



# The Effectiveness of the ASIK (Asynchronous Online Learning Based on Constructivist Theory) Model Assisted by Multimedia among University Students

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## ABSTRACT

This study aimed to analyse differences in learning outcomes between university students who participated in the ASIK (Asynchronous Online Learning Based on Constructivist Theory) model assisted by multimedia and those who participated in learning without the ASIK model, and to describe the implementation of learning activities in the experimental group. The study employed a post-test-only quasi-experimental design involving 38 students of the Educational Technology Study Programme at Universitas Negeri Padang, comprising 19 students in the experimental group and 19 in the control group. The ASIK model was implemented through four stages, namely Pelajari, Dalami, Terapkan, and Evaluasi, supported by e-modules, videos, Case-Based Learning (CBL), and Project-Based Learning (PjBL). Data were analysed using descriptive statistics, normality and homogeneity tests, and an independent-samples t-test at  $\alpha = 0.05$ . The results showed a mean learning outcome score of 85.16 (SD = 10.71) for the experimental group and 77.05 (SD = 8.65) for the control group. There was a statistically significant difference between the groups,  $t(36) = 2.566$ ,  $p = 0.015$ , with a mean difference of 8.11 points and Cohen's  $d = 0.83$ . The implementation of learning activities in the experimental group reached 97.14%. The findings indicate that implementation of the multimedia-assisted ASIK model was associated with higher learning outcomes under the conditions of this study. The study was limited by the sample size, the context of a single institution and course, the duration of the intervention, and the post-test-only design.

## 1. Introduction

The development of digital technology has driven significant changes in higher education. Online learning, particularly asynchronous learning, provides students with flexibility to access learning materials, manage their study time, and complete learning activities without having to be in the same place and at the same time as the lecturer. However, such flexibility does not automatically result in meaningful learning. In digital learning environments, student engagement is an important aspect because learning success is determined not only by the availability of technology but also by how students interact with learning materials, lecturers, and their peers (Nkomo et al., 2021). Systematic

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reviews have shown that student engagement in technology-enhanced learning is a multidimensional construct comprising behavioural, cognitive, and affective dimensions.

This issue is particularly important in asynchronous learning because students have a higher degree of autonomy in managing their learning processes. Unlike synchronous learning, which allows direct interaction, asynchronous learning may present challenges such as limited interaction, delayed feedback, and difficulty maintaining student engagement. Zeng and Xin (2025), for example, showed that persistence and engagement in asynchronous learning are associated with autonomous academic motivation and time-management skills. These findings suggest that asynchronous learning design needs to provide a clear structure of activities so that students not only receive learning materials but are also guided to engage systematically in cognitive and social activities.

These issues were also identified during the needs analysis in the present study. An initial survey of 81 students from various study programmes indicated that the asynchronous online learning experienced by the students had not adequately provided deep understanding, supported independent knowledge construction, encouraged students to think more actively, provided enjoyable learning experiences, or made the topics being studied meaningful. Further analysis also indicated that the learning materials used in online learning were not sufficiently engaging and interactive. These findings provided the basis for developing an asynchronous online learning model based on constructivist theory and assisted by multimedia.

From a constructivist perspective, meaningful learning occurs when students actively construct knowledge through experience, interaction, interpretation, and reflection on the information they learn. Therefore, asynchronous learning should not be designed merely as a process of distributing materials through a Learning Management System (LMS), but should provide activities that enable students to construct knowledge actively. Research on online case-based learning has shown that case discussions can support problem-solving processes, although their collaborative benefits depend substantially on activity design and student participation (Koehler et al., 2022). Zhang et al. (2023) also showed that student-centred case-based learning can encourage active student engagement in knowledge construction.

One approach that can be used to activate students' thinking processes in asynchronous learning is Case-Based Learning (CBL). CBL provides students with opportunities to learn concepts through cases or problems related to real-life situations. In online environments, CBL can provide a context in which students analyse information, discuss problems, develop alternative solutions, and connect concepts with prior experiences or knowledge. A review of online case-based learning indicates that case-based approaches can support active and collaborative learning when accompanied by appropriate pedagogical frameworks and activity designs (Donkin et al., 2023). Alizadeh et al. (2024) also showed that virtual CBL combined with other learning strategies can enhance students' learning experiences and motivation.

