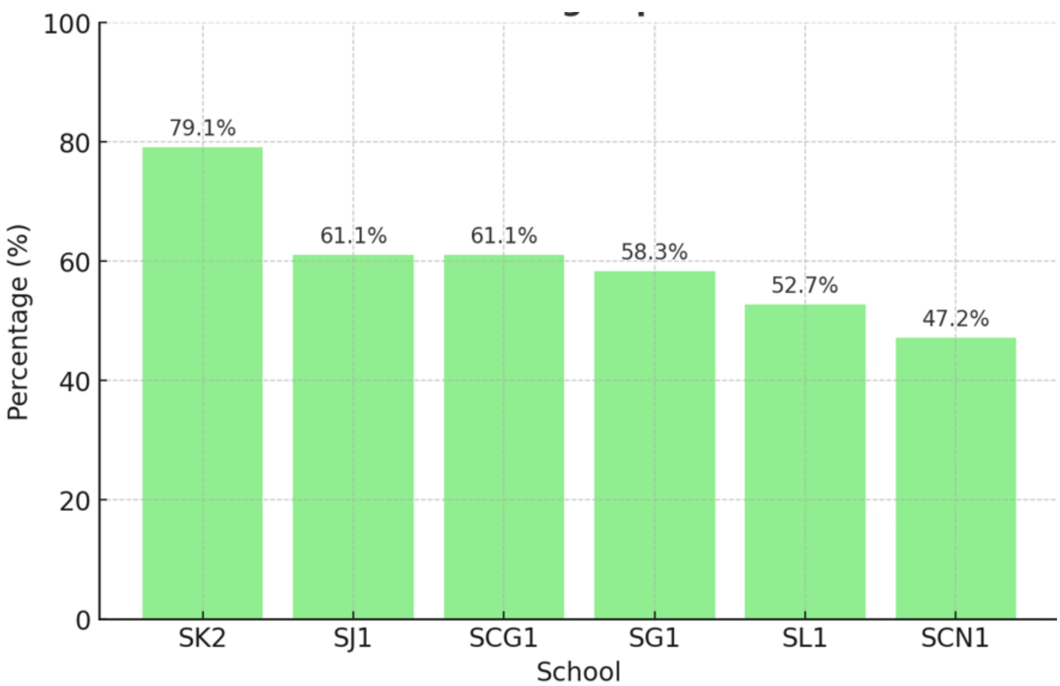

Figure 3. Presentation of Learning Implementation Results

The summary of learning observations was conducted based on a single session by six Biology teachers. Observations were carried out in one selected class from each school, following a predetermined schedule agreement. The results of the observations are summarized based on three main stages of learning: Introduction, Core Activities, and Closure.

Table 1. The Observational Results of Preliminary Activities

Indicator	SK2	SJ1	SCG1	SG1	SL1	SCN1
Conducting preliminary activities	Greetings, prayers, attendance, preparation for learning	Greetings, prayers, attendance	Greetings, prayers, attendance, preparation for learning	Greetings, prayers, attendance	Greetings, prayers, attendance	Greetings, prayers, attendance
Preparing prior knowledge activation	Prior material activation	Core material activation	Core material activation	Core material activation	Did not provide activation	Did not provide activation
Motivating students	Did not motivate students	Did not motivate students	Did not motivate students	Did not motivate students	Did not motivate students	Did not motivate students
Communicating learning objectives	With Basic Competencies (KD)/indicators	With material topics	With material topics	With material topics	With material topics	With material topics

The observations revealed that only the teacher at SK2 mentioned the Basic Competencies (KD) and learning indicators, while teachers at other schools only stated the subject topic without explaining the competencies that needed to be achieved.

