Exploration of Biology Learning Experiences Among Students of SMAN 3 Singaraja: A Review of Offline and Online Learning

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ABSTRACT

This study aims to explore the learning experiences of biology students, particularly within the realms of face-to-face and online learning, and to identify solutions for enhancing the quality of education. The research methodology employed is the Convergent Mixed Methods Design. The participants in the study encompassed 43 twelfth-grade students specializing in the natural sciences and three biology teachers. Data collection was conducted through questionnaires, interviews, and observations, followed by a comprehensive analysis employing both quantitative and qualitative descriptive techniques. The research findings reveal that the primary challenges faced by students in the realm of biology education include difficulties in recalling scientific terminology, inadequate preparation prior to lessons, limited engagement with everyday biological issues, struggles in time management for studying, a lack of focus during learning, and difficulties in comprehending biological concepts. Over half of the students exhibit a preference for face-to-face learning, though online learning and hybrid modes are also popular. Among the Learning Management Systems (LMS) in use, Google Classroom stands out as the most frequently employed. The principal sources of internet access for the students include home Wi-Fi, tethering from the devices of parents, siblings, or friends, and internet cafes. While internet connectivity at school is generally available, the issue of unstable signals persists. The research outcomes carry significant implications for the development of more effective strategies in biology education, such as interactive approaches, the integration of real-world contexts, and the augmentation of digital infrastructure. Additionally, external factors and social considerations necessitate careful consideration in the development of comprehensive teaching strategies.

Keywords: Learning Experiences, Offline and Online Learning

INTRODUCTION

The COVID-19 pandemic has reshaped the global educational landscape (McClure *et al.*, 2023). Social restrictions and school closures have compelled educational institutions and students to embrace online learning as an alternative urgently (McClure *et al.*, 2023; Ritchie *et al.*, 2023). Amid this significant transformation, the exploration of students' biology learning experiences becomes critically important. Government policies regarding the Merdeka Curriculum, which aim to provide more freedom to schools and students in the learning process(Hamdi *et al.*, 2022), further underscore the urgency of this research. Therefore, this study is indispensable to understand the implications of the pandemic and the Merdeka Curriculum on the biology learning experiences at SMAN 3 Singaraja.

Many other studies have discussed efforts to improve post-COVID-19 pandemic learning related to the learning process (Casmat and Pribadi, 2022; Iwantoro *et al.*,

2022; Saputra and Fernandes, 2023) and the paradigm shifts that have occurred (Fikri *et al.*, 2023; Langgar *et al.*, 2023; Ratten, 2023). However, there are still few studies that examine students' learning experiences, both in offline and online settings. This research distinguishes itself from previous relevant studies by focusing on two key aspects. First, it examines explicitly the biology learning experiences of students at SMAN 3 Singaraja, an aspect that might not have been extensively studied in this context. Second, it incorporates the post-COVID-19 perspectives within the framework of the Merdeka Curriculum, enabling relevant and contextual analysis of both offline and online learning. Thus, this research provides a fresh and contemporary perspective on the challenges and opportunities in biology education in the post-pandemic era and within the Merdeka Curriculum. The novelty of this research is that it provides a richer understanding of the dynamics of biology learning among students and provides a basis for the development of future learning policies and strategies.

This research aims to delve into the biology learning experiences of students, particularly within the realms of face-to-face and online learning. Through the outcomes of this study, it is anticipated that solutions or recommendations can be identified to enhance the quality of biology education and address the challenges faced by learners.

