Development of Physics Learning Video Media Based on Microlearning

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Abstract

This study aims to produce learning media through microlearning-based physics learning videos. The feasibility test is measured through validation by experts and responses from teachers and students. So, the problem formulation for this research is: (1) How is the feasibility of the developed microlearning-based physics learning videos? (2) How did the Class XI MA PP DDI As-Salman Allakuang students respond to the developed microlearning-based physics learning video? (3) What is the teacher's response to the microlearning-based physics learning video? This research uses research and development methods, often called research and development (R&D). In this study, the ADDIE development design was used. This design consists of five development stages: analysis, design, development, implementation, and evaluation. The media and material validation results by the two validators were analyzed using the Gregory model, and the results of Gregory's analysis obtained the coefficient. Gregory's internal consistency is ≥ 0.75. In this case, microlearning video media can be used. As for the results of the analysis of student responses to this development, the video media received a very good response from students, with 98 students in a score interval of 81–100 in the "Very Good" category. Meanwhile, in the analysis of teacher responses, the developed video media received a very good response from the teachers, with two teachers scoring at an interval of 81–100 in the "Very Good" category. Based on the results of the research put forward, it can be concluded that the developed microlearning-based physics learning video media is suitable for support the learning process and gets a very good response from students and teachers.

Keywords: *ADDIE; Microlearning; Physics Learning*

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INTRODUCTION

In the advancing digital age, video media has become one of the popular tools in education. The use of video media in education has shown a significant upward trend in recent years (Putry et al., 2020). Efficiently harnessing technology to support education can make education more relevant and engaging and enhance meaningful skills for learners (Archibald et al., 2014; Oktavia, 2017; Pearth et al., 2017; Williams et al., 2017). In physics, instructional video media has been widely used to help learners understand complex and abstract concepts. Effendy et al. (2019) explained in their journal
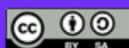
that physics is integral to natural science. Essentially, physics is the study of natural phenomena in the form of facts, concepts, and laws that have been tested through a series of research.

Learning objectives are more likely to be achieved when instructional media and supporting materials are used in the learning process. Furthermore, instructional media can motivate learners (Puspitarini & Hanif, 2019).

The utilization of video media in physics education offers several significant advantages. Video media can deliver learning content in a visual and audiovisual manner, enhancing learners' appeal and interest in the learning material. By presenting engaging images, animations, and demonstrations, video media can help learners visualize difficult physics concepts that are hard to grasp through text or static images. Learners can actively participate in the teaching and learning process and use media to meet their learning needs and preferences (Jennah, 2009).

Moreover, video media allows learners to access learning materials anytime and anywhere. In a busy and highly mobile world, this flexibility is invaluable. Learners can review and access instructional videos as needed, allowing them to learn independently and at a pace that suits their abilities.

However, instructional video media also has some disadvantages. One is the challenge of ensuring the quality of the presented video content. Instructional video content must be carefully designed to remain accurate, relevant, and easy to understand for learners. Additionally, limitations in accessibility and the availability of the necessary technology devices to play videos can be obstacles for some learners. Especially for physics education, teachers are expected to communicate these concepts with methods relevant to everyday life because physics content is related. One of the abstract topics learners consider is

pressure; many learners struggle to understand the content with concrete methods. Because many formulas are required to apply physics, many learners eventually become disinterested in the subject. If only lectures are used, students will become very bored. Teachers must select materials and content to shift learners' perspectives (Astuti et al., 2017).

In the subject of physics for high school students, it is considered difficult by learners. Therefore, great focus and concentration are required during the learning activities. "... student attention during lectures tends to wane after approximately 10–15 minutes." Bradbury (2016) quoted from the book "Tools for Teaching," Davis (1993) stated that learner focus during learning tends to decline after approximately 10-15 minutes. In recent years, there has been significant development in the utilization of video media to support microlearning concepts. Microlearning is a learning approach that presents information and learning materials in bite-sized or small digestible formats.

The development of education based on microlearning started due to this research. Since microlearning associates educational goals with performance outcomes, it is short-term, with a single conceptual objective. Storyboards and narratives are formed in the creation process of microlearning, one of which is the creation of actual products (Ariantini et al., 2019). According to Nugraha et al. (2021), various different media formats can be used in microlearning, including animated videos, whiteboard animations, kinetic text-based animations, explainer videos, interactive parallax scrolling, webcasts or podcasts, expert videos or webinars, and mobile applications.

