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EFFECTIVENESS OF VIDEO-BASED MICROLEARNING IN ENHANCING STUDENTS' LEARNING OUTCOMES ON THE CONCEPT OF HUMAN COORDINATION SYSTEM

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ABSTRACT

This study aims to determine the effectiveness of the use of microlearning video coordination system in improving the learning outcomes of grade XI students of SMA Negeri 2 Makassar. This study used a pre-experimental design method with a One Group Pretest-Posttest design. The research sample consisted of 30 grade XI Biology 1 students selected using a purposive sampling technique. The research instrument used was a multiple-choice learning outcome test consisting of 15 questions given before learning (pretest) and after learning (posttest). The research data were analyzed using descriptive statistical analysis and the N-Gain test to determine the improvement in student learning outcomes after the implementation of microlearning videos. The results showed that there was an increase in student learning outcomes after the implementation of microlearning videos. The average pretest score of 49.77 increased to 79.77 in the posttest. In addition, the results of the N-Gain analysis obtained an average of 60.83 which is in the moderate or quite effective category. Most students are in the quite effective category with a percentage of 63.43%, while 3.33% are in the effective category. These results indicate that the use of microlearning videos has a positive impact on improving student learning outcomes in the coordination system material. Therefore, microlearning videos can be used as an alternative, engaging, flexible, and effective learning medium in biology learning.

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Introduction

Rapid technological advancements have also driven the development of teaching materials in education. Teaching materials are learning resources containing information, learning materials, and evaluations that are systematically structured, taking into account learning principles, to facilitate student understanding. The advent of digital technology has meant that teaching materials are no longer limited to printed formats, but have evolved into more innovative and interactive digital learning-based teaching materials (Pebriantika et al., 2021). The current generation has grown up in a digital age that is intimately connected with technology. They are accustomed to finding solutions to various problems through apps and search engines. Therefore, technology-based learning is essential for improving the quality of education, as it provides a broader, more engaging, and more effective learning experience.

Despite the widespread integration of technology in education, many learning challenges remain. One of the primary issues encountered in schools is the low learning achievement of students. In the learning process, teachers naturally expect students to achieve optimal learning outcomes. However, in reality, many students still demonstrate learning outcomes below expectations. Despite teachers' best efforts, some students still achieve unsatisfactory grades. One cause is the use of learning media that is less engaging and tends to be monotonous, making students less interested in participating in learning (Saragih, 2022). This condition results in low student engagement in the learning process, which ultimately affects their learning outcomes.

The problem becomes more apparent in biology learning, particularly in the topic of the coordination system. The coordination system is a complex biological concept that discusses how the nervous system, endocrine system, and sensory organs interact to regulate and coordinate bodily functions. Students often find this topic difficult because it involves abstract concepts, interconnected physiological processes, and scientific terminology that require deep understanding. Traditional instructional approaches and lengthy learning videos frequently fail to maintain students' concentration, causing cognitive overload and reducing the effectiveness of learning.

The challenges associated with understanding complex biological concepts can be explained through Cognitive Load Theory proposed by Sweller. This theory states that learners possess limited working memory capacity, and excessive information presented simultaneously may overload cognitive processes, making learning less effective (Agustin et al., 2025). Long instructional videos often present too much information at once, increasing extraneous cognitive load and reducing students' ability to process and retain essential information. Therefore, learning materials should be designed in smaller, manageable segments that reduce unnecessary cognitive burden and allow students to focus on key concepts.

One learning strategy that can be implemented is microlearning. This strategy uses various media formats to present information concisely, concisely, and focused, making it easier for students to understand the material quickly and flexibly. Microlearning allows students to learn independently anytime and anywhere using the technological devices they own. The main goal of this approach is not only to convey knowledge but also to create a fun, efficient, and meaningful learning experience (Yusnidar & Syahri, 2022). By presenting material in concise content, it is hoped that students will more easily understand, remember, and apply the information learned in their daily lives.