METHODS

The research methodology employed in this study is the Convergent Mixed Methods Design (Creswell & Clark, 2018). Here, both quantitative and qualitative data were collected simultaneously and analyzed separately, and then their interrelationship was confirmed (Creswell and Clark, 2018; Hirose and Creswell, 2023). The participants in this study consisted of 42 twelfth-grade students specializing in the natural sciences and three biology teachers. The data collection involved triangulation of data collection techniques, including an electronic questionnaire using Google Form (https://docs.google.com/forms/d/e/1FAIpQLSfhXndZ_3nYQhGyUwqrtZ7wAsDH HllE2_Tis7yM4fJzfx-z9Q/viewform) with multiple-choice checkboxes and several open-ended questions to understand perceptions of offline and online learning post-pandemic. Interviews were conducted with three biology teachers to validate these student perceptions, supplemented by observations of the learning process. The multiple-choice checkboxes data were analyzed descriptively quantitatively with percent values, while the interview and observation data were described qualitatively.

RESULTS AND DISCUSSION
Results
Challenges Faced by Students in Biology Learning
Table 1. Challenges Faced by Students in Learning Biology

No.	Challenges	Percentage
1	Difficulty in remembering scientific terminology in biology lessons	54.8%
2	Insufficient preparation for learning before class	26.2%
3	Limited awareness of environmental biological issues	
4	Difficulty in time management between study and other activities	26.2%
5	Lack of focus during biology study	23.8%
6	Struggles in comprehending concepts related to biology content	19.0%
7	Non-conducive learning environment	14.3%
8	Inadequate study facilities at my disposal	11.9%

Challenges frequently expressed by learners include (1) Difficulty in remembering scientific terminology in biology lessons (54.8%); (2) Insufficient preparation for learning before class (26.2%); (3) Limited awareness of environmental biological issues (26.2%); (4) Difficulty in time management between study and other activities

(26.2%); (5) Lack of focus during biology study (23.8%); and (6) Struggles in comprehending concepts related to biology content (19%). Other challenges, reported by less than 15% of the learners, include: (1) The learning environment is not conducive (14.3%) and (2) Inadequate study facilities at my disposal (11.9%).

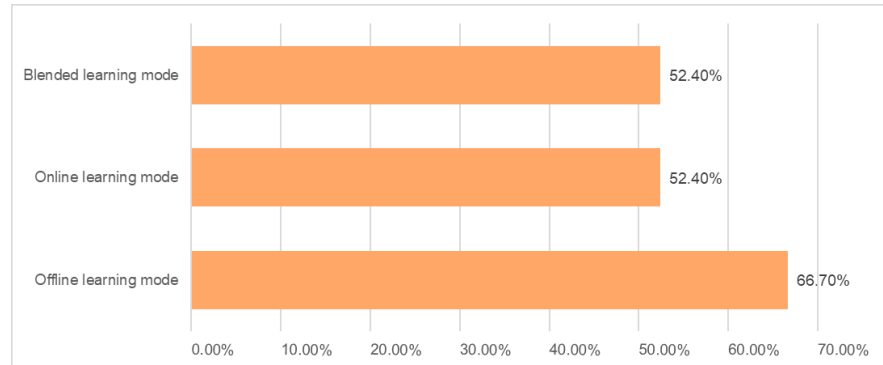*Modes of Biology Learning Previously Undertaken by Students at School*

Figure 1. Survey Results on the Modes of Biology Learning Previously Undertaken by the Participants in School