However, case analysis alone may not be sufficient to ensure that students can apply the knowledge they acquire. Learning needs to continue with activities that enable students to use that knowledge to produce a product or solve an authentic problem. In this context, Project-Based Learning (PjBL) can complement CBL because students not only analyse problems but also develop products through processes of planning, implementation, and evaluation. Crespí et al. (2022) showed that PjBL in higher education contributes to the development of students' interpersonal competences. Meanwhile, Huang et al. (2023) found that PjBL can enhance students' perceived relevance of learning in online learning contexts. Thus, integrating CBL and PjBL has the potential to create a learning sequence that moves from conceptual understanding and problem analysis to the application of knowledge through products or projects.

In addition to pedagogical strategies, multimedia is an important component of asynchronous learning design. Students who learn independently require learning resources that present information clearly, systematically, and engagingly. The use of text, images, animation, and video can help students construct mental representations of the material when designed according to multimedia learning principles. The Cognitive Theory of Multimedia Learning (CTML) explains that humans process information through verbal and visual channels with limited capacity; therefore, multimedia learning should help students actively select, organise, and integrate information (Mayer, 2024).

The application of CTML in online learning has also received support from previous research. Cavanagh and Kiersch (2023) showed that CTML principles can be used to design online multimedia learning by using commonly available technologies. They emphasised the importance of multimedia design that supports generative activities, information organisation, and student control over the learning process. Thus, multimedia in asynchronous learning should not merely function as decoration or as a variation in content presentation, but should be positioned as an integral part of the learning strategy. Instructional video is one relevant form of multimedia in this context.

Garcia and Yousef (2023) showed that asynchronous video design needs to consider cognitive and affective aspects because limited direct interaction in online learning can influence students' learning experiences. Furthermore, research on asynchronous instructional videos indicates that presentation characteristics, including visual elements and instructor presence, can influence students' cognitive and affective processes (Garcia & Yousef, 2023). Mayer (2024) also emphasised that multimedia design principles should support active processing rather than merely increase the amount of visual information presented to learners.

The need for multimedia design integrated with learning activities has become increasingly important because asynchronous learning carries the risk that students may become passive recipients of information. Recent research indicates that student engagement in asynchronous learning is influenced by the design of the learning environment and the quality of available interaction. Lee and Kim (2025) showed that an approach oriented towards student autonomy and the use of learning analytics can support student engagement in asynchronous learning. Meanwhile, Culbreth and Martin (2025) showed that synchrony characteristics in online learning environments are related to how students engage in learning activities. These findings reinforce the need to design asynchronous learning that is not only flexible but also provides an activity structure that encourages students to learn actively.

Based on these needs, this study developed an asynchronous online learning model based on constructivist theory and assisted by multimedia. The ASIK model was designed by integrating constructivist principles, multimedia, CBL, and PjBL into an asynchronous learning environment. The model comprises four main stages, namely Pelajari, Dalami, Terapkan, and Evaluasi. The Pelajari stage provides students with opportunities to acquire initial knowledge through multimedia, particularly e-modules and instructional videos. The Dalami stage guides students to deepen their understanding through CBL activities. The Terapkan stage provides opportunities for students to apply their knowledge through PjBL, whereas the Evaluasi stage is used to assess students' understanding and learning outcomes. Learning activities in the ASIK model are also divided into Independent Asynchronous (AM) and Collaborative Asynchronous (AK), thereby maintaining the flexibility of asynchronous learning while providing opportunities for interaction and knowledge construction.

The integration of these components constitutes a distinctive feature of the ASIK model. Previous studies have extensively examined asynchronous learning, multimedia learning, CBL, and PjBL separately. However, there remains a need for a learning design that systematically integrates constructivist theory as a pedagogical foundation, multimedia as a learning resource, CBL as a

deepening activity, and PjBL as an application activity within a single asynchronous learning model. This need is increasingly relevant because research on online learning indicates that flexibility alone is insufficient to ensure student engagement and learning success (Akpen et al., 2024; Zeng & Xin, 2025).

The ASIK model was subsequently implemented in the IT-Based Entrepreneurship course in the Department of Curriculum and Educational Technology, Faculty of Education, Universitas Negeri Padang. The implementation was conducted through an e-learning platform and involved learning activities covering digital entrepreneurship and the creative economy, entrepreneurial opportunities and failures, selection of business ideas, and SWOT analysis. The model had been developed using the ADDIE approach, comprising Analysis, Design, Development, Implementation, and Evaluation.

