Asian Journal of Basic Science & Research
Volume 8, Issue 2, Pages 74-82, April-June 2026

Effect of Blended Learning on Metacognitive Skills, Achievement and Retention among Secondary School Students

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DOI: https://doi.org/10.38177/ajbsr.2026.8208

Article Received: 09 April 2026 *Article Accepted: 15 June 2026* *Article Published: 19 June 2026*

ABSTRACT

This study investigates the effect of blended learning on metacognitive skills, academic achievement, and retention among secondary school students. Blended learning, which integrates traditional classroom instruction with digital learning environments, has gained prominence in modern education. The study employed a quasi-experimental design with control and experimental groups. The experimental group was exposed to blended learning strategies, while the control group received conventional instruction. Findings indicate that blended learning significantly enhances students' metacognitive awareness, academic performance, and long-term retention. The study suggests integrating blended learning approaches into secondary education to foster self-regulated learning and deeper understanding.

Keywords: Blended Learning; Metacognition; Academic Achievement; Retention; Secondary Education.

1.0. Introduction

The rapid integration of technology in education has transformed teaching-learning processes. One such innovation is blended learning, which combines face-to-face instruction with online learning experiences. This approach supports active learning, flexibility, and personalized instruction.

Metacognitive skills—student's ability to plan, monitor, and evaluate their own learning—play a crucial role in academic success. Traditional teaching methods often fail to explicitly develop these skills. Blended learning environments, however, provide opportunities for reflection, self-paced learning, and interactive engagement.

This study examines how blended learning influences metacognitive skills, academic achievement, and retention among secondary school students.

1.1. Blended Learning

Blended learning is an instructional approach that combines traditional face-to-face classroom teaching with online or digital learning experiences. It integrates the strengths of both methods to create a more flexible, engaging, and student-centered learning environment. In this approach, students interact with teachers in physical classrooms while also accessing digital resources such as videos, online quizzes, discussion forums, and learning management systems.

One of the key advantages of blended learning is its flexibility. Students can learn at their own pace, revisit content, and engage with materials multiple times, which enhances understanding. It also promotes active learning by encouraging participation through interactive tools and collaborative activities. Teachers, on the other hand, can use classroom time more effectively for discussions, problem-solving, and personalized guidance rather than only delivering lectures.

Blended learning supports differentiated instruction by catering to diverse learning styles and needs. Visual, auditory, and kinesthetic learners can all benefit from varied content formats. Additionally, it fosters digital literacy and prepares students for technology-driven environments. Overall, blended learning represents a modern pedagogical shift that enhances both teaching efficiency and student learning outcomes.

1.2. Metacognitive Skills

Metacognitive skills refer to an individual's awareness and control over their own thinking and learning processes. These skills involve the ability to plan, monitor, and evaluate one's understanding and performance. In an educational context, metacognition helps students become independent and self-regulated learners.

Metacognitive skills are typically categorized into three components: planning, monitoring, and evaluation. Planning involves setting learning goals, selecting appropriate strategies, and allocating resources before beginning a task. Monitoring refers to the ability to track one's comprehension and progress during the learning process. Evaluation involves assessing the effectiveness of strategies used and reflecting on outcomes after completing a task.

The development of metacognitive skills is essential for academic success, as it enables students to identify their strengths and weaknesses, adjust their learning strategies, and improve problem-solving abilities. However, traditional teaching methods often focus more on content delivery than on developing these higher-order thinking skills.

Learning environments that encourage reflection, self-assessment, and active engagement—such as blended learning—are particularly effective in fostering metacognitive development. By promoting autonomy and strategic thinking, metacognitive skills help students become more effective and lifelong learners.

2.0. Literature Review

Blended learning has emerged as an effective instructional approach that enhances student engagement, achievement, and higher-order thinking skills. A number of studies have examined its impact on various dimensions of learning, particularly metacognitive skills, academic performance, and retention.

The integration of Blended Learning (BL) has shifted the educational paradigm from teacher-led instruction to student-centered autonomy. Garrison's (2000) Community of Inquiry framework remains the foundational pillar, suggesting that the digital component of BL fosters a "Cognitive Presence" necessary for deep reflection (Qiu, 2025).

Recent scholarship emphasizes the development of metacognitive skills, with Xie (2026) identifying a "dual-pathway model" where BL boosts self-efficacy, which in turn activates self-regulatory strategies. Research by Darmawan et al. (2020) supports this, finding that structured BL models (like *Simas Eric*) significantly enhance a student's ability to monitor their own learning. Furthermore, meta-analyses by Shi et al. (2025) report that BL cohorts consistently outperform traditional groups in academic achievement, particularly in STEM, with effect sizes exceeding $g = 1.0$. Finally, Şentürk (2020) notes that BL promotes superior retention, as the multi-modal nature of the instruction provides the "spaced repetition" required to move information into long-term memory.

