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Online Blended Learning Model to Improve Learning Independence and Learning Outcomes of High School Students

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Abstract: *The shift to online learning during the COVID-19 pandemic has challenged students' ability to learn independently, highlighting the need for effective teaching models to support both autonomy and achievement. This study aims to evaluate the effectiveness of a blended learning model in improving learning independence and chemistry learning outcomes among XI-grade science students at SMA Zion. A classroom action research (CAR) design was employed over two cycles, each comprising planning, action, observation, and reflection phases. The intervention integrated synchronous (real-time online) and asynchronous (independent) learning activities. Thirty-four students participated. Learning independence was measured using a questionnaire, and learning outcomes were assessed through multiple-choice tests on hydrocarbon compounds. In Cycle I, students exhibited low learning independence (57.71%) and achievement (29.41% reached the minimum completion standard). Following targeted improvements such as learning journals, motivational strategies, and instructional videos in Cycle II, both indicators improved markedly: learning independence rose to 76.94%, and 82.35% of students met the minimum standard. The findings demonstrate that the blended learning model significantly enhances both learning independence and academic achievement, emphasizing the importance of innovative, adaptable pedagogical strategies in online education settings.*

Keywords: *blended learning; learning independence; learning outcomes; online learning*

INTRODUCTION

The current implementation of the 2013 curriculum refers to improving student learning outcomes, which include aspects of knowledge, attitude, and skills (Fadilah, 2021). During the learning process, we expect one aspect of attitude to improve: independence. According to the Big Indonesian Dictionary (KBBI), independence is defined as a state of being able to stand alone or not depend on other people. In other words, independence is a readiness and ability that a person has. An independent attitude can be applied in many ways, one of which is independent learning (self-regulated learning), which must be possessed by students to become active learners (Fadilah,

2021; Hidayat et al., 2020; Rahmawati & Alaydrus, 2021; Trisnawati, 2018; Wahyudi et al., 2022).

Aini, (2021) believe that learning independence is a drive from within a person to carry out and be responsible for learning activities. Learning independence arises due to limitations and demands to achieve learning goals (Fadilah, 2021; Fitriani & Rahimah, 2021; Pasaribu, 2021). Independent learning does not have to be done individually; it is a process that requires students to be able to determine, manage, and utilize learning resources independently. Wahyudi et al., (2022) formulated six indicators of learning independence, namely: (1) not depending on other people, (2) self-confidence, (3) discipline, (4) responsibility, (5) own initiative, and (6) self-control.

The emergence of the COVID-19 pandemic requires people to be able to search for various information or learn independently, which has been widely done through online learning (Apsari & Lestari, 2023; Hikmah & Chudzaifah, 2020; Kusumasari et al., 2022). Student learning independence is very necessary so that the learning process remains productive and of high quality. If students have been able to learn independently, then students will try to learn optimally without any dependence on others, such as only being able to learn if explained directly by the teacher, having to be reminded by parents, or seeing their friends' work when doing learning assignments. In the end, students will have fundamental knowledge that they can use in a variety of future situations or develop into lifelong learners. This is in line with the results of research conducted by Gumilar & Hermawan, (2021), which states that individuals who actively learn can determine and manage learning activities and learning strategies are individuals who have high learning independence. Furthermore, research conducted by Loka et al., (2024) concluded that learning independence has a positive during the COVID-19 pandemic requires students to learn independently to address the deficiencies encountered in their education (Jabnabillah & Margina, 2022; Mutaqinah & Hidayatullah, 2020; Rofingah, 2021).

One cause of low learning independence among students, including those at SMA Zion, is the learning system that does not yet require them to actively seek the information they need for their learning process. Changing students' learning habits from a pattern of receiving explanations of lesson materials from teachers to active, independent learning is still very difficult. However, Nurhamidah et al., (2022) said that to support students' efforts to adapt to their learning context, environmental changes are needed. One of them is the application of learning that requires students to actively seek their own learning materials. According to research conducted by Syelitiar & Putra, (2021), the blended learning model is effective in increasing student learning independence and is an alternative learning method that can be applied during the COVID-19 pandemic (Aini, 2021; Hidayat et al., 2020; Husni & Nasution, 2023; Islamy et al., 2022; Loka et al., 2024). This model can be used by teachers in learning activities to create a new learning atmosphere.