The effectiveness of the model in this study was analysed through learning outcomes and student learning activities. In the effectiveness test, the experimental and control groups each comprised 19 students. The experimental group obtained a mean learning outcome score of 85.16 with a standard deviation of 10.71, whereas the control group had a mean of 77.05 with a standard deviation of 8.65. The t-test yielded  $t = 2.566$ ,  $df = 36$ , and  $p = 0.015$ , indicating a difference in learning outcomes between the two groups under the conditions of this study. In addition, observation showed that student learning activities throughout the ASIK stages reached 97.14%, including reading the e-module, watching videos, discussing CBL cases, completing tasks, participating in evaluation activities, carrying out PjBL, and submitting projects.

This study aimed to analyse differences in learning outcomes between students who participated in the multimedia-assisted asynchronous online learning model and students in the control group, and to describe the implementation of student learning activities during the ASIK intervention. The study is expected to provide empirical evidence regarding an asynchronous learning approach that integrates knowledge construction, case-based learning, project-based learning, and multimedia within a single learning sequence.

## **2. Methodology**

### **2.1 Research Design**

This study employed a quantitative approach with a post-test-only quasi-experimental design. The design was used to compare students' learning outcomes in the experimental and control groups after completion of the learning sequence. Because the study did not include an initial measurement of learning outcomes, the interpretation focused on differences in final outcomes between the groups and was not treated as causal evidence beyond the context of the study.

The experimental group received instruction using the multimedia-assisted ASIK model, whereas the control group received instruction in the same course without the ASIK model. Learning outcomes constituted the primary outcome compared inferentially. Student learning activities in the experimental group were observed as supporting data to describe implementation of the ASIK stages.

The comparative design was selected to obtain empirical evidence regarding differences in learning outcomes following implementation of ASIK. Because the study groups came from existing class contexts and no individual randomisation or pre-test was conducted, the findings were interpreted as differences in final outcomes between groups within the context of the implementation.

The ASIK model tested in this study had previously been developed through research and development. In this article, the model was treated as a learning intervention. ASIK integrates asynchronous learning with constructivist principles, multimedia, Case-Based Learning (CBL), and Project-Based Learning (PjBL) through the sequence of *Pelajari*, *Dalami*, *Terapkan*, and *Evaluasi*.

## **2.2 Participants and Research Context**

The study was conducted in the IT-Based Entrepreneurship course in the Department of Curriculum and Educational Technology, Faculty of Education, Universitas Negeri Padang. The participants comprised 38 students, with 19 students in the experimental group and 19 in the control group. The experimental group received instruction using the multimedia-assisted ASIK model, whereas the control group received instruction in the same course without the ASIK model. Because information on individual randomisation or pre-test measurement was not available in the data used for this article, the groups were treated as pre-existing groups.

The course was selected because its learning content enabled students to understand concepts, analyse problems, and apply knowledge in an entrepreneurial context. These characteristics corresponded to the ASIK intervention, which connects initial understanding, case analysis, and application through projects. The learning implementation took place over four sessions through the Universitas Negeri Padang e-learning platform. The learning materials covered digital entrepreneurship and the creative economy, entrepreneurial opportunities and failures, selection of entrepreneurial ideas and SWOT analysis, and assessment of learning outcomes

## **2.3 Learning Intervention**

The experimental group received instruction using the multimedia-assisted ASIK asynchronous online learning model. The model was designed to address one of the main challenges of asynchronous learning, namely the possibility that students may merely receive materials passively without cognitive engagement and structured learning activities.

The implementation of ASIK comprised four learning stages, namely Pelajari, Dalami, Terapkan, and Evaluasi. The Pelajari stage enabled students to acquire initial knowledge through e-modules and instructional videos. The Dalami stage guided students to analyse and discuss cases through CBL. Next, the Terapkan stage enabled students to apply the knowledge they had acquired through PjBL activities. The Evaluasi stage was used to assess students' understanding and learning outcomes.

Learning activities were conducted through a combination of Independent Asynchronous (AM) and Collaborative Asynchronous (AK). Thus, the time flexibility characteristic of asynchronous learning was maintained, but students were not merely directed to consume learning materials. They also engaged in analysis, discussion, task completion, and project development.