Tabel 2. Summary of Observations on Core Learning Activities in Biology Classes Using the Scientific Approach"

Indicator	SK2	SJ1	SCG1	SG1	SL1	SCN1
Observation Opportunity	Seeing, listening, reading	Seeing, listening	Listening, reading	Seeing, reading	Seeing, reading	Seeing, reading
Facilitating Student Attention	Seeing, reading, listening	Seeing, listening	Listening, reading	Listening, reading	Reading	Reading
Guidance in Asking Questions	Directed, does not develop competence	Directed questioning	No guidance	Directed questioning	Directed questioning	No guidance
Training Students to Ask Independently	Training 5W+1H, high curiosity	Training 5W+1H, passive class	Training 5W+1H, passive class	Training 5W+1H, passive class	No questioning process	No questioning process
Opportunity to Collect/Try	Reading sources & observing objects	Reading sources & observing objects	Reading sources & observing objects	Reading sources & observing objects	Reading sources & observing objects	Reading sources & observing objects

The table 3 provides a summary of observations on the implementation of learning activities in Biology classes across six senior high schools, focusing on factors that support the application of the scientific approach. Key aspects assessed include the use of teaching methods and models, utilization of learning resources, classroom management skills, teacher's ability to explain concepts, questioning techniques, and response to student inquiries. The findings highlight variations in instructional practices, with some schools effectively integrating diverse and scientific-based teaching strategies, while others show limitations in method application, student engagement, and instructional clarity.

Table 3. Summary of Observations on Learning Implementation Based on Support for the Scientific Approach

Indicator	SK2	SJ1	SCG1	SG1	SL1	SCN1
Use of teaching methods/models	Appropriate, varied, scientific, character development	Appropriate, engaging, scientific	Appropriate, facilitating scientific approach	Appropriate, varied, scientific	Appropriate, varied, scientific	Did not apply a teaching method
Utilization of learning resources/media	CloudX, Google Meet, Classroom, WhatsApp	YouTube, Classroom, WhatsApp	WhatsApp, Classroom	WhatsApp, Classroom	WhatsApp, Classroom	WhatsApp, Classroom
Classroom management skills	Responsive, attentive, reinforcement, clear instructions	Responsive, corrective, responsible	Responsive, attentive, demanding responsibility	Responsive, attentive, demanding responsibility	Responsive, demanding responsibility, clear instructions	Responsive, demanding responsibility, clear instructions
Teacher's explanation skills	Comprehensive, clear, but unstructured	Comprehensive, clear, but unstructured	Incomplete, hesitant	Comprehensive, clear, but unstructured	Incomplete, hesitant	Incomplete, hesitant
Teacher's questioning skills	Encouraging critical thinking	Encouraging material exploration	Encouraging material exploration	Encouraging material exploration	Encouraging student responses	Encouraging material exploration
Teacher's ability to answer questions	Answered but not well understood	Answered, easily understood	Answered, easily understood	Answered, easily understood	Answered, easily understood	Answered, easily understood

The Figure 4 presents a summary of the observation results on the implementation of closure activities in Biology learning across six senior high schools. It highlights the number and types of activities conducted by teachers during the closing phase of the lesson, including reflection, feedback, assessment, and planning for the next session. The findings indicate variations in the extent to which closure activities were implemented, with some schools demonstrating a more comprehensive approach while others had minimal engagement. This data provides insights into the effectiveness of lesson closure strategies and their role in reinforcing student understanding and engagement.