Blended learning is learning that combines face-to-face (conventional) learning with online learning (Febriani & Azizah, 2021; Fitria et al., 2023; Fitriani & Rahimah, 2021; Sugita & Muchlis, 2022). In online learning sessions, students are facilitated to be able to learn and repeat the material independently using online learning materials and resources, while other parts of the session are done face-to-face. By dividing two learning activities, namely synchronous learning and asynchronous learning, we can also apply the blended learning model to online learning (Damanik et al., 2024; Ginting & Purba, 2024; Hafiza et al., 2022; Maesaroh & Sutrisno, 2024; Yunsyahana et al., 2022). Blended learning is widely applied in learning activities in schools because it is considered capable of facilitating the speed and learning needs of diverse students (Febriani & Azizah, 2021; Haka et al., 2020; Ismaniati et al., 2015;

Tua et al., 2021). The asynchronous learning system used in the blended learning model allows students to explore more teaching materials and gain independent learning experiences (Ayuningsih et al., 2025; Azah & Abror, 2023; Nurhamidah et al., 2022; Sudana, 2021).

The flipped class is one of the class models that can be applied in blended learning. In flipped class learning, the typical learning cycle is reversed compared to conventional learning. During asynchronous classes, students will learn independently from learning materials sent by teachers or various learning resources on the internet. One of the class models applicable to blended learning is the flipped class. In flipped class learning, the typical learning cycle is reversed compared to conventional learning. During asynchronous classes, students learn independently using the learning materials provided by the teacher or various online resources.

In synchronous classes, students begin working on and completing their assignments, and they have the opportunity to seek help through class discussion activities. This flipped class was chosen for online chemistry learning in class XI IPA Alps SMA Zion, with the consideration that learning is more focused on face-to-face learning sessions (synchronous). Several other characteristics that are considered are learning facilities, availability of access to technology, and students' learning abilities and independence. The implementation of blended learning is carried out as an effort to improve students' learning independence and chemistry learning outcomes.

METHODS

This study used a classroom action research (CAR) approach, aiming to improve student learning independence and learning outcomes in chemistry during the COVID-19 pandemic. The research was conducted in two cycles, each consisting of the stages of planning, action, observation, and reflection.

Participants

The subjects were 34 students of Class XI IPA Alps at SMA Zion in the 2021/2022 academic year.

Research Design

The classroom action research (CAR) model was adopted, involving iterative cycles as proposed by Kemmis and McTaggart. Each cycle included:

- Planning: Developing blended learning lesson plans, preparing materials (videos, documents, online resources), and determining assessment strategies.
- Action: Implementing the blended learning model, combining asynchronous (independent learning) and synchronous (online face-to-face) activities.
- Observation: Collecting data using learning independence questionnaires and multiple-choice tests for learning outcomes, as well as observing classroom activities.
- Reflection: Analyzing results from each cycle to inform improvements in subsequent cycles.

Data Collection Instruments

- Learning Independence Questionnaire: Based on indicators developed by Hidayati & Listyani, (2010), using a Likert scale.
- Learning Outcome Test: 20 multiple-choice questions on hydrocarbon compounds, assessed against the Minimum Completion Standard (KKM) of 75.

Data Analysis

Descriptive statistical analysis was used to calculate percentages of learning independence and completeness of learning outcomes. The effectiveness of interventions was tested using a paired t-test to compare results between cycles.

Descriptive statistical analysis was employed to determine the percentage of learning independence and the completeness of student learning outcomes. These metrics

served as benchmarks for evaluating success, with a minimum target of 75% for both indicators. The gain score was calculated to assess the improvement from Cycle I to Cycle II. For significance testing, a paired t-test was utilized, or a Wilcoxon test for non-normal distributions, to evaluate whether observed improvements were statistically significant ($p < 0.05$). These analyses ensured a robust evaluation of both learning independence and outcomes.

Gain Score Calculation Method

To analyze the increase in students' learning independence, we used the gain score method, which quantifies the improvement from Cycle I to Cycle II.

The gain score is calculated as follows:

$$Gain\ Score = \bar{X}_{cycle\ II} - \bar{X}_{cycle\ I}$$

Where:

- $\bar{X}_{cycle\ II}$ = Average (mean) score of students' learning independence or learning outcomes in Cycle II.
- $\bar{X}_{cycle\ I}$ = Average (mean) score of students' learning independence or learning outcomes in Cycle I.

Interpretation

A positive gain score indicates an improvement in student learning independence or learning outcomes between cycles. The larger the value, the greater the improvement.