The development of physics learning video media based on microlearning is a response to this trend. Compared to other educational methods used to address contemporary educational issues,

microeducation is perhaps the best option, according to Ruhaliah's research (Ruhaliah et al., 2020). Marti & Ariani (2023), in their article, explained the research on the development of video learning media conducted in the Computer Science S1 Study Program at Undhiksa. They deemed it necessary to develop microlearning-based learning designs in the learning process. The reason for adopting a microlearning-based learning design is that the course demands deep cognitive understanding. By providing short content and instructional videos, it is hoped that learners can better understand the material quickly, thus achieving the learning objectives.

Javocik & Polasek (2019) conducted research and found that people are beginning to avoid lengthy and time-consuming e-courses, requiring a different approach that suits modern lifestyles. Even learners want to see courses broken down into smaller parts. This can be seen in learners' activities at the beginning of the semester; they check all subjects, download important materials, and submit assignments or take quizzes at the end of the semester. Javocik assumes that by providing material in smaller segments, learners can learn at their own pace by adapting microlearning to meet their needs, and teachers can easily manage instructional materials. It is clear that to keep up with current trends, we do not need to change educational content but only its format (especially the duration of learning).

In Giurgiu's research (2017), Giurgiu concluded that microlearning can be used as a pragmatic innovation. By pragmatic, it means that it aligns with current information and communication and can be easily adapted to support self-directed learning needs, especially in outside-the-classroom learning.

However, these studies have not specifically focused on developing instructional videos for physics with a micro-learning approach. This paper describes how video media can be effectively developed to support physics concepts through a microlearning approach. Effective video design methods to create engaging and easily understandable physics learning materials in a bite-sized format are explored. Then, the advantages and challenges of using microlearning-based video instructional media in improving learner outcomes are discussed.

This approach is known to have the advantage of presenting learning materials briefly and in a structured way, making it easier for learners to remember and understand the concepts presented. Therefore, the development of physics learning video media based on microlearning in three-minute animated videos uploaded to social media is conducted. The animations displayed in the microlearning video include typography, laboratory practice animations, and illustrations. These advantages would have a significant impact on the world of educational media.

METHOD
This research utilized the Research and Development (R&D) method, known as R&D, which is a research strategy to create and evaluate learning products. (Akker et al., 2006) stated that development research is research conducted to produce a product while considering its quality. On the other hand, according to Herlanti, it is an effort to develop a product and not to test theories (Herlanti, 2014).

The participants in this research were teachers and students of class XI and XII at MA PP DDI As-Salman Sidrap, who accessed the developed video learning media. The total number of subjects is 113 students and two teachers.

The developed microlearning videos are animated videos with 3-5 minutes covering the material from class XI of

high school, specifically hydrostatic pressure. The microlearning video content is divided into three types out of thirteen developed videos: Definition, Experiment, and Sample questions. In the Definition content, illustrations are presented to visually explain the learning material so that students can understand the concept being taught. In the Experiment content, animated videos of simple experiments are shown to demonstrate the concepts learned in the Definition content. This content aims to guide students in conducting their experiments with the help of a teacher. The last content is the Sample questions, which include example questions based on the experiments students have performed, allowing them to compare physics theory with the experiments they have conducted. Based on the explanation above, it can be concluded that each content is interrelated even though they are divided into small parts. The developed microlearning videos are uploaded to social media platforms so students can access them freely.

The ADDIE development design is applied in this research. Analyze, Design, Develop, Implement, and Evaluate are the five development stages for this design. Dick and Carey developed this design. Creating physics learning video media based on microlearning is organized using the ADDIE development design. Below is the diagram of the ADDIE development design.
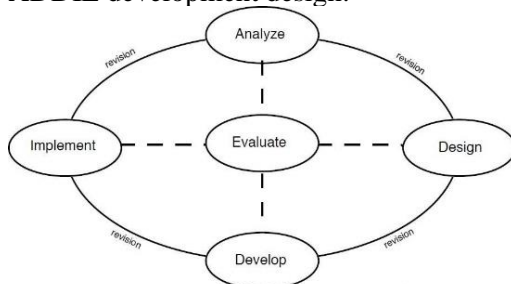

Figure 1 ADDIE development design diagram

This research consists of analyze, plan, develop, implement, and evaluate stages.