Multimedia in the intervention consisted primarily of e-modules and instructional videos. Multimedia was positioned as part of the learning strategy rather than merely as a means of delivering content. This approach is important because research on asynchronous video learning indicates that student engagement is associated with learning outcomes; for example, a field experiment involving 196 students showed that more active learning activities during asynchronous video learning were associated with higher engagement and post-test outcomes. Therefore, the main characteristic of the ASIK intervention lies in the integration of multimedia materials with constructive and application-oriented activities, rather than merely in the use of an LMS or the provision of materials online.

## **2.4 Research Variables and Instruments**

### **2.4.1 Learning Outcomes**

Learning outcomes were measured using a test administered at the end of the learning sequence. The test was used to obtain students' cognitive achievement scores in the experimental and control groups. This article reports the final measurement available in the research data. Test scores were analysed descriptively using minimum, maximum, mean, and standard deviation. The difference in

mean learning outcomes between the experimental and control groups was subsequently analysed inferentially.

#### *2.4.2 Student Learning Activities*

Student learning activities were observed during implementation of the ASIK model using an observation sheet. The instrument covered seven activities: (1) downloading and reading the e-module; (2) watching instructional videos; (3) discussing CBL cases; (4) submitting case-discussion reports; (5) completing learning questions; (6) carrying out PjBL; and (7) submitting the project on time. These seven indicators represented implementation of the main activities in the ASIK intervention, from obtaining information through multimedia and processing information through CBL to applying knowledge through PjBL. Because observations were conducted only in the experimental group, these data were used as supporting evidence of intervention implementation rather than as a basis for comparing activity effectiveness with the control group. Student activities were used as process data to complement the interpretation of learning outcomes. The data were not treated as a comprehensively measured engagement construct, but as observed implementation of activities during ASIK.

#### *2.5 Data Collection Procedure*

Data collection was conducted after completion of the learning sequence. Learning outcomes were obtained through a final test in the eighth week. The data were used to compare final outcomes between the experimental and control groups. In the experimental group, observations were conducted while students participated in ASIK learning activities on the e-learning platform. The observed activities included students' access to multimedia, participation in CBL activities, completion of tasks, implementation of PjBL, and completion of projects.

#### *2.6 Data Analysis*

Data analysis comprised descriptive statistics, tests of statistical assumptions, and a test of differences in means. First, descriptive analysis was conducted by calculating the mean and standard deviation (SD) of learning outcomes in the experimental and control groups. Second, statistical assumptions were tested. The normality of the data distribution was assessed using the Kolmogorov–Smirnov test, while equality of variances between groups was assessed using Levene's test. The Kolmogorov–Smirnov test produced a significance value of 0.200 in both groups, while Levene's test produced a significance value of 0.384. These results indicated that the data met the assumptions required for an independent-samples t-test. Third, the difference in learning outcomes between the experimental and control groups was analysed using an independent-samples t-test at  $\alpha = 0.05$ . Analyses were conducted using SPSS. The statistical hypotheses tested were:

$H_0$ : There is no difference in mean learning outcomes between the experimental and control groups.

$H_1$ : There is a difference in mean learning outcomes between the experimental and control groups.

Student learning activities were analysed descriptively by calculating the percentage of implementation based on observation scores. The observation results were used as supporting evidence regarding implementation of the ASIK learning activities.

### 3. Result

#### 3.1 Analysis of Learning Outcomes

The main analysis focused on differences in learning outcomes between the experimental and control groups after implementation of the learning. The experimental group received instruction using the multimedia-assisted ASIK asynchronous online learning model, whereas the control group received instruction in the same course without the ASIK model.

Learning outcomes were analysed sequentially through descriptive statistics, tests of assumptions, and a test of differences in means. Descriptive statistics were used to describe learning outcomes in both groups. Normality and homogeneity tests were then conducted to determine the suitability of parametric analysis. After both assumptions were met, differences in mean learning outcomes were analysed using an independent-samples t-test.

Learning outcome data were obtained from 38 students, comprising 19 students in the experimental group and 19 in the control group. The test was administered after completion of the learning sequence. In addition to learning outcomes as the primary outcome, student learning activities in the experimental group were analysed descriptively as supporting data to describe implementation of the ASIK learning stages.

#### 3.2 Descriptive Statistics of Learning Outcomes

The learning outcome data showed a difference in achievement between the experimental and control groups. Scores in the experimental group ranged from 64 to 100, whereas scores in the control group ranged from 60 to 95.