Figure 1 indicates that 28 students (66.7%) find face-to-face learning at school enjoyable. This suggests that this mode remains the primary choice for many students in studying biology. This mode involves biology education conducted in a physical classroom setting. Furthermore, 22 students (52.4%) expressed their preference for online learning at school, indicating its popularity and student interest, especially in the post-COVID-19 era. Hybrid learning, which combines both in-person and online modes, allowing students to choose the learning approach that suits their needs and situations, is depicted in Figure 1. The figure shows that 22 students (52.4%) appreciate the hybrid learning mode that has been implemented at school. Hybrid learning provides flexibility and variation for students in their biology learning journey. The majority of students (59.5%) do not have a specific monthly budget allocation for purchasing internet data plans. Students who do not have a dedicated allocation for internet data plans typically relied on the following sources for internet access during previous online learning:
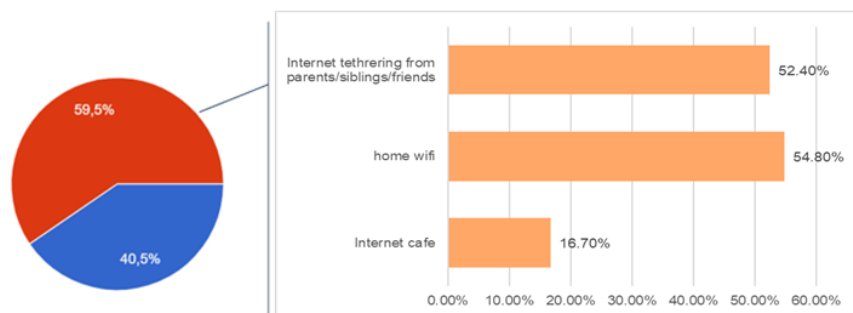

Figure 2. Sources of Internet Access Utilized by Students for Learning

Figure 2 illustrates that more than half of the students (54.8%) rely on home Wi-Fi connections as their primary source of internet access for daily learning. This indicates that the majority of students depend on Wi-Fi networks within their home environments to access online learning materials. Approximately half of the students (52.4%) utilize 'tethered' internet connections from mobile devices belonging to parents, siblings, or friends as their source of internet access for online learning. This suggests that students often rely on internet connections from family or friends' mobile devices. Only a tiny fraction of students (16.7%) use internet cafes (cyber cafes) as their source of internet access for online learning. This factor highlights that the use

of public facilities like internet cafes in online learning is less common, and most students prefer more personal internet sources. The Learning Management Systems (LMS) used in online or hybrid learning are indicated in Figure 3.
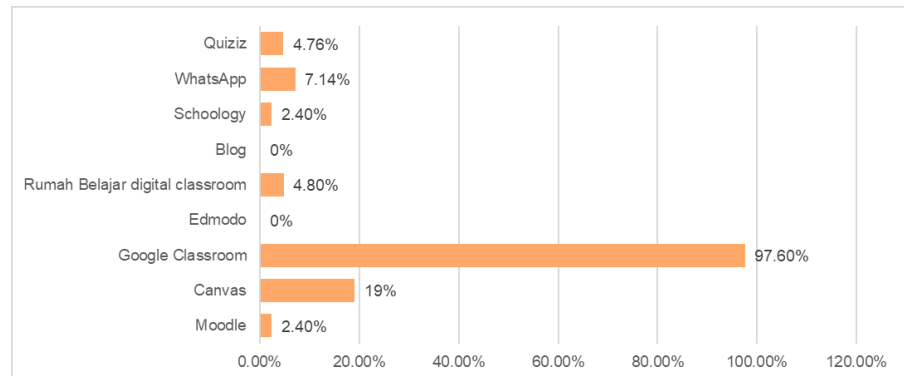

Figure 3. Survey Results of Learning Management Systems (LMS) Previously Utilizedin Online or Hybrid Learning

Google Classroom is an online learning platform that enables teachers and students to interact, share materials, complete assignments, and provide feedback. Figure 3 shows that 41.97% of individuals prefer using this Learning Management System (LMS) for online or hybrid learning. This indicates the high popularity and extensive use of this LMS, particularly in the post-COVID-19 era. Canvas is an online learning platform that offers various features and functions to support learning, such as calendars, announcements, discussions, quizzes, reports, and more. Research results reveal that 19% of individuals favor using this LMS for online or hybrid learning. This suggests that Canvas is quite popular and trusted, especially in the higher education sector. *Rumah Belajar* Digital Classroom is an online learning platform developed by the Ministry of Education and Culture of Indonesia. This LMS provides various learning content, including videos, animations, simulations, exercises, and more. The chart indicates that 9.52% of individuals enjoy using this LMS for online or hybrid learning, showcasing its potential and benefits, particularly in primary and secondary schools. WhatsApp is an instant messaging application that can be used for communication, file sharing, and voice or video calls. Figure 3 demonstrates that 8.33% of individuals have used this LMS for online or hybrid learning, highlighting it as a choice for those seeking convenience and speed in communication. Figure 1 also illustrates the percentage of individuals who have used other LMS in online or hybrid learning, such as Moodle (7.14%), Quizzes (3.57%), Google Forms (2.38%), Zoom (1.19%), and Edmodo (0%). This indicates the existence of various LMS variations and preferences used by individuals according to their needs and situations.