The following are the developmental methods carried out in this research.

Analysis Stage

The analysis stage is conducted to obtain the necessary data before the planning phase. Data collection techniques are strategic steps in research to obtain data (Sugiono, 2015). This data will be used as a guideline for creating learning media. In this analysis stage, the researchers analyzed several aspects, including a) The data collected includes competency standards from Fluid Statics materials, indicators, and learning materials. This ensures that the media created aligns with the learning objectives. As explained by Rohman (2013), the required data includes: a) all the teaching aids needed by the teacher to deliver the material to the students in teaching activities and facilitate the achievement of learning objectives; b) Data collected include available learning media previously used at the research site; c) Data collection about student analysis to understand the characteristics and abilities of students.

Interviews are a data collection technique conducted to obtain more detailed data from respondents (Sugiono, 2015), especially related to respondents' behavior in the research (Indrawati, 2018). Therefore, the Physics teacher at MA DDI As-Salman Sidrap was observed and interviewed as part of field observation. Learning resources include textbooks and modules, in line with the interviews conducted.

In addition to module and textbook media, MA DDI As-Salman Sidrap school also has an LCD projector that teachers can use to support teaching activities in the classroom. Moreover, students each have gadgets, and some even have laptops that can support the learning process both in the classroom and for self-study at home. Data collection related to the characteristics of students resulted in the finding that students of class XI and XII at MA DDI

As-Salman Sidrap have a visual learning style and a reading learning style, with average student abilities being standard.

The data collection results indicated that students' lack of interest and focus during learning is a major problem in studying physics. Only a small percentage of students are enthusiastic about working on practice questions when instructed by the teacher, as explained by the teacher. Due to their perception that physics is difficult to understand, students are usually less enthusiastic about attending physics lessons. Since not much learning material is available outside of school hours, students have to spend their study time in class, reducing their enthusiasm for learning physics.

A good learning video can engage students in the learning process. Mutia (2017) emphasized in her journal that 90% of a person's learning outcomes are achieved through visual perception, 5% through hearing, and 5% through other senses. To make the video appealing to students, a good script scenario needs to be developed in the second stage.

Design Stage

The second stage involves creating the design of the media to be developed. The approach is to design a storyline and then create a storyboard that outlines the design plan for the Static Fluids material based on the data obtained during the analysis process. The content of the microlearning video media includes an explanation, experiments, and sample questions related to static fluids.

The planning for creating the microlearning video is based on the information obtained during the analysis stage. The findings from the analysis indicate that engaging learning resources are needed for students to continue their studies outside the classroom. The planning results for the entire process of creating microlearning videos are depicted in Figure 2.
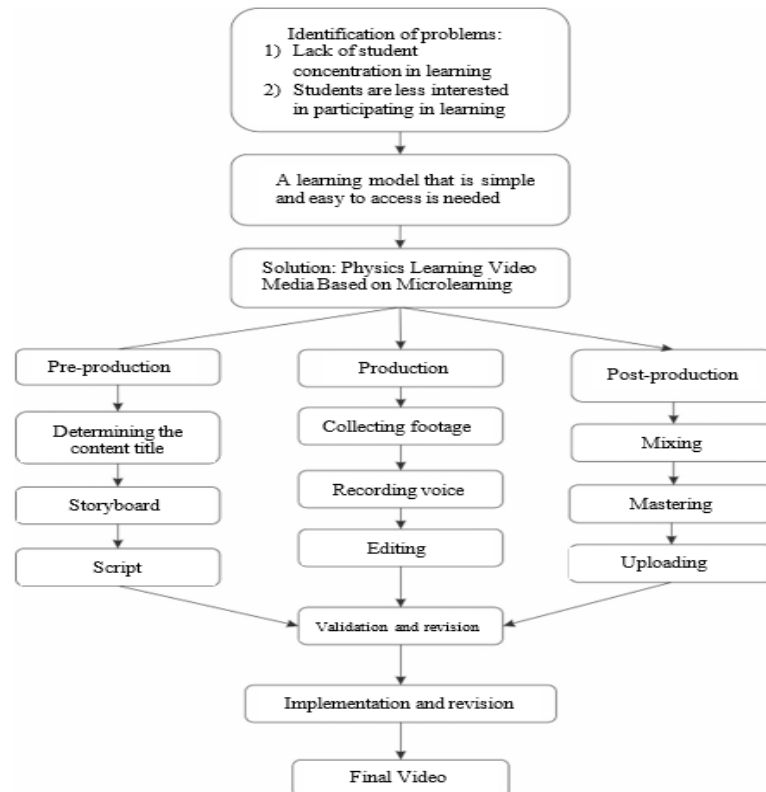