Research conducted by Kosim et al. explains that microlearning is an e-learning approach that emphasizes the delivery of material in short forms through various media such as videos, podcasts, blogs, and infographics. One effective form of

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microlearning is video learning. Microlearning videos have the advantage of presenting material concisely yet comprehensively by effectively combining visual and theoretical elements. Furthermore, microlearning videos are easily accessible, flexible to use, and help students grasp the material more quickly. The consistent, efficient, and practical presentation of material makes microlearning videos a relevant alternative learning medium in the digital age (Kosim et al., 2025).

The effectiveness of microlearning videos can also be explained through Mayer's Multimedia Learning Theory. According to this theory, learning becomes more effective when information is presented through a combination of words, images, animations, and audio rather than through text alone (Putri & Lestari, 2025). The integration of visual and auditory elements allows learners to process information through dual channels, enhancing comprehension and retention. Microlearning videos utilize these principles by presenting essential content through concise visual explanations, narration, illustrations, and animations, making complex biological concepts easier to understand.

Microlearning-based video learning is a learning innovation that presents material in small segments containing important and focused information. The material is systematically structured into short units so that students can understand the learning more quickly and efficiently. Based on research conducted by Surahman et al., the use of video microlearning aims to simplify the learning process by presenting material that is concise, focused, and easily accessible at any time without requiring excessive study time. Thus, learning becomes more practical and easier to implement (Surahman et al., 2020).

The coordination system is a topic in biology that discusses the body's mechanisms of functioning in regulating and controlling the activity of organs. The coordination system plays a crucial role in ensuring that each organ functions in an integrated and harmonious manner (Aisyah & Rosnita, 2021). This material is considered suitable for development in the form of microlearning-based instructional videos because it involves quite complex concepts that require clear and structured explanations. Microlearning videos allow material to be presented in several short, interconnected videos, making it easier for students to grasp specific concepts. Furthermore, concise, clear, and concise presentations can help improve student focus and interest in learning (Dolasinski & Reynolds, 2020).

Various previous studies have also shown that the use of microlearning-based instructional videos produces positive results. Rahayu's research indicates that microlearning-based instructional videos are worthy of testing for their practicality and effectiveness in the learning process (Rahayu, 2025). Another study conducted by Sekar Syawalahayati on Instagram-based microlearning demonstrated excellent results, with a feasibility rate reaching 95% in a large-scale trial of 100 students (Sozmen, 2022). These results demonstrate that microlearning has significant potential to improve learning quality. Similarities between previous research and this study lie in the use of a microlearning approach as a technology-based learning medium to improve the quality and effectiveness of learning. Furthermore, these studies both focus on increasing student engagement and learning outcomes through more engaging and flexible digital media.

However, despite these promising findings, a significant research gap remains. Most previous studies have primarily focused on developing microlearning media and evaluating their feasibility, practicality, or user perceptions. Limited research has specifically investigated the effectiveness of microlearning videos in improving students' learning outcomes, particularly in biology subjects involving complex concepts such as the coordination system. Furthermore, studies examining the implementation of microlearning videos in senior high school biology classes, especially at SMA Negeri 2 Makassar, remain scarce. Therefore, empirical evidence regarding the direct impact of microlearning

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videos on students' academic achievement is still insufficient.

To address this gap, the present study proposes the use of microlearning-based instructional videos specifically designed for coordination system material. Unlike conventional long-duration videos, microlearning videos divide learning content into shorter segments that focus on a single concept or learning objective. This design is expected to reduce cognitive load, increase students' attention and engagement, facilitate concept mastery, and ultimately improve learning outcomes. By providing concise and structured learning experiences, microlearning videos offer a practical solution to the challenges encountered in biology learning.