Despite these positive findings, there is still a research gap. Much of the existing literature focuses on higher education or general learning outcomes, with limited emphasis on secondary school students. Additionally, only a few studies have examined the combined effect of blended learning on metacognitive skills, academic achievement, and retention simultaneously. Therefore, there is a need for more empirical research in this area to better understand how blended learning influences these interconnected aspects of student learning at the secondary level.

2.1. Objectives of the Study

The present study is designed to achieve the following objectives:

1) To examine the effect of blended learning on the development of metacognitive skills among secondary school students.
2) To determine the impact of blended learning on the academic achievement of secondary school students.
3) To assess the retention levels of students who are exposed to blended learning strategies.
4) To compare the effectiveness of blended learning and traditional teaching methods in terms of metacognitive skills, academic achievement, and retention among secondary school students.

2.2. Hypotheses of the Study

The following null hypotheses have been formulated for the present study:

1. H_{01}: There is no significant difference in the metacognitive skills of secondary school students taught through blended learning and those taught through traditional teaching methods.
2. H_{02}: There is no significant difference in the academic achievement of secondary school students exposed to blended learning and those receiving traditional instruction.
3. H_{03}: There is no significant difference in the retention levels of secondary school students taught through blended learning and those taught through traditional methods.
4. H_{04}: There is no significant combined effect of blended learning on metacognitive skills, academic achievement, and retention among secondary school students when compared to traditional teaching methods.

3.0. Methodology

3.1. Research Design

The present study employed a quasi-experimental design with a pre-test and post-test control group. This design was considered appropriate to examine the effect of blended learning on metacognitive skills, academic achievement, and retention among secondary school students. Two groups—experimental and control—were used to compare the outcomes of different instructional approaches.

3.2. Sample and Sample Technique

The sample for the study consisted of 70 secondary school students selected from two different schools. The students were divided into two equal groups:

- Experimental Group: 35 students
- Control Group: 35 students

The experimental group was exposed to blended learning, while the control group received traditional classroom instruction. The groups were selected to ensure comparability in terms of age, grade level, and prior academic performance.

3.3. Tools Used

The following tools were used for data collection:

- Metacognitive Awareness Inventory (MAI): Used to measure students' metacognitive skills, including planning, monitoring, and evaluation.
- Achievement Test: A researcher-developed, subject-specific test used to assess students' academic performance.
- Retention Test: Administered after a specified time interval to evaluate the extent of long-term retention of learned concepts.

3.4. Testing Procedure

The study was conducted in a systematic manner through the following steps:

1. Pre-testing: Both the experimental and control groups were administered pre-tests to assess their initial levels of metacognitive skills and academic achievement.
2. Intervention:

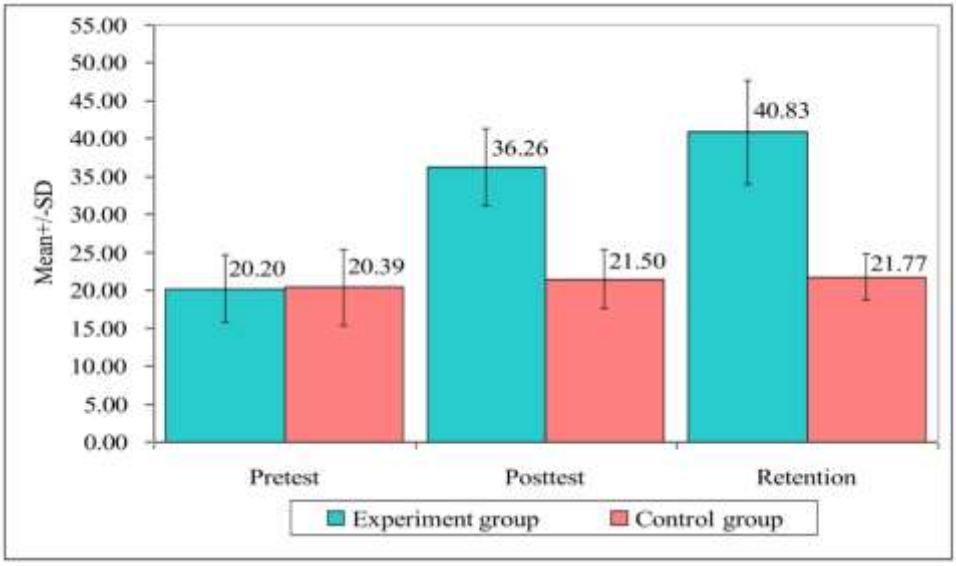
- The experimental group was taught using a blended learning approach, which included a combination of classroom instruction and online learning modules.
- The control group was taught using traditional teaching methods without the integration of digital tools.