Figure 2 Flowchart of the microlearning video media development stage

Research Instruments

The research instruments used have met the requirements of Gregory's validation theory, which involves two validators. The internal consistency coefficient of this research instrument is 1, which is considered valid for measuring the responses of students and teachers.

The results of the validation assessment of the instructional media in the form of guided video can be interpreted into several types: a) The microlearning video can be used without any revisions, b) The microlearning video can be used with minor revisions, c) The microlearning video can be used with significant revisions, d) The microlearning video cannot be used and requires consultation.

The analysis used to test content validity can be conducted both qualitatively and quantitatively by several expert individuals. The analysis method used is based on the agreement of two Gregory formula experts, recorded in a cross-tabulation table, as shown in Table 1.

Table 1 Table of Gregory formula

Table of Gregory		Validator 1	
		Score 1-2 (Irrelevant)	**Score 3-4** (Relevant)
Validator 2	**Score 1-2** (Irrelevant)	**A**	**B**
	Score 3-4 (Relevant)	**C**	**D**

Gregory's Internal Consistency Coefficient is the number of items in column D divided by the total number of items in the assessment items in columns A + B + C + D (Privitera, 2015). The obtained level of validity will be compared with the validity test criteria. If the Gregory internal consistency coefficient is≥ 0.75, it can be considered valid. Therefore, it can be concluded that the physics learning video media based on microlearning is suitable for supporting the learning process.

In addition, questionnaires were conducted to measure the reactions of students and teachers as follows. The student response questionnaire is used to understand students' perceptions after using the physics learning video media based on microlearning. The questionnaire indicators used include media presentation, media duration, utility of using media, content presentation, coherence of examples/illustrations with the material, and the use of language in the media. The teacher response questionnaire is used to understand the assumptions of physics teachers when using the physics learning video media based on microlearning. The questionnaire indicators used include media presentation, media duration, utility of using media, content presentation, coherence of examples/illustrations with the material, and the use of language in the media.

Information analysis was conducted based on the scores obtained from the observation of teacher and student response questionnaires. Scoring in this research used a Likert scale, as shown in Table 2.

Table 2 Likert scale

Category	Score
Strongly Agree (SA)	5
Agree (A)	4
Uncertain (U)	3
Disagree (D)	2
Strongly Disagree (SD)	1

(Sugiyono, 2012)

If the percentage scale score indicates a percentage above 61%, then the media is considered attractive and efficient for learning.

RESULTS AND DISCUSSION
Pre-Production Phase
The researchers established the goals for creating microlearning videos and

created content for the media that aligns with the learning objectives and basic competencies. The selected basic competencies include 3.3 Applying the laws of static fluids in everyday life and 4.3 Designing and conducting experiments that utilize the properties of static fluids, including the presentation of experiment results and their applications. The design of microlearning videos requires supporting components such as material summaries, learning evaluations, practical worksheets (*Lembar Kerja Peserta Didik*/LKPD), storylines, storyboards, and other media support components.

The initial title concepts for microlearning video content included Introduction to Hydrostatic Pressure, Pascal's Law and Its Applications, The Working Principle of Submarines, and Pressure at the Ocean Floor. These initial titles were evaluated and revised to make them more specific and focused so they would align better with the microlearning videos. As a result, the final titles were as follows: What is Pressure, Hydrostatic Pressure, Examples of Hydrostatic Pressure Problems, Hydrostatic Pressure Experiments, Archimedes' Principle, Examples of Archimedes' Principle Problems, Pascal's Law, Examples of Pascal's Law Problems, What is Capillarity, Contact Angle in Capillarity, and Viscosity. In addition to planning, the content titles, storyboards, and scripts were created to facilitate the development of the microlearning video.