Support for Technology-Based Biology Learning Facilities
All students indicated that they have utilized projectors/LCDs in the learning process. The majority of students (95.2%) stated that there is internet access available at school. However, 59.5% of students reported unstable internet signals. 95.2% of students expressed that mobile devices/gadgets can facilitate the learning process. The types of gadgets that facilitate the learning process, according to students, are as follows:
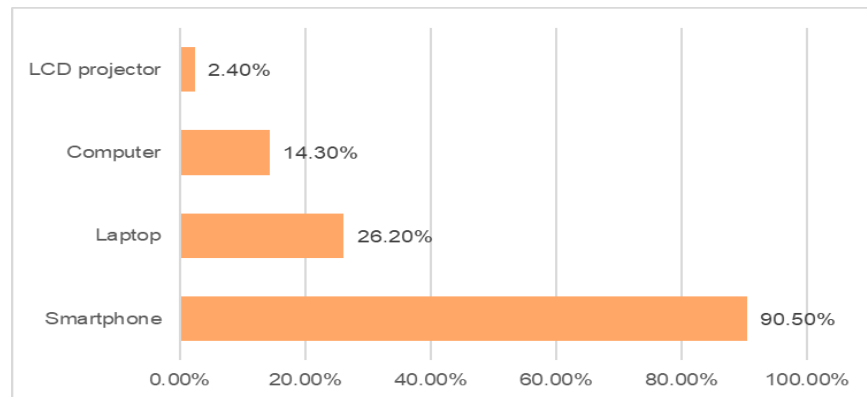
Figure 4. Learning Support Devices in Biology Used by Students

Figure 4 depicts the types of devices that facilitate the learning process according to students. Smartphones are the most commonly used devices among students, with 38 individuals, or 90.5% of the total students, utilizing smartphones to support their learning process. Smartphones can be employed to access the internet, social media, educational applications, and more. Laptops are the second most frequently used devices by students, with 11 individuals, or 26.2% of the total students, using laptops to aid their learning process. Laptops can be utilized for typing, creating presentations, video editing, and other purposes.

Challenges Faced by Students Based on the Implemented Learning Modes
Table 2 below shows various obstacles experienced by students in offline and online learning.

Table 2. Obstacles experienced by students in offline and online learning

Online Learning	Offline Learning
1. Internet signal; 2. internet quota; 3. The material explained online by the teacher is not clear; 4. The material is not well delivered; 5. There is no practice/practicum; 6. The existence of terms that are difficult to understand; 7. Smartphone storage/memory is full.	1. Classes that are less conducive so that learning focus is disrupted; 2. Learners lack understanding of the teacher's explanation; 3. The existence of terms that are difficult to understand; 4. The teacher's explanation was too fast; 5. The material explained by the teacher and the question material are different.

DISCUSSION
Challenges Faced by Students in Biology Learning
Students encounter various challenges in biology learning, encompassing several aspects. These challenges include difficulties in recalling scientific terminology, lack of preparation before class, limited engagement with biological issues in their surroundings, struggles with time management, lack of focus during learning, and challenges in understanding concepts related to biology materials. Additionally, some students also face challenges related to the conduciveness of the learning environment and the availability of learning facilities.