The significance of this study is reflected in both theoretical and practical contributions. Theoretically, the study contributes to the growing body of knowledge regarding technology-enhanced learning by providing empirical evidence on the effectiveness of microlearning videos in biology education. It also strengthens the application of Cognitive Load Theory, Multimedia Learning Theory, and Constructivist Theory within digital learning environments. Practically, the findings can serve as a reference for teachers in selecting effective instructional media, assist schools in optimizing the use of educational technology, and support students in achieving better learning outcomes through more engaging and flexible learning experiences.

SMA Negeri 2 Makassar has already integrated technology-based learning media into classroom instruction, including the use of educational videos. Nevertheless, the videos currently used are generally lengthy because they are mostly obtained from online platforms such as YouTube. As a result, students often struggle to maintain concentration, become bored, and exhibit low learning motivation. This situation occurs despite the availability of adequate technological facilities such as computers, laptops, internet access, and projectors that can support innovative digital learning practices.

Based on these considerations, researchers are interested in developing and implementing microlearning-based instructional videos for the coordination system topic. Therefore, this study is conducted under the title "The Effectiveness of Using Microlearning Videos on Coordination Systems in Improving Learning Outcomes at SMA Negeri 2 Makassar."

Research Methods

This study employed a pre-experimental research method using a One Group Pretest-Posttest design to examine the effect of microlearning videos on coordination systems in improving the learning outcomes of class XI students at SMA Negeri 2 Makassar. In this design, students were given a pretest before the implementation of the treatment and a posttest after the learning process using microlearning videos. The study was conducted during the even semester of the 2026/2027 academic year and involved one experimental class, namely XI Biology 1, consisting of 30 students. The sample was selected using purposive sampling, considering that the class had characteristics relevant to the objectives of the study and was accessible to the researchers.

Although the One Group Pretest-Posttest design allows researchers to measure changes in students' learning outcomes before and after the treatment, it has several limitations. Since the study did not include a control group, the findings may be influenced by threats to internal validity such as maturation, testing effects, and external factors occurring during the research period. Therefore, the results should be interpreted as evidence of the potential effectiveness of microlearning videos rather than definitive proof of causality.

The research instrument consisted of a multiple-choice learning outcomes test comprising 15 items designed to measure students' cognitive achievement in the domains of C1 (remembering), C2 (understanding), C3 (applying), and C4 (analyzing). The test items were developed by the researchers

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based on the learning objectives and indicators of the coordination system topic. Prior to their use in the study, the items underwent validity testing through expert judgment and empirical item analysis. Reliability testing was also conducted to ensure the consistency of the instrument, while item analysis included the examination of item difficulty levels and discrimination indices to determine the quality of each question.

Data were collected through pretest and posttest administrations and analyzed using descriptive statistical techniques and the N-Gain test. Descriptive statistics were used to describe students' learning outcomes before and after the treatment, while the N-Gain test was employed to determine the magnitude of learning improvement resulting from the implementation of microlearning videos. Through the application of microlearning videos that present learning materials in short, focused, and engaging segments, this study is expected to provide a more effective learning experience and enhance students' understanding of coordination system concepts.

Result and Discussion

The research phase began with instrument validation by expert validators to ensure the instrument's suitability and quality before use in data collection. Next, the research data were analyzed using descriptive statistical analysis to provide an overview of the research data, as well as an N-Gain test to determine improvements in student learning outcomes after implementing video microlearning.

Descriptive Statistical Analysis

Table 1. Results of the Pretest-Postest Descriptive Statistics Test

Descriptive Statistics	Learning Outcomes	
	Pretest	***Posttest***
Sample	30	30
Maximum Score	86,67	100
Minimum Score	20,00	60,00
Median	46,67	80,00
Mode	33,33	73,33 and 80,00
Mean	49,77	79,77