Hypothesis

This study was based on the conceptual assumption that a blended learning model combining asynchronous and synchronous learning would enhance students' independence and learning outcomes. Specifically, we expected that increased opportunities for self-regulated and interactive learning would foster both autonomy and academic achievement in students. Based on this assumption, the research hypothesis was: "The implementation of a blended learning model significantly improves learning independence and outcomes among high school students." Statistically, this is formulated as:

- H_0: There is no significant difference in learning independence and outcomes between Cycle I and Cycle II.
- H_a: There is a significant difference in learning independence and outcomes between Cycle I and Cycle II.

RESULT AND DISCUSSION

RESULTS

This research lasted for two cycles, each consisting of four stages. Cycle I lasted twice of learning for each asynchronous class and synchronous class, and one meeting for the final test of the cycle. Cycle II, at the action stage, also lasted twice as Cycle I and had one meeting for the final test of the cycle.

Student Learning Independence

Student learning independence was obtained through a learning independence questionnaire given at the end of each cycle. As shown in Table 1, the percentage of student learning independence for each indicator in Cycle I is presented in detail. For example, the 'Not dependent on others' indicator was only 51.18%, indicating that more than half of the students still relied on external help. This low percentage highlights the challenge faced by students in adapting to independent learning.

Table 1. Percentage of Student Learning Independence by Indicator in Cycle I (n=34, Class XI IPA Alps SMA Zion)

Aspect	Percentage
Not dependent on others	51.18%
Have self-confidence	60.00%
Behave in a disciplined manner	60.59%
Responsibility	57.45%
Behave on your own initiative	61.18%
Exercising self-control	55.88%
Average	57.71%

Improvements in the implementation of learning have a positive impact on students' learning independence. Table 2 summarizes the improvement in each indicator of learning independence in Cycle II. Notably, the indicator 'Behave in a disciplined manner' rose from 60.59% in Cycle I to 80.20% in Cycle II, reflecting the positive impact of introducing learning journals and group discussions. Each aspect such as 'self-

confidence' and 'own initiative' also surpassed the minimum threshold, emphasizing the effectiveness of the implemented interventions.

Table 2. Percentage of Student Learning Independence by Indicator in Cycle II (n=34, Class XI IPA Alps SMA Zion)

Aspect	Percentage
Not dependent on others	79.26%
Have self-confidence	77.06%
Behave in a disciplined manner	80.20%
Responsibility	73.73%
Behave on your own initiative	75.29%
Exercising self-control	76.08%
Average	76.94%

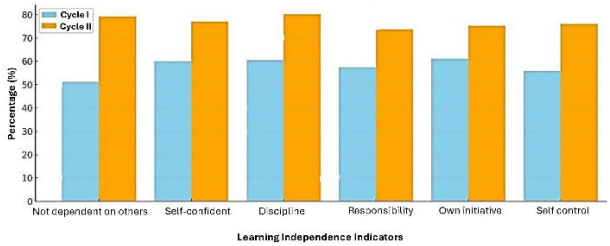

Figure 1. Comparison of Student Learning Independence by Each Indicator between Cycle I and Cycle II in Class XI IPA Alps SMA Zion

Learning Outcomes

The results of evaluation tests at the end of each cycle serve as the variable for student learning outcomes. The criteria used are the Minimum Completion Standard (KKM) for chemistry subjects used in SMA Zion, which is 75. We declare students incomplete if their scores fall below the KKM.

Table 3. Distribution of Student Learning Outcome Completion in Cycle I Based on KKM 75 (n=34, Class XI IPA Alps SMA Zion)

Score Range	Completion Category	Number of Students (n)	Percentage of Respondents (%)
75–100	Completed	10	29.41%
<75	Not Completed	24	70.59%
	Total	34	100%

As shown in Table 3, out of 34 respondents (n=34), only 10 students (29.41%) achieved scores within the completion category (≥75), whereas 24 students (70.59%) did not. In Cycle II (Table 4), 28 students (82.35%) reached completion, demonstrating significant improvement.

Table 4. Distribution of Student Learning Outcome Completion in Cycle II Based on KKM 75 (n=34, Class XI IPA Alps SMA Zion)

Score Range	Completion Category	Number of Students (n)	Percentage of Respondents (%)
75–100	Completed	28	82.35%
<75	Not Completed	6	17.65%
	Total	34	100%

This table shows the marked improvement in student achievement after the implementation of revised blended learning strategies, with 28 students achieving the minimum standard.