Prior research has indicated the importance of active and interactive learning strategies in addressing difficulties related to recalling scientific terms and comprehending concepts (Apodaca *et al.*, 2019; Lufri *et al.*, 2020; Mazowiecki-Kocyk, 2021). Cognitive theories, such as dual coding theory and cognitive load theory (Kusumawati and Rachmawati, 2017; Schnotz and Kürschner, 2007; Zhao and Hu, 2021), can provide insights into optimizing the teaching of biology materials. Furthermore, previous research on time management, motivation, and learning effectiveness has offered various approaches that can be applied to assist students in overcoming

challenges related to time, focus, and prior preparation (Stark, 2019).

Difficulties in recalling scientific terms and understanding concepts can hinder the effectiveness of learning (Pitaloka and Suyanto, 2019; Ristanto *et al.*, 2019). Teachers need to employ strategies that help students better understand the material and retain it in the long term. Students' inability to prepare themselves before class underscores the significance of metacognitive education and learning planning skills (Antika, 2020; Mahande *et al.*, 2021; Ristanto *et al.*, 2019; Yulia S. Belenkova, 2021). Students need guidance in developing these skills. The limited engagement with biological issues in their surroundings indicates the need to integrate everyday life contexts into biology learning. Contextual learning can make the learning process more relevant and motivating for students (Das and TSB, 2023; Heald *et al.*, 2023; Vermunt *et al.*, 2023). Challenges in time management and maintaining focus are critical aspects of learning success. Students need assistance in developing time management and concentration skills. A less conducive environment and limited facilities can affect the comfort and efficiency of learning (Elmehdi and Tato, 2023; Gad Al Rab Abdo Madkour, 2020; Ijadunola *et al.*, 2019). Schools and educators should pay attention to these aspects to create a better learning environment.

Modes of Biology Learning Experienced by Students in School

The survey results indicate that the majority of students (66.7%) opted for the face-to-face mode of learning, involving classroom-based learning using textbooks, teaching aids, or experiments. This aligns with the preference of many students for in-person learning, which facilitates direct interaction with teachers and peers. Constructivism theory emphasizes the importance of social interaction in learning (Detel, 2015). Face-to-face learning provides opportunities for direct interaction with teachers and peers, which can enhance students' understanding and engagement (Butts *et al.*, 2013; Huong, 2022; Simić *et al.*, 2022).

Approximately 52.4% of students chose the online learning mode, involving online learning using the internet, applications, videos, or social media. This reflects the popularity of online learning, especially during the COVID-19 pandemic, when online learning became a pressing need. Online learning theories emphasize flexibility and accessibility in online learning (Budi Harijanto *et al.*, 2021; Mulyatiningsih *et al.*, 2023). Students can access materials anytime and anywhere, which can enhance their engagement (Indrawan, Pramana, *et al.*, 2019; Mulyatiningsih *et al.*, 2023).

52.4% of students also opted for the blended learning mode, combining face-to-face and online learning. This provides flexibility for students to choose the learning method that suits their needs and situations. Blended learning theories highlight the benefits of integrating face-to-face and online learning (Ariawan *et al.*, 2022; Indrawan, Saskara, *et al.*, 2019; Mahande *et al.*, 2021; Purwasih *et al.*, 2021). This can maximize the advantages of both approaches, such as social interaction in face-to-face learning and flexibility in online learning (Mazowiecki-Kocyk, 2021; Purwasih *et al.*, 2021; Sharma and Sarkar, 2020).

The survey results also include the percentage of the use of various Learning Management Systems (LMS) in online or blended learning. Most students have used Google Classroom, indicating its popularity in the context of online learning. LMS effectiveness theories emphasize user-friendliness, interactivity, and accessibility (Cheng *et al.*, 2022; Rahayu *et al.*, 2022; Toring *et al.*, 2023). Google Classroom has proven to meet these needs, explaining its popularity among students.