According to Daryanto (2013), video scriptwriting involves designing various variations of sound and images to capture the audience's interest. Therefore, good scriptwriting is essential for instructional videos to ensure learners receive complete and clear information through their senses. Fauzan & Rahdiyaanta (2017) researched video-based teaching media that was validated by content experts and found a percentage of 96.50% with a classification of "very good." Likewise, when media experts validated the videos, a percentage of 80.63% with a classification of "very good" was obtained. The perception of subject teachers resulted in 76.25% with a classification of "very good," and the evaluation responses from students yielded a percentage of 80.52% with a classification of "strongly agree" regarding the use of this instructional media.

Production Phase
The Dolby on application was used for recording narrations in the development of microlearning video media. Dolby On is both a recording and sound editing application. After all the recorded narrations were collected, the next step was to edit or edit the video. The application used for video editing was Adobe After Effects. Animation for the microlearning video was created using the Adobe After Effects application. The editing process in Adobe After Effects is shown in Figure 3.
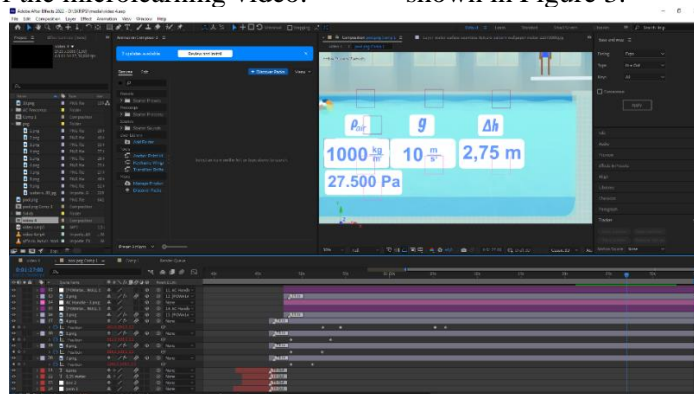

Figure 3 Editing process in adobe after effects

In the next stage, all the supporting components from the design phase were combined to create a video that lasted less than 2 minutes. The microlearning video was then uploaded to YouTube.

Post-Production Phase
The first step in this phase was mixing. This involved adding an intro and outro to the video as complements and a way to provide identity to the developed microlearning video.

After the mixing stage was completed, the next step was to render or process the entire video. Rendering is converting the video and audio that have been combined into a format that users can access, such as MP4, MKV, AVI, or other formats. Additionally, during the rendering stage, the video's resolution can be adjusted and compressed to make the file size more efficient without compromising its quality.

Once the video had been rendered, the final step was uploading the video to the intended platform, which, in this case, is the YouTube channel. When uploading the video, it is important to ensure that it has a clear description, appropriate metadata, and tags or categories that facilitate users in finding and accessing it (Anam, 2020).

The microlearning video developed on YouTube was then validated to assess the suitability of the content and the medium. The response questionnaire was validated before being used to assess the responses of both students and teachers. Two media experts validated the microlearning video and response questionnaire. The instruments to be validated included media validation, content validation, and validation of questionnaires for teachers and students. After validation, the microlearning video and response questionnaire are revised based on the feedback from both validators. Data from the validation results were analyzed using the Gregory formula.

In this research, content validation was conducted to evaluate the content within the media. Validation is performed by content experts who gather and modify suggestions and opinions. The material verification sheet consists of 15 items, and the results of the content verification are shown in Table 4.

Table 4 Content validation results by validators

Assessment Indicator	Validator Assessment		Score	Information
	1	**2**		
Alignment of Content with Learning Objectives	4	4	D	Valid
Content Accuracy	4	4	D	Valid
Content Novelty	4	4	D	Valid
Presentation Technique	4	4	D	Valid
Clarity	4	4	D	Valid
Communicative	4	4	D	Valid
Language Suitability	4	3	D	Valid

The results of the Gregory analysis obtained a Gregory internal consistency coefficient of ≥ 0.75. In this case, the microlearning video media can be used.