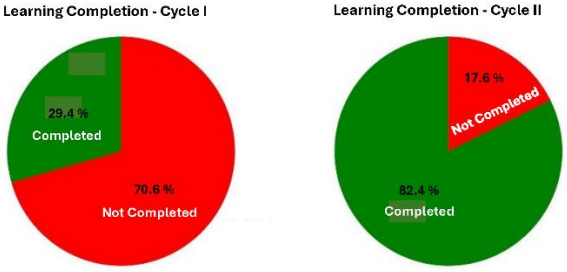

Figure 2. Comparison of Percentage of Students Achieving Learning Outcome Completion (KKM 75) between Cycle I and Cycle II in Class XI IPA Alps SMA Zion

DISCUSSIONS

Student Learning Independence

The results of the learning independence test showed a paired t-test for normal distribution, with a t-statistic of -9.65 and a p-value of 0.0002 (<0.05), which means there was a significant increase in the average learning independence from Cycle I to Cycle II. The Wilcoxon test for non-normal distribution shows a W-statistic of 0.0 and a p-value of 0.0312 (<0.05), indicating that the results support the paired t-test, which found that the increase in learning independence is statistically significant.

Based on Table 1, it can be concluded that students' learning independence is still

low in all aspects. The data shows that students still find it difficult to change their learning paradigm, which assumes that learning can only be done together with a teacher, as happens in conventional learning. It appears that the absence of direct guidance and learning control from teachers during asynchronous classes has an impact on a low sense of responsibility, and students do not exercise self-control in learning. The results of observations of synchronous class activities illustrate that most students tend to be passive, so that learning is still dominated by teachers. These results indicate that online learning with the blended learning model in class XI IPA Alps SMA Zion still requires corrective action in the next cycle II learning.

Several corrective actions carried out in cycle II as a result of the reflection stage of cycle I are as follows: (1) Students make a journal of learning activities during asynchronous classes as a learning control and to monitor learning activities; (2) students are motivated to be more active in learning in both asynchronous and synchronous classes; (3) learning resources provided are supplemented with videos explaining the material by the teacher; (4) synchronous class learning is carried out using question and answer techniques at the beginning of learning, then continued with small group discussions while completing learning tasks.

Table 2 shows that all aspects of students' learning independence in cycle II have reached the minimum standard determined with an average above 75%, namely 76.94%. There was an increase in the average learning independence of students from cycle I to cycle II by 19.22%. These results suggest that the blended learning model can enhance students' learning independence during the online learning process. By "forcing" students to learn without a teacher during asynchronous classes, the blended learning model accustoms them to adjust and manage their own time, place, speed, and learning style. In addition to the additional learning resources provided, the blended learning model also gives students the freedom to access learning materials in various forms and learning platforms available on the internet. These factors contribute to the increased learning independence of Class XI IPA Alps SMA Zion students. These results are in line with research conducted by(Kurniawan & Safri, 2019), which concluded that the blended learning model can increase students' learning independence.

Figure 1 shows that all indicators increased in Cycle II. Regarding the indicator of independence, Cycle I recorded a score of 51.18%, categorized as low, which increased to 79.26% in Cycle II, categorized as high. This indicates that students become more independent in learning without relying on others after improvements in learning in Cycle II. Then the self-confidence indicator in Cycle I increased by 60.00% to 77.06%, where improvements in blended learning increased students' confidence in their abilities. In the discipline indicator, Cycle I obtained 60.59% and increased in Cycle II by 80.20%; this shows that increased discipline reflects the effectiveness of learning strategies that encourage learning time management. The responsibility indicator, which obtained 57.45% in Cycle I, increased to 73.73% in Cycle II, where responsibility increased along with students' habituation of recording learning activities through journals and reflections.

Figure 1 provides a clear visual comparison between Cycle I and Cycle II for each learning independence indicator. The bar representing ‘Exercising self-control’ demonstrates the most significant improvement, rising from 55.88% in Cycle I to 76.08% in Cycle II. This upward trend across all indicators visually reinforces the statistical findings and confirms the success of the corrective actions. All indicators of learning independence showed a significant increase, with the average overall independence increasing from 57.71% in Cycle I to 76.94% in Cycle II. This shows that the blended learning model consistently improves learning independence through a

combination of asynchronous and synchronous sessions.