Based on the data in Table 1 on Descriptive Statistics of Pretest-Posttest, there is a significant increase in the learning outcomes of class XI Biology 1 students after the learning process was implemented. This can be seen from the increase in the average score (mean) from 49.77 in the pretest to 79.77 in the posttest. In addition, an increase was also seen in the minimum score which was initially 20.00 increased to 60.00, while the maximum score in the posttest reached 100. This positive change was also reinforced by the increase in the median score from 46.67 to 80.00, indicating that most students obtained better learning outcomes after the treatment was given. In terms of mode, the most frequently appearing score in the pretest was 33.33, while in the posttest the most frequently appearing scores shifted to the higher categories, namely 73.33 and 80.00. In general, the results of the descriptive statistical analysis indicate that the use of microlearning videos has a positive influence on improving students' understanding and learning outcomes in the coordination system material. Next, student learning outcomes will be classified based on learning outcome categories.

Table 2. Distribution of Learning Outcome Grade Categories

Category	Learning Outcomes			
	Pretest		Postest	
	Frequency	Percentage	Frequency	Percentage
Very High	2	6,67	10	33,33
High	6	20,00	20	66,67
Moderate	3	10,00	-	-
Low	11	36,67	-	-
Very Low	8	26,67	-	-

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Table 2 shows a significant improvement in the learning outcomes of eleventh-grade Biology students between the pretest and posttest scores. In the pretest, the majority of students remained in the low and very low learning achievement categories. The low category was the most dominant, with 11 students (36.67%), followed by the very low category with 8 students (26.67%). Furthermore, 6 students (20.00%) were in the high category, 3 students (10.00%) were in the medium category, and only 2 students (6.67%) were in the very high category. These data indicate that before the learning intervention, more than half of the students still had a low level of understanding of the coordination system material.

After the implementation of the video microlearning learning process, the posttest results showed significant improvement. There were no longer any students in the medium, low, or very low categories. All students experienced improved learning outcomes, with 20 students (66.67%) in the high category and 10 students (33.33%) in the very high category. Thus, all students (100%) achieved high and very high scores in the posttest. These results indicate that the use of microlearning videos positively impacts student learning outcomes and is effective in helping students better understand the coordination system material.

N-Gain Test

Table 3. N-Gain Test Results: Pretest-Posttest

Statistics	Score
N	30
Minimum	45,45
Maximum	100,00
Average	60,83

Based on Table 3, the analysis results show that the average N-Gain score for students was 60.83, with a median score of 60.00. These results indicate that, in general, the improvement in student learning outcomes is in the moderate category. Of the 30 students in the study sample, the lowest N-Gain score was 45.45, while the highest score reached 100, indicating that some students experienced maximum learning improvement. Most students achieved N-Gain scores in the range of 55 to 67, indicating that almost all students experienced improved learning abilities, albeit at varying levels. This improvement in learning outcomes indicates that the use of microlearning videos in the learning process has a positive impact on student understanding of the coordination systems material.

Table 4. Categories Based on Scores

Effectiveness	Number of Students	Percentage
Effective	1	3,33
Quite Effective	19	63,43
Less Effective	10	33,33
Ineffective	0	0
Average		**60,83**

Based on Table 4, the results of the effectiveness analysis based on the N-Gain percent value show that the majority of students, namely 19 students (63.43%), are in the fairly effective category with a value range of 56–75%. Furthermore, as many as 10 students (33.33%) are included in the less effective category with a value range of 40–55%, while only 1 student (3.33%) reached the effective category with a value above 76%. In addition, there are no students in the ineffective category. The average N-Gain percent value obtained is 60.83 which is in the fairly effective category. These results indicate that the use of microlearning videos in the learning process can provide improvements in student learning outcomes, although its effectiveness still needs to be improved to obtain more optimal results.

Microlearning is a learning approach that presents material in small, concise, and focused units, making it easier for students to understand information in a relatively short time. Microlearning is particularly suitable for self-paced and just-in-time learning because it allows students to access material according to their needs. In the context of digital learning, it is also explained that implementing microlearning through digital and mobile devices can increase learning flexibility and student engagement, especially

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among the digital native generation, who are accustomed to using technology in their daily lives (Lisa et al., 2025).