The experimental group had a mean learning outcome score of 85.16 with a standard deviation of 10.71, whereas the control group had a mean of 77.05 with a standard deviation of 8.65. Thus, the experimental group had a mean score 8.11 points higher than the control group. The difference in means was subsequently tested inferentially to determine whether the difference in learning outcomes between the two groups was statistically significant.

**Table 1.** Descriptive Statistics of Learning Outcomes

| Group        | N  | Minimum | Maximum | Mean  | SD    |
|--------------|----|---------|---------|-------|-------|
| Experimental | 19 | 64      | 100     | 85.16 | 10.71 |
| Control      | 19 | 60      | 95      | 77.05 | 8.65  |

#### 3.3 Tests of Statistical Assumptions

##### 3.3.1 Normality Test

Normality was assessed using the Kolmogorov–Smirnov test. The null hypothesis stated that the learning outcome data came from a normal distribution. The results showed a Kolmogorov–Smirnov significance value of 0.200 for the experimental group and 0.200 for the control group. Both values were greater than 0.05. Therefore, there was no statistical evidence of deviation from a normal distribution in either group, and the data met the normality assumption.

**Table 2.** Kolmogorov–Smirnov Normality Test

| Group        | N  | Sig.  | Decision |
|--------------|----|-------|----------|
| Experimental | 19 | 0.200 | Normal   |
| Control      | 19 | 0.200 | Normal   |

##### 3.3.2 Homogeneity of Variance Test

Homogeneity was assessed using Levene's test to determine whether the variances of learning outcomes were equal between the experimental and control groups. The test yielded a Levene statistic of 0.775, with  $df_1 = 1$  and  $df_2 = 36$  and a significance value of 0.384. Because  $p = 0.384 >$

0.05, there was no statistical evidence of a difference in variances between the groups. Thus, the variances of learning outcomes could be treated as homogeneous. Based on the normality and homogeneity tests, the data met the assumptions required for an independent-samples t-test.

**Table 3.** Homogeneity of Variance Test

| Levene Statistic | df1 | df2 | Sig.  |
|------------------|-----|-----|-------|
| 0.775            | 1   | 36  | 0.384 |

### 3.4 Difference in Learning Outcomes Between Groups

The difference in learning outcomes was tested using an independent-samples t-test at  $\alpha = 0.05$ . The null hypothesis ( $H_0$ ) stated that there was no difference in mean learning outcomes between the experimental and control groups, whereas the alternative hypothesis ( $H_1$ ) stated that there was a difference between the two groups. The analysis yielded  $t = 2.566$ ,  $df = 36$ , and  $p = 0.015$ . Because  $p < 0.05$ ,  $H_0$  was rejected. Thus, there was a statistically significant difference in learning outcomes between students in the experimental and control groups.

**Table 4.** Independent-Samples t-Test

| Comparison               | t     | df | Sig. (2-tailed) | Decision       |
|--------------------------|-------|----|-----------------|----------------|
| Experimental vs. Control | 2.566 | 36 | 0.015           | $H_0$ rejected |

When considered alongside the descriptive statistics, the experimental group had a mean learning outcome score of 85.16, whereas the control group had a mean of 77.05. The mean difference of 8.11 points indicates that the final achievement of the experimental group was higher under the conditions of this study.

### 3.5 Effect Size

In addition to statistical significance, the difference in learning outcomes between the two groups was calculated using Cohen's  $d$ . The calculation provides information about the magnitude of the standardised difference, rather than statistical significance alone. Based on the means, standard deviations, and group sizes, the pooled standard deviation was 9.73. With a mean difference of 8.11 points, Cohen's  $d$  was 0.83.

**Table 5.** Difference in Learning Outcomes

| Parameter         | Value |
|-------------------|-------|
| Experimental mean | 85.16 |
| Control mean      | 77.05 |
| Mean difference   | 8.11  |
| Pooled SD         | 9.73  |
| Cohen's $d$       | 0.83  |

A Cohen's  $d$  of 0.83 indicates a relatively large standardised difference in mean learning outcomes between the two groups. This effect size complements the t-test by providing information about the magnitude of the standardised difference.

### 3.6 Implementation of Learning Activities

Implementation of learning activities in the experimental group was also observed as supporting data. The observations showed that students completed most of the activities designed in the ASIK model. Each indicator was scored based on the observation results, and the scores were summed to obtain the total activity score. Six indicators received a score of 5, while the indicator concerning timely project submission received a score of 4. The total score was 34 out of a maximum of 35, corresponding to 97.14% implementation of the learning activities in the ASIK model.