Asynchronous learning enables students to study independently, without direct teacher supervision. They can access materials at any time and manage their own schedules and learning methods. In the first cycle, students' average learning independence was only 57.71%, suggesting a continued reliance on teachers. Low motivation and self-control during asynchronous sessions contributed to this result.

Conversely, synchronous learning, where students interact directly with teachers and peers, improves engagement and provides essential social support. During these sessions, students are more active in discussions, ask questions, and complete assignments together. After implementing improvement strategies in the second cycle, learning independence increased to 76.94%. Activities such as small group discussions proved highly effective in fostering initiative, self-control, and a stronger sense of responsibility.

Yuliati & Saputra, (2020) also agree with this study that asynchronous activities tend to be less popular with students when compared to face-to-face sessions. Their research found that students involved in synchronous learning were better able to manage their learning time and were more motivated to explore the material independently. This conclusion is in line with research findings that show that the combination of asynchronous learning supported by synchronous sessions provides a more balanced experience to enhance learning independence.

Learning Outcomes

Referring to Table 4, it can be seen that the number of students achieving learning completion (scores ≥ 75) rose to 82.35% in Cycle II, a substantial improvement from 29.41% in Cycle I as shown in Table 3. This substantial increase directly reflects the effectiveness of added instructional resources and more active synchronous learning sessions. This result is in line with the research conducted by Sjukur, (2012), which concluded that there was an increase in student learning outcomes due to the implementation of blended learning. Meanwhile, the results of research conducted by Juliati et al., (2022) found that there was a positive influence of learning independence on learning outcomes, so the increase in student learning outcomes obtained in this study can also be said to be the influence of student learning independence that has increased. In addition to increased learning independence and student learning outcomes, in general, students can also follow the blended learning model in Cycle II well, so it can be concluded that the research success indicators have been achieved.

Figure II shows that only 29.41% achieved learning completion in Cycle I, while in Cycle II, learning completion increased significantly to 82.35%. It can be seen that in Cycle I, there were 10 students who completed learning, and 24 other students did not complete it. The majority of students have not achieved a score of ≥ KKM (75). This evidence shows that the initial learning strategy is still not effective enough. Cycle II revealed that 28 students (82.35%) successfully completed their learning, while 6 students (17.65%) did not. After improving learning, most students managed to achieve learning completion. The increase in the percentage of learning completion from 29.41% in Cycle I to 82.35% in Cycle II shows the effectiveness of improving blended learning, such as adding learning resources in the form of videos, getting used to group discussions in synchronous sessions, and using learning journals for self-control. Therefore, the improved learning strategy has a significant impact on student learning completion, with an increase of 52.94% from Cycle I to Cycle II.

The results of the gain score calculation demonstrate a marked improvement in students' learning independence after the implementation of the

blended learning model, with the gain score reaching 19.23 percentage points (from 57.71% in Cycle I to 76.94% in Cycle II). This improvement indicates that the strategies applied in Cycle II such as the introduction of learning journals for self-monitoring, increased teacher motivation, and the use of instructional videos were effective in fostering greater autonomy among students. These findings are in line with previous research that highlights the ability of blended learning models to promote student independence and adaptability in learning environments where direct teacher supervision is reduced (Ayuningsih et al., 2025; Kurniawan & Safri, 2019).

The increase in gain score further reflects how the blended learning approach, which combines asynchronous and synchronous activities, allows students to develop self-regulation, discipline, and initiative, key components of learning independence as described by Wahyudi et al., (2022). As students engage more actively in asynchronous sessions, they learn to manage their own time and resources, which directly contributes to their overall independence (Azah & Abror, 2023; Nurhamidah et al., 2022). Additionally, the statistically significant results ($p < 0.05$) support the conclusion that these improvements are not due to chance but rather to the structured interventions provided during the study.

This evidence suggests that blended learning is not only effective in enhancing learning outcomes but also in cultivating essential 21st-century skills such as self-directed learning and lifelong learning attitudes (Fitria et al., 2023; Syelitiar & Putra, 2021). Therefore, the significant gain in student independence observed in this study supports the continued use and further development of blended learning strategies, especially in contexts where online and face-to-face learning need to be integrated to support student growth.

Asynchronous learning allows students to learn at their own pace and style, which gives them the freedom to repeat the material as needed. However, based on the results of this study, during the first cycle, student learning completion only reached 29.41%. This shows that although asynchronous learning gives students freedom, the lack of direct supervision and interaction with the teacher makes it difficult for some students to understand the material well. Some students may feel demotivated when they study independently without direct guidance, which has the potential to affect their learning outcomes.