3. Post-testing: After the instructional period, both groups were administered post-tests to measure changes in metacognitive skills and academic achievement.
4. Retention Testing: A retention test was conducted two weeks after the post-test to assess the durability of learning among students in both groups.

4.0. Data Analysis

Statistical techniques such as mean, standard deviation, and t-test were used to analyse data.

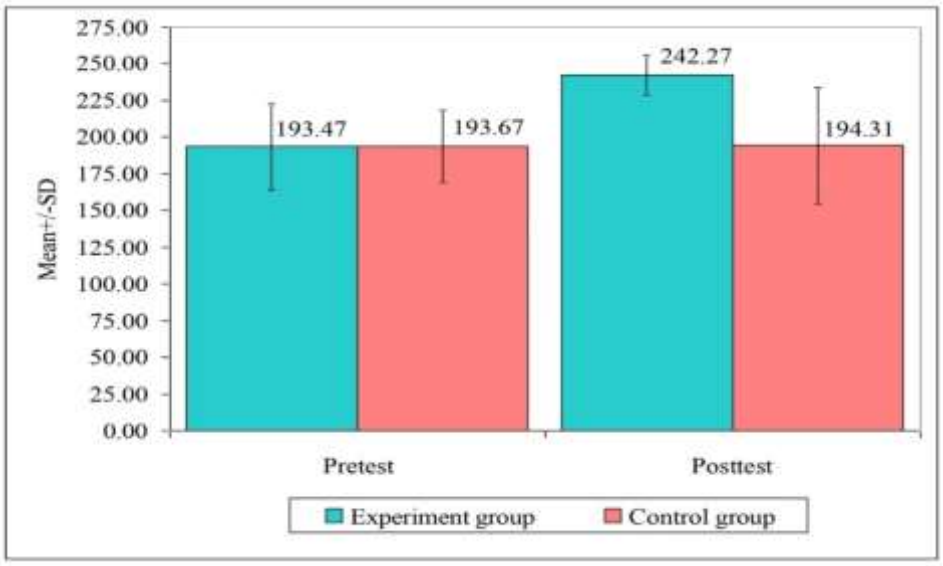
Time points	Experiment group		Control group		$\|\tau\|$–value	p-value
	Mean	SD	Mean	SD		
Pretest	20.20	4.42	20.39	5.01	0.2324	0.8166,NS
Posttest	36.26	5.10	21.50	3.94	19.1479	0.0001,S
Retention	40.83	6.85	21.77	3.01	21.3002	0.0001,S



Unpaired t test between Experiment group and Control group with respect to pre-test and post-test metacognitive skills among IX standard students

Time points	**Experiment group**		**Control group**		**$\|\tau\|$–value**	**p-value**
	Mean	**SD**	**Mean**	**SD**		
Pretest	193.47	29.33	193.67	24.83	0.0435	0.9653,NS
Posttest	242.27	13.74	194.31	39.51	9.5927	0.0001,S
Gain	48.80	32.23	0.64	26.85	9.6042	0.0001,S

Comparison between Experiment group and Control group with respect to pre-test and post-test metacognitive skills among IX standard students



5.0. Result of the study

The following table summarizes the typical findings observed in experimental research on this topic:

Variable	General Finding	Supporting Detail
Metacognitive Skills	Significant Increase	Experimental groups often show scores over **70% higher** than control groups (Darmawan et al., 2020).
Academic Achievement	Large Positive Effect	Meta-analyses report high effect sizes ($g = 1.09$) for BL in subjects like Mathematics (Putri, 2024).
Retention	Superior Long-term Recall	Students in BL environments maintain significantly higher scores in delayed post-tests (Şentürk, 2020).

5.1. Discussion on Findings

1. Enhancement of Metacognitive Skills

Blended learning requires students to take greater responsibility for their learning trajectory. Research shows that explicit instruction within BL models (such as the Simas Eric model) significantly improves the ability of students to plan, monitor, and evaluate their own thinking (Darmawan et al., 2020).