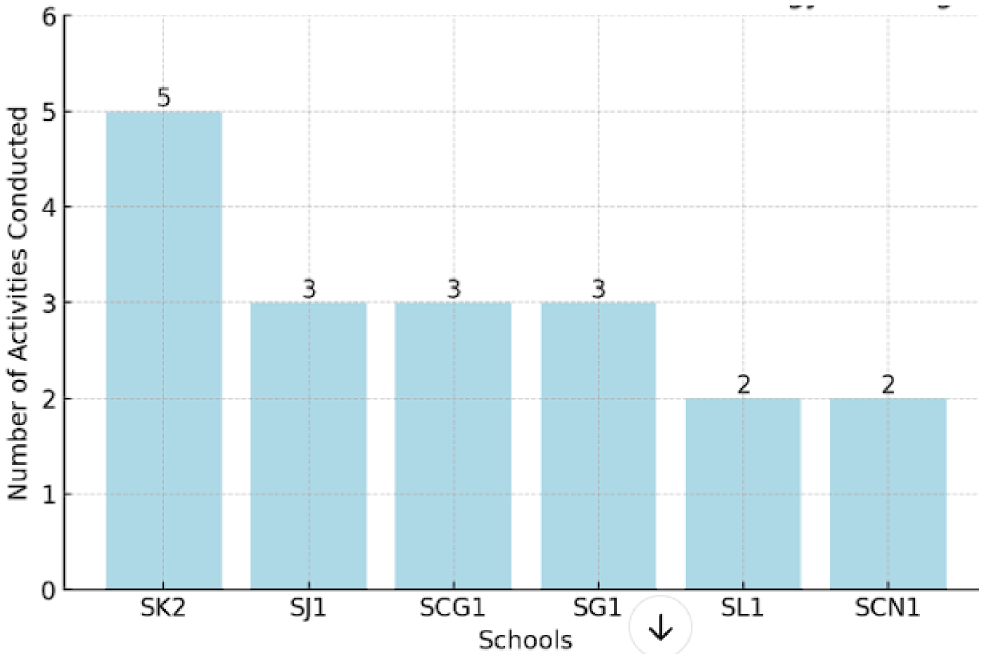

Figure 4. Observation Results of Closure Activities in Biology Learning

Discussion

Implementation of Process Standards in the 2013 Curriculum for Biology Learning

The findings of this study indicate that while most schools have developed lesson plans (RPP) following Circular Letter No. 14 of 2019, the actual implementation in the classroom has yet to fully align with these plans. The scientific approach, which forms the backbone of the 2013 Curriculum, has not been optimally applied, particularly in encouraging students to question and develop critical thinking skills. This aligns with the study by Adnyana & Sudaryati (2022), which emphasized that blended learning strategies infused with green education principles can enhance student engagement and understanding in Biology but require proper implementation.

Despite the presence of structured lesson plans, inconsistencies in the use of scientific methods persist. For example, the inquiry-based learning component, which is crucial for fostering scientific reasoning, is often underutilized due to teachers' reliance on traditional lecture-based teaching. This supports the findings of Agustian et al. (2022), who highlighted that even in laboratory-based Chemistry education, active student engagement remains a challenge without well-structured pedagogical approaches. Similarly, Amon & Bustami (2021) found that school-based curriculum management requires systematic teacher training to ensure that curriculum implementation translates effectively into classroom practices.

Challenges in the Application of the Scientific Approach

The research identified key challenges in implementing the scientific approach, such as limited learning media, difficulties in applying scientific-based teaching strategies, and low student engagement in online learning. Alam & Mohanty (2023) argue that integrating virtual laboratories into teaching can significantly enhance student engagement and understanding of complex scientific concepts, particularly in contexts where physical laboratory access is limited. This suggests that integrating virtual labs into Biology education in Kuningan Regency could be a viable solution to bridge this gap.

Moreover, the low engagement of students in online learning reflects global challenges observed during the COVID-19 pandemic. Studies such as Bawaneh (2021) and Darici et al. (2021) highlight that a lack of proper digital tools and ineffective instructional design contribute to disengagement. The research findings further align with Dustman et al. (2021), who demonstrated that gamified and interactive virtual learning environments could mitigate these challenges, making Biology learning more engaging and student-centered.

The Role of Digital Learning Tools and Self-Regulated Learning

Another key issue identified in this study is the lack of digital literacy and self-regulated learning among students, particularly in online and hybrid learning environments. Alt & Naamati-Schneider (2021) discuss how digital concept mapping and self-regulation techniques can help students take control of their own learning process, ensuring better retention of biological concepts. These strategies, if implemented effectively, could enhance the scientific inquiry component of the 2013 Curriculum.

Similarly, Gkintoni et al. (2021) found that neurocognitive and emotional factors significantly affect student learning. The absence of motivational strategies in Biology classrooms, as observed in this study, suggests the need for interventions that foster student curiosity and engagement. Teachers need to incorporate motivational elements, such as student-led discussions and real-world problem-solving activities, to make the learning process more interactive and stimulating.