Following that, media validation was performed. Ten statements regarding visual, audio, and video duration indicators form the media validation. The results of media validation are shown in Table 5.

Table 5 Validation results by validators

Assessment Indicator	Validator Assessment		Score	Information
	1	2		
Visual	4	4	D	Valid
Audio of the Video	4	4	D	Valid
Duration	4	4	D	Valid

The results of the media validation analysis yield a Gregory internal consistency coefficient of ≥ 0.75. In this case, the microlearning video media can be used with minor revisions. The media validation sheet also included a comments or improvement ideas column, which can be used to identify items that validators believe need to be changed or improved.

Validator 1 provided feedback suggesting improvements to some videos, particularly regarding the speed of narration in the audio, which made it difficult for the validator to grasp the content presented in the video.

Validator 2 suggested that the microlearning video media could be used with some minor revisions, including the addition of Competency Standards and learning objectives to the microlearning video media to help teachers and students select videos for learning. These changes can be seen in Figure 4 and Figure 5.
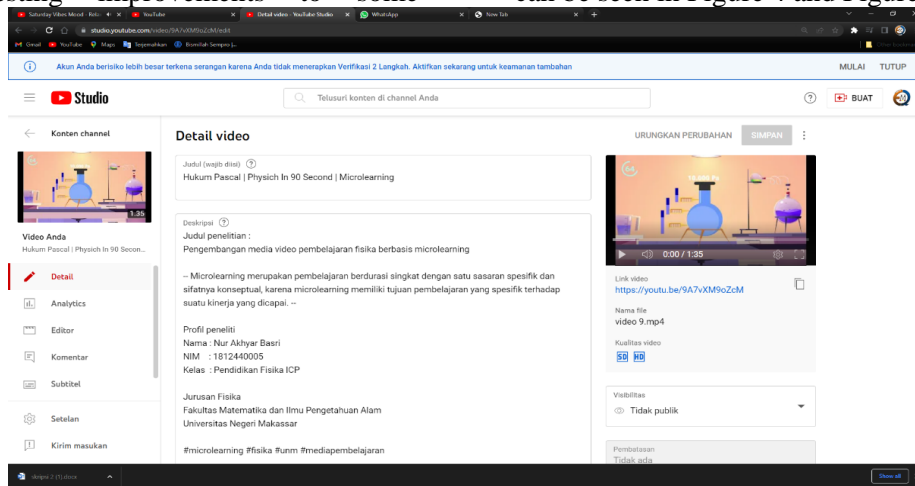

Figure 4 Description display on youtube social media before revision
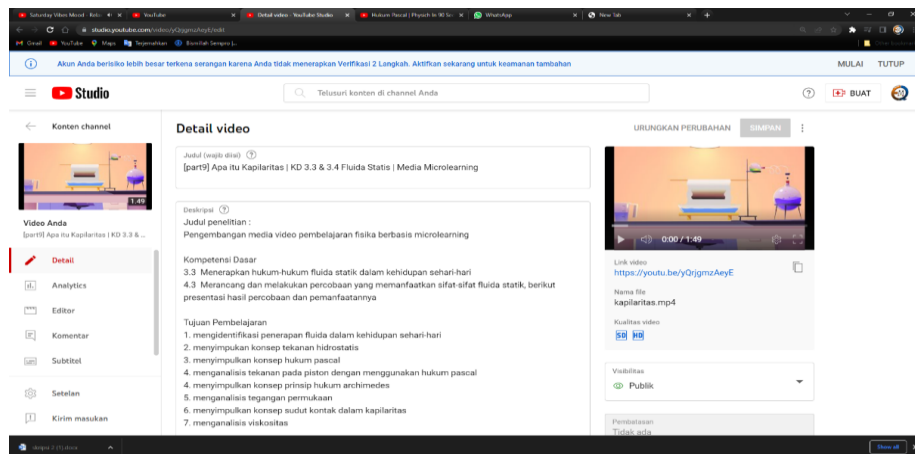

Figure 5 Description display on youtube social media after revision

Implement Phase

The product is implemented after revisions to the microlearning video, student response questionnaires, and teacher response questionnaires. The microlearning video media was implemented from October 26 to November 9, 2022. This phase was applied to 113 students and two 11th and 12th-grade science teachers. The implementation of the microlearning video involved socializing the students about the microlearning video media and how to access it. This was followed by explaining the microlearning video media to the teachers. Students were directed to access the microlearning video gradually outside regular class hours.