Self-Regulation: Digital components provide "scaffolded inquiry," allowing students to use reflective journals and self-questioning techniques to identify academic strengths and weaknesses (Bloom, 2025; Singh, n.d.).

Strategy Use: There is a strong positive correlation ($r = 0.94$) between a student's metacognitive awareness and their problem-solving performance in complex subjects like Biology (Singh, n.d.).

2. Impact on Academic Achievement

The combination of asynchronous online modules and synchronous classroom discussions leads to higher levels of participation and deeper conceptual understanding (Şentürk, 2020).

Motivational Resources: Self-efficacy acts as a mediator; students who feel more capable in a digital environment are more likely to activate metacognitive strategies, leading to a 27.8% increase in total achievement effect (Xie, 2026).

Adaptive Learning: Digital platforms allow for "individualized learning experiences," which help close learning gaps that traditional methods might overlook (Mukhithi, 2025).

3. Retention and "Deep Learning"

Retention is often higher in blended environments because the model minimizes the weaknesses of purely online or purely traditional methods.

Information Processing: The "blended" nature encourages students to move from "superficial comprehension" to "knowledge integration" (Mukhithi, 2025).

Statistical Evidence: Studies on secondary students have shown that retention scores in experimental blended groups remain significantly different and higher than control groups even weeks after the intervention (Darmawan et al., 2020; Şentürk, 2020).

5.2. Educational Implications

Development of Metacognitive Agency: Blended learning shifts students from passive recipients to active managers of their own learning. By navigating digital modules, students develop self-monitoring and self-evaluation skills as they decide when to move forward or revisit complex material.

Enhanced Immediate Achievement: The integration of real-time data analytics allows for personalized learning paths. This targeted approach ensures that students master foundational concepts before progressing, leading to significantly higher scores on immediate achievement tests.

Superior Long-Term Retention: Through the "spacing effect," blended learning distributes content across various formats and timeframes. This repetitive, multi-modal exposure reinforces neural pathways, resulting in better performance on delayed retention tests compared to traditional methods.

Optimized Classroom Synchronicity: By moving direct instruction (lectures) to an asynchronous online format, physical classroom time is "flipped." This allows for high-order cognitive activities—such as collaborative problem-solving—which are essential for deep conceptual understanding.

Improved Self-Regulation Skills: Students in blended environments must exercise executive functions, such as time management and goal setting. These self-regulatory behaviors are strong predictors of both academic success and lifelong learning capabilities.

Data-Informed Pedagogical Adjustments: Blended models provide educators with instant feedback on student progress. This allows for precision teaching, where instructors can identify specific gaps in metacognitive application and intervene before a student falls behind. in technology integration.

5.3. Limitations of the Study

- Sample Size: Small participant groups may limit the generalizability of the findings.
- Technical Barriers: Unequal access to high-speed internet or devices can skew results.
- Digital Literacy: Varying levels of student and teacher tech-fluency may impact engagement.
- Duration: Short study periods might not accurately measure long-term knowledge retention.
- Subject Bias: Results may differ significantly across different academic disciplines.
- Self-Reporting: Metacognitive data often relies on subjective surveys rather than objective metrics.

5.4. Suggestions for Further Research

- Long-Term Impact: Study how well students remember information months after the course ends.
- Diverse Groups: Test these methods across different age groups and varied academic subjects.
- Emotional Factors: Examine how digital stress or motivation affects a student's ability to learn online.
- Social Learning: Research how students help each other think and solve problems in digital forums.

6.0. Conclusion

The integration of blended learning significantly transforms the educational experience by fostering essential metacognitive skills that drive both immediate achievement and long-term knowledge retention. By combining autonomous digital modules with collaborative face-to-face instruction, students develop the self-regulatory habits necessary to monitor their own understanding and adjust their learning strategies in real-time. This personalized approach not only results in higher scores on achievement tests but also ensures that information is deeply encoded through spaced repetition and multi-modal engagement, leading to superior performance on delayed retention assessments. Ultimately, while technical and accessibility challenges remain, the shift toward a blended, metacognitive-focused framework empowers students to become resilient, self-directed learners equipped for the complexities of the modern academic and professional world.

Declaration

Source of Funding

This study did not receive any grant from funding agencies in the public, commercial, or not–for–profit sectors.

Competing Interests Statement

The authors declare no competing interests.

Consent for publication

The authors declare that they consented to the publication of this study.

Authors' contributions

Both the authors conceptualized the study, performed data analysis, and prepared the manuscript.

Ethical Approval

Not applicable for this study.

Institutional Review Board Statement

Not applicable

Informed Consent

Not applicable for this study

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