Disparities in Lesson Plan Implementation and Teacher Readiness

The results also indicate disparities in lesson plan execution, with some schools demonstrating higher adherence to curriculum guidelines than others. This aligns with the findings of Greene et al. (2021), who noted that the effectiveness of curriculum implementation depends heavily on teachers' ability to model self-regulated learning behaviors and engage students in deep conceptual understanding. Furthermore, Kotzebue et al. (2021) emphasize the importance of digital competencies among teachers in STEM education, suggesting that teacher training in digital tools and interactive learning strategies should be prioritized to enhance curriculum implementation.

A significant finding of this study is that while some schools effectively integrate digital learning platforms such as Google Classroom and WhatsApp, others rely solely on traditional methods, resulting in inconsistencies in Biology instruction. Souto-Otero (2021) highlights the role of informal and non-formal learning validation in formal education settings, indicating that teachers should incorporate a wider range of learning resources, including digital and experiential learning tools, to fully realize the potential of the 2013 Curriculum.

Strengthening Scientific Inquiry and Student Engagement

One major gap in implementation is the underdevelopment of students' questioning and reasoning skills. The study shows that few teachers provide structured opportunities for students to engage in inquiry-based learning. Schiering et al. (2023) argue that proficiency in pedagogical content knowledge (PCK) among teachers is critical for fostering higher-order thinking skills. Enhancing teachers' PCK in Biology could be a key strategy for addressing these gaps.

Additionally, the findings highlight that many students struggle with making connections between Biology concepts and real-world applications. Anđić et al. (2024) explored the use of 3D modeling and printing in Biology education for visually impaired students, illustrating how interactive, hands-on learning can enhance conceptual understanding. This supports the notion that more interactive and experiential learning approaches should be incorporated into the 2013 Curriculum to ensure deeper student engagement.

Enhancing Reflection and Feedback Mechanisms

The lack of reflection and feedback in lesson closures, as identified in the study, limits opportunities for students to consolidate their learning. Levy et al. (2021) advocate for incorporating civic science education principles into curriculum design to encourage student reflection and deeper engagement with scientific issues. Additionally, Ghosh & Bir (2023) emphasize the importance of metacognitive strategies in competency-based education, suggesting that structured reflection exercises should be embedded in Biology lessons to help students assess their understanding and identify areas for improvement.

Furthermore, Nieto-Escamez & Roldán-Tapia (2021) found that gamification strategies in online learning can foster better student engagement and retention. Integrating such strategies into Biology lessons—particularly in the lesson closure phase—could help address the observed gaps in student reflection and feedback.

Conclusion

This study highlights the challenges and inconsistencies in implementing the process standards of the 2013 Curriculum (K-13) in Biology learning at the senior high school level in Kuningan Regency. While most schools have adopted the one-page lesson plan format, their practical application in classrooms remains suboptimal. The scientific approach, intended to enhance inquiry-based learning and critical thinking, has not been fully realized. Teachers face difficulties in integrating this approach due to limited learning media, ineffective teaching methods, and low student engagement, especially in online learning. Additionally, introductory and closing activities often lack structured motivation, reflection, and feedback, affecting the overall learning process.

To improve the implementation of K-13, schools and educators need to adopt more interactive and technology-enhanced teaching strategies. Methods such as blended learning, gamification, and virtual laboratories can help engage students and facilitate better conceptual understanding. Teacher training programs must be strengthened to ensure educators can effectively apply scientific-based teaching methods and digital tools in their lessons. Schools should also invest in technology and resources that support a more interactive and inquiry-driven learning environment. Enhancing the role of reflection and feedback in lessons is equally crucial to help students develop analytical and self-assessment skills.

Ensuring a more effective implementation of the K-13 process standards requires a holistic approach, combining pedagogical improvements, teacher development, and better resource allocation. Strengthening these aspects will contribute to a more effective and engaging Biology learning experience, fostering critical thinking and problem-solving skills among students. Future research should explore the long-term impact of these improvements and assess the curriculum's effectiveness in other subject areas and educational settings.

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