The results of the analysis of student and teacher response questionnaires for each assessment indicator are shown in Table 6 and Table 7.

Table 6 Analysis of student responses for each indicator

Assessment Indicator	Percentage Average (%)	Criteria
Media appearance	89%	Very Good
Duration of media	81%	Very Good
Advantages of media use	88%	Very Good
Material presentation	83%	Very Good

Table 7 Analysis of Teacher Responses for Each Indicator

Assessment Indicator	Percentage Average (%)	Criteria
Media appearance	96%	Very Good
Duration of media	90%	Very Good
Advantages of media use	93%	Very Good

Assessment Indicator	Percentage Average (%)	Criteria
Alignment of Content with Learning Objectives	943%	Very Good
Sample coherence/ illustration	95%	Very Good
Language esp. Language on media	100%	Very Good

In addition to the analysis based on indicators, an overall assessment of the microlearning video media can also be determined. The frequency of student responses and teacher feedback as a whole is shown in Table 8 and Table 9.

Table 8 Student response categories

Interval of Score	Frequency	Category
81-100	98	Very Good
61-80	15	Good
41-60	0	Fair
21-40	0	Poor
0-20	0	Very Poor

Table 9 Teacher response categories

Interval of Score	Frequency	Category
81-100	2	Very Good
61-80	0	Good
41-60	0	Fair
21-40	0	Poor
0-20	0	Very Poor

In Table 8, the analysis of student responses indicated that the developed microlearning video media received a "Very Good" response from students, with 98 students falling within the score range of 81-100 in the "Very Good" category. Meanwhile, in Table 9, the analysis of teacher feedback shows that

the developed microlearning video media received a "Very Good" response from teachers, with two teachers falling within the score range of 81-100 in the "Very Good" category.

Product evaluation was conducted after implementing the microlearning video media on static fluid materials for the test subjects. The evaluation phase was the final stage of the ADDIE design development process, but if revisions were deemed necessary, they would be carried out.

Based on the analysis results from the implementation phase, the microlearning video media can be used with minor improvements. These improvement suggestions come from teachers who were test subjects in this research. The suggested improvements included providing various options for social media sites to access the microlearning video media so that students can access the video on their social media platforms.

The evaluation results are based on feedback from teachers during the implementation process. Therefore, it is considered necessary to realize the suggestions from teachers so that students can access the microlearning video on other social media sites. Thus, Instagram, TikTok, and YouTube were chosen as social media platforms for publishing the microlearning video, whereas previously, the microlearning video could only be accessed on YouTube.

Based on the results of the development research of microlearning videos presented, two main points indicate that the developed microlearning video media is suitable for use:

Based on expert assessments:

Through media validation and material validation by two expert media validators, the analysis results show that the internal consistency coefficient Gregory ≥ 0.75. This indicates that the media and content in the microlearning videos used in the research have a high level of consistency. In this analysis phase, the researchers used instruments to measure the effectiveness of microlearning video media (Gregory, 2015).

Results indicating good internal consistency coefficients indicate that the microlearning videos are reliable and provide consistent and trustworthy results. Therefore, indicators such as material compatibility with basic competencies, material currency, material accuracy, material presentation technique, language conformity, video appearance, and audio and video duration have met acceptable standards for use. Therefore, this supports the usability of the developed microlearning video media.

Based on Student and Teacher Responses:

Based on the assessment indicators in the questionnaires for both teachers and students, including (1) media appearance, (2) media duration, (3) usefulness of the media, (4) material presentation, (5) coherence of illustrations with the material, and (6) language usage in the media, it was found that students responded with scores ranging from 81-100, indicating a "Very Good" rating. This suggests that students liked and found the video media helpful in learning. Similarly, teachers rated it as "Very Good," indicating that teachers consider the video media effective and relevant in delivering the learning material. With positive responses from students and teachers, it can be interpreted that the microlearning video media has succeeded in achieving its development goal as an effective learning tool.

Based on the results described above, this research can be accepted because the evaluation results indicate that the developed microlearning video media is effective and functions well in