Understanding students' preferences for learning modes and LMS can help schools and educators design more suitable learning strategies for students. In the context of the post pandemic and the "Kurikulum Merdeka," this research can provide a foundation for developing learning strategies that combine the advantages of face-to-face and online learning modes. Facilities and accessibility of LMSs need to be improved so that more students can easily access them, especially those in environments with unstable internet signals.

Support for *Technology-Based Biology Learning Facilities*

The research findings on technology-based biology learning facility support provide essential insights into the infrastructure and devices used by students in the learning process. The significance of using projectors/LCDs in the learning process is a positive

step, indicating the integration of technology in school education. The research results show that 95.2% of students believe that devices/gadgets can facilitate the learning process, emphasizing the importance of personal devices in their learning, such as smartphones, laptops, and computers. Ninety point five percent of students utilize smartphones as part of their learning process, particularly for sourcing information. Smartphones are versatile tools that allow students to access the internet, engage with social media, use educational applications, and more (Alkhalifa and Alghazo, 2018; González *et al.*, 2015; Han, 2022).

The fact that the majority of students (95.2%) state that the availability of internet networks in schools is a positive indication of supporting technology-based learning. However, the issue of unstable internet signals (59.5%) is a barrier that needs attention. Some classrooms cannot access WIFI signals because WIFI sources are only available at specific points. The success of online learning greatly depends on consistent internet signal availability (Al-Ahmad *et al.*, n.d.; Dambanemuya and Horvát, 2021; Indrawan *et al.*, 2022; Suwardika *et al.*, 2023). Schools need to address the issue of unstable internet signals to ensure the continuity of online learning.

Furthermore, in the context of students' daily lives, particularly outside of school, the fact that the majority of students (59.5%) do not have a specific monthly budget allocation for purchasing internet data indicates that financing online learning is still a concern. Students outside of school obtain internet access from home WIFI, tethering from parents/siblings/friends, and internet cafes, illustrating the various ways in which students access the internet. This indicates students' efforts to secure internet access for learning purposes.

The results of this research provide an in-depth understanding of the role of technology in biology learning, the available resources, and the barriers that need to be addressed to ensure effective technology-based education. This underscores the importance of improving digital infrastructure and providing appropriate support to students in facing the challenges of online learning. In recent studies, technology needs that support technology-based learning such as AR, VR, and AI (Ciloglu and Ustun, 2023; Hassoun *et al.*, 2022).

Challenges Faced by Students Based on the Learning Mode Implemented

First, we will discuss the challenges of online learning experienced by students. Constraints in internet access are the major issues that students face when participating in online learning. Limitations in internet signal and data quotas can hinder their access to learning materials. Digital literacy theory emphasizes the importance of adequate internet access in online learning (Alt and Raichel, 2020; Tomczyk, 2020). These constraints indicate the need for better digital infrastructure investments. They reflect the importance of delivering content more clearly and understandably. Students require clear instructions to understand concepts. Practical learning theory emphasizes clear communication in content delivery (Kang *et al.*, 2022; Wagner *et al.*, 2024).

Further support, such as structured instructional videos, can help address this issue. Biology learning that lacks practical or laboratory components can reduce the understanding of concepts that should be gained through direct experience. Constructivist learning theory emphasizes the importance of practical experience in biology learning (Detel, 2015; Mills *et al.*, 2006; Pande and Bharathi, 2020). Adaptation of teaching methods is required to facilitate practical experiences in the online environment. Difficulty in understanding scientific terms and limitations in personal device storage space indicate the need for the development of online dictionaries and efficient memory management. Constructivist theory emphasizes the development of understanding through the use of scientific terms in relevant contexts (Detel, 2015; Pande and Bharathi, 2020). Well-structured dictionaries and memory management can support this understanding.