**Table 6.** Observation Results for Student Learning Activities

| No.                | Activity Indicator                         | Score  |
|--------------------|--------------------------------------------|--------|
| 1                  | Downloading and reading the e-module       | 5      |
| 2                  | Watching instructional videos              | 5      |
| 3                  | Discussing Case-Based Learning (CBL) cases | 5      |
| 4                  | Submitting the case-discussion report      | 5      |
| 5                  | Completing learning questions              | 5      |
| 6                  | Carrying out Project-Based Learning (PjBL) | 5      |
| 7                  | Submitting the project on time             | 4      |
| Actual total score |                                            | 34     |
| Maximum score      |                                            | 35     |
| Percentage         |                                            | 97.14% |

### 3.7 Discussion

The difference in final achievement between the experimental and control groups indicates that implementation of ASIK was associated with higher learning outcomes under the conditions of this study. This finding should be interpreted in light of the post-test-only design and the limited sample size. The 97.14% implementation of student learning activities provides further insight into the learning process supported by ASIK. Students did not merely access e-modules and videos; they also analysed cases through CBL, completed tasks, and produced products through PjBL. This pattern indicates that asynchronous activities in ASIK were designed as generative activities rather than merely as content consumption. The finding is consistent with Maré and Mutezo (2025), who emphasised the importance of self-regulation, co-regulation, and social presence in building engagement in online learning. Zhong et al. (2025) similarly showed that student engagement is an increasingly important research area, with attention to the relationships among learning characteristics, interaction, and learning regulation. In project-based learning, the integration of authentic and collaborative activities provides opportunities for students to connect concepts with problem solving and product development. Recent research on PjBL also indicates its potential contribution to academic achievement and higher-order thinking skills, although the strength of the evidence is influenced by variation in research designs and study quality.

Overall, the findings indicate that a key contribution of ASIK lies in the coherence among technology, cognitive activity, collaboration, and knowledge application in an asynchronous environment. Multimedia provides representations of learning materials that can be studied independently; CBL encourages analysis of problems; PjBL guides students to apply knowledge in producing products; and evaluation activities provide opportunities to check students' understanding. This pattern is consistent with research showing that online engagement is shaped by interactions among student factors, learning design, technology, social interaction, and instructor support. Hu and Xiao (2025) identified self-directed learning, regulation, collaboration, task characteristics, and environmental support as important determinants of engagement, while Prananto et al. (2025) emphasised the importance of instructor support for student engagement. Research on online CBL and PjBL also indicates that problem- and project-based activities can strengthen active learning when designed with clear structures, interactions, and objectives.

Thus, the findings of this study indicate that ASIK may be a relevant approach for supporting asynchronous learning because it integrates independent learning, collaborative interaction, multimedia, problem solving, and product development within a single pedagogical sequence. However, because the study involved only 38 students and lasted four sessions, these findings should be examined further through longer implementations, larger samples, and different course contexts.

This study has several limitations. The sample comprised only 38 students from one course at one institution, and the intervention lasted four sessions. In addition, the post-test-only design did not allow initial differences in ability to be statistically controlled. Activity observations were also conducted only in the experimental group. Therefore, the findings should be understood as contextual evidence and confirmed through studies involving larger samples, longer intervention periods, more diverse groups, and pre-test and post-test measurements.

#### **4. Conclusion**

The study found a statistically significant difference in learning outcomes between students who participated in the multimedia-assisted ASIK model and those in the control group, with mean scores of 85.16 and 77.05, respectively,  $t(36) = 2.566$ ,  $p = 0.015$ , and Cohen's  $d = 0.83$ . Implementation of the learning activities in the experimental group reached 97.14%. These findings suggest that the ASIK model, which integrates asynchronous learning, constructivist principles, multimedia, CBL, and PjBL through the Pelajari–Dalami–Terapkan–Evaluasi sequence, was associated with higher learning outcomes in the context studied. Nevertheless, the post-test-only design, absence of individual randomisation and pre-test measurement, limited sample, single institutional and course context, short intervention, and experimental-group-only activity observation constrain the interpretation and generalisability of the findings. Further studies should examine ASIK using larger and more diverse samples, longer interventions, and pre-test–post-test or other stronger comparative designs.

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