The microlearning approach is a relevant learning innovation in today's digital era because it adapts to the characteristics of students who tend to prefer practical, fast, and easily accessible learning. Delivering material in a concise format can help students maintain focus, making the information received easier to understand and remember. Furthermore, the use of digital media in microlearning provides students with the opportunity to learn flexibly according to their individual time and learning needs.

The results of the research data analysis, presented in Appendix C1 on page 156, indicate that the use of microlearning videos positively impacted the learning outcomes of eleventh-grade Biology 1 students. This study aimed to determine the improvement in student learning outcomes after the implementation of microlearning videos on the coordination system topic. Based on the data analysis, a significant improvement in learning outcomes was observed between pretest and posttest scores. In the pretest, the average student score was 49.77. This score indicates that students' initial understanding of the coordination system topic is still relatively low, falling below the minimum mastery standard, which is generally set at 70–75.

The distribution of pretest scores shows considerable variation in students' initial understanding. The lowest score was 20.00, while the highest was 86.67. The significant difference between the minimum and maximum scores indicates heterogeneity in students' initial understanding of the learning material. Of the 30 students, 22 scored below 70, while only 8 students scored above 70. This indicates that most students still need effective learning strategies to improve their understanding of the coordination systems material.

After the video microlearning learning process was implemented, posttest results showed a significant improvement. The average student score increased to 79.77. This 30-point increase from 49.77 to 79.77 indicates that the use of video microlearning had a positive impact on student learning outcomes. In addition to improving the class average, this learning also helped narrow the understanding gap between high-ability students and those with low initial abilities. This demonstrates that the learning implemented was able to accommodate students' learning needs more equitably.

This improvement in learning outcomes indicates that video microlearning can create a more active and engaging learning environment than conventional learning. Students found it easier to grasp the material because information was presented in stages and focused on the core learning points. Furthermore, the use of short videos prevents students from getting bored easily, thus maintaining their attention to the learning material throughout the learning process.

Microlearning videos are characterized by short, concise, visual presentations that focus on core concepts. For the coordination system, this approach helps students understand the structure, function, and disorders of the nervous system, the hormonal system, and the sensory system more easily. Presenting material in an engaging visual format also increases students' attention, motivation, and memory during the learning process.

In addition to helping improve conceptual understanding, microlearning videos also provide students with the opportunity to review the material independently outside of class hours. Students can re-access the learning videos at any time if they experience difficulty understanding certain material. This flexibility is one of the main advantages of microlearning, as the learning process does not only take place in the classroom but can also be done independently according to the students' needs.

Based on the analysis results in Table 3 and Appendix C1, the average N-Gain value was 60.83, with a median value of 60.00. These results indicate that the improvement in student learning outcomes is in the moderate category. Of the 30 students studied, the lowest N-Gain score was 45.45,

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while the highest score reached 100, indicating that some students experienced maximum learning improvement. Most students obtained N-Gain scores in the range of 55–67, indicating that almost all students experienced learning improvement, although the level of improvement varied. This improvement indicates that the use of microlearning videos has a positive influence on students' understanding of the coordination system material.

The results of this study align with research conducted by Sa'diah and Muliyandari, which states that microlearning can improve learning performance, intrinsic motivation, and emotional and behavioral engagement of students in the learning process (Sa'diah & Muliyandari, 2024). Microlearning is considered appropriate for the characteristics of the current generation, which prefers practical, flexible, and accessible learning. Furthermore, microlearning is also seen as a modern learning design that utilizes digital technology to create a more engaging and effective learning experience.

This study also shows that the use of innovative learning media can help teachers create a more varied learning process. Lessons that previously tended to be monotonous can become more interactive because students are actively involved in understanding the content of the learning videos. This indirectly increases students' motivation to learn and curiosity about the biology material being studied.