Second, let's discuss the challenges in the face-to-face learning mode experienced by students. Difficulty in focusing due to a lack of conducive classroom environments is a common issue for students in online learning. Learning must supports concentration and focus (Dai *et al.*, 2023; Liu *et al.*, 2023; Schaffir *et al.*, 2023; Schweder and Raufelder, 2024). Teachers need to create a conducive online learning environment. Difficulty in understanding teacher explanations is a frequent obstacle. Students

require more precise and more in-depth explanations. Practical communication theory emphasizes the importance of delivering understandable messages (Allam *et al.*, 2023; Nurani *et al.*, 2020). Teachers need to adapt how they deliver content in the online context. Difficulty in understanding challenging scientific terms is a similar challenge encountered in face-to-face learning. Constructivist theory emphasizes the understanding of scientific terms through practical use in relevant contexts (Detel, 2015; Larrinaga, 2021; Mills *et al.*, 2006). A similar approach to face-to-face learning can be applied. Teacher explanations that do not align with students' comprehension levels are a significant obstacle affecting the effectiveness of learning. Learning theory emphasizes the importance of adjusting the delivery speed to students' understanding levels (Schunk, 2012). Teachers need to provide opportunities for students to follow and ask questions.

Other research shows similar data, where obstacles in online learning for students include connectivity, e-learning system support, technological problems, and self-regulation (Aini *et al.*, 2020). Meanwhile, face-to-face learning has constraints related to the learning environment which causes limited interaction, limited time, class management, and not all students get feedback on their learning performance (Adiyono, 2021).

CONCLUSION

The findings of this research illustrate the various challenges that students face in biology learning. They encounter difficulties in recalling scientific terminology, a lack of preparation before class, and limited engagement with everyday biological issues. Additionally, students struggle with time management, maintaining focus during learning, and comprehending biology concepts. In terms of learning modes, face-to-face learning is preferred, but online learning has also become a popular choice, especially during the pandemic, with some students opting for a combination of both. The widespread use of Learning Management Systems (LMS), primarily using Google Classroom, emphasizes the importance of flexibility in teaching methods.

Regarding technology-based learning facilities, most students have access to projectors/LCDs and internet networks at school, although the significant obstacle is unstable internet signals. Gadgets, especially smartphones, dominate in supporting learning, although many students do not have a specific budget allocation for internet data and rely on sources such as home Wi-Fi, tethering from their parents' or relatives' devices, or internet cafes. To address the challenges in learning modes, such as difficulties in maintaining focus, classroom conduciveness, and understanding scientific terminology, there is a need for the development of more effective teaching strategies. Reliable internet access and sufficient data quotas are also crucial factors in overcoming these challenges. Furthermore, the delivery of content needs to be more straightforward, and teachers should adapt their explanations to ensure better understanding. The results of this research have practical value in developing more effective biology learning strategies in the era of pandemics and the implementation of the Independent Curriculum (Kurikulum Merdeka).

The implications of this research are highly relevant in the development of more effective biology learning strategies, especially in facing post-pandemic learning challenges and within the context of implementing the Independent Curriculum. Teachers need to adopt more interactive teaching strategies, involve students in practical experiences, and select teaching methods that are more flexible and adaptive to meet various student preferences.

Limitations of this research include the small sample size of students (43 students) and biology teachers (3 teachers), which may be too small to generalize the research findings to a larger population. The research could be more beneficial with a larger sample size. This study focused on the students' learning experiences and internal school aspects. External factors such as social influence, family environment, or broader educational policy changes may also play a significant role in the biology learning experience.

Future research could involve a more significant number of students and biology teachers. With a larger sample size, the research findings would be more representative

and provide deeper insights into the challenges in biology learning in various contexts. A more comprehensive study should consider external factors that can influence the biology learning experience. This could include social influences, family environments, or broader educational policy changes. Interdisciplinary studies involving experts in psychology, sociology, and education policy could provide a more holistic perspective. Additionally, the findings in this research could serve as the basis for developing more effective learning models for high school students, particularly at SMAN 3 Singaraja.

ACKNOWLEDGEMENTS

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