In contrast, synchronous learning, where students interact face-to-face with the teacher and classmates, resulted in a significant increase in learning completion. In the second cycle, after the implementation of improvement strategies involving more interactive discussions and group activities, learning completion increased to 82.35%. Direct involvement in synchronous learning allows students to ask questions and get direct feedback, which is very important for understanding the material and improving learning outcomes. This study is in line with Sjukur, (2012), which states that synchronous learning is more effective in achieving learning completion. The study revealed that students who learned using the synchronous method were more likely to achieve minimum completion criteria because they had the opportunity to interact directly, discuss the difficulties they faced, and learn from their peers in a collaborative atmosphere.

External factors can influence the results of research on blended learning in various ways. not all students have the same access to technological devices such as smartphones, tablets, or computers, as well as adequate internet connections. These limitations can affect students' ability to participate in online learning effectively, especially in asynchronous sessions, which can impact their independence and learning outcomes. The condition of the home environment, including parental support, a conducive learning atmosphere, and quietness while studying, plays an important role in successful learning.

Students who study in noisy or unsupportive environments may have difficulty focusing, which can affect their learning outcomes. Students' attitudes toward online learning and their intrinsic motivation to learn are very influential. Motivated students tend to be more proactive in seeking information and completing assignments, while less enthusiastic pupils may not try hard in the learning process. The quality of interactions between teachers and students, as well as interactions between students during synchronous learning, can affect students' understanding of the material. Teachers who actively encourage discussion and feedback can increase student engagement, which in turn can affect independence and learning outcomes.

The socio-economic conditions and emotional support from the family are also very important. Families with higher levels of education are usually better able to provide academic support to their children, while families with economic constraints may not have the resources to help their children learn. Policies from educational institutions or governments regarding online learning during the pandemic can also affect learning quality and accessibility. Policies that support technology and teacher training in implementing blended learning will have a positive impact, while less supportive regulations can be obstacles. The COVID-19 pandemic itself creates additional challenges and stressors for students, such as health anxiety, changes in routine, and social isolation, all of which can affect their focus and learning outcomes.

Research Innovation

This research introduces a flipped class-based blended learning model into bold chemistry learning (i.e., online and distance education) during the COVID-19 pandemic, addressing the urgent need for adaptable and student-centered pedagogical approaches. The innovation lies in two main aspects:

- Integration of the Flipped Classroom in Blended Learning

  The study designs and implements a blended learning environment that combines asynchronous independent study (flipped classroom) with synchronous interactive sessions. In the flipped classroom component, students are provided with digital learning resources and pre-recorded instructional videos to study independently before class meetings. Synchronous sessions then focus on problem-solving, discussions, and collaborative activities, allowing students to deepen understanding and apply concepts actively.
- Dual Emphasis on Learning Outcomes and Student Independence

  Unlike traditional studies that mainly assess academic achievement, this research places equal emphasis on fostering student learning independence—a critical competency for success in bold (online) learning settings. The interventions target not only improvement in test scores and completion rates but also measurable growth in students' self-regulation, initiative, responsibility, and confidence. This is achieved through the use of learning journals, group discussions, and reflective practices that empower students to manage their own learning processes.

By integrating the flipped classroom approach within a blended learning framework and explicitly targeting both academic performance and independent learning skills, this study offers a comprehensive, evidence-based model for effective online chemistry education. The results demonstrate significant increases in both learning outcomes and learning independence, underscoring the value of innovation in meeting the challenges of remote and hybrid education environments. This research not only provides evidence for the effectiveness of blended learning in chemistry but also offers practical guidance for other schools seeking to boost student independence and achievement in various learning scenarios, both during and after periods of disruption.

CONCLUSION

In conclusion, the application of a blended learning model has been shown to significantly enhance both learning independence and academic achievement among XI-grade science students at SMA Zion. The average learning independence increased from 57.71% in the first cycle to 76.94% in the second, while learning outcome completion rose from 29.41% to 82.35%. These results underscore the importance of integrating online and face-to-face sessions to foster independent, self-regulated learners. Educators are encouraged to adopt blended learning strategies, supplementing them with varied resources and interactive activities to maximize student engagement and success. Future research is recommended to explore blended learning's effectiveness across different subjects and educational levels, as well as to identify potential challenges in broader implementation.

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