Based on Table 4, the results of the N-Gain percentage analysis show that no students fell into the ineffective category. Ten students (33.33%) fell into the less effective category, 19 students (63.43%) fell into the moderately effective category, and only one student (3.33%) reached the effective category with an N-Gain score above 76%. These results indicate that the majority of students experienced significant improvements in learning outcomes after implementing microlearning videos. However, some students remained in the less effective category, requiring the development of more innovative and varied learning strategies to optimize learning outcomes. Overall, the use of microlearning videos can be said to have a positive and quite effective impact on improving student learning outcomes.

The findings of this study have important implications for biology teaching practices at the high school level. The improved learning outcomes demonstrated that microlearning videos can be an effective alternative learning medium, particularly for biology materials with complex concepts. Variations in N-Gain values across students also demonstrate the importance of implementing learning that takes into account differences in students' initial abilities and learning styles, thus optimizing the learning process.

Furthermore, the use of microlearning videos can be a solution for teachers in leveraging technological developments to support 21st-century learning. Teachers serve not only as transmitters of material but also as facilitators capable of delivering creative and innovative learning experiences. By utilizing digital technology appropriately, the learning process is expected to improve critical thinking skills, learning independence, and students' ability to understand scientific concepts.

The results of this study are also supported by the Multimedia Theory proposed by Richard E. Mayer in Kusumaningrum et al., which states that the combination of text, images, and visuals can improve students' understanding and retention of information. Microlearning can increase learning effectiveness through segmented content presentation and the use of engaging media (Kusumaningrum et al., 2026).

Although the research results indicate that microlearning videos are categorized as moderately effective with an average score of 60.83, this learning effectiveness has not yet reached the fully effective category. This is likely influenced by the fact that some students still received low scores, namely 45.45. This condition indicates that not all students are able to optimally understand the material

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through learning videos. Differences in student learning styles are suspected to be a contributing factor. Furthermore, the significant difference between the minimum and maximum scores indicates that students' levels of understanding are still uneven.

Another factor that can influence student learning outcomes is the individual's ability to utilize technology-based learning media. Some students may more easily understand material through visual and audio learning, while others require assistance or additional learning methods to fully understand the material. Therefore, teachers need to combine the use of microlearning videos with other learning strategies to ensure optimal learning outcomes for all students.

These research findings also align with the learning theory proposed by Edward Lee Thorndike. In implementing microlearning videos, students learn the material through short videos before the learning activity begins. This aligns with the law of readiness, as students already have a prior understanding before participating in classroom learning. Furthermore, the law of exercise is implemented through learning activities that provide opportunities for students to review and practice the material they have learned. The law of effect is evident when students receive positive feedback that increases their learning motivation (Mispandi et al., 2023).

The findings of this study demonstrate that the use of technology-based learning media, particularly microlearning videos, not only assists teachers in delivering learning materials but also increases student motivation, attention, and engagement during the learning process. Therefore, teachers need to develop skills in designing digital learning media that are appropriate to student characteristics and curriculum needs to make the learning process more engaging, effective, and meaningful.

Conclusion

Based on the results of the research that has been conducted, it can be concluded that the use of microlearning videos on the coordination system material has a positive influence on improving the learning outcomes of class XI Biology 1 students of SMA Negeri 2 Makassar. This is indicated by an increase in the average score of students from 49.77 in the pretest stage to 79.77 in the posttest stage. In addition, the results of the N-Gain analysis showed an average score of 60.83 which is in the moderate or quite effective category. Most students experienced an increase in learning outcomes and were in the fairly effective to effective category after the implementation of learning using microlearning videos. The use of microlearning videos that present material in a short, focused, interesting, and easily accessible way can help students understand the coordination system material better, increase learning motivation, and create a more effective and interactive learning process. Thus, microlearning videos can be used as an alternative learning media that supports improving student learning outcomes in biology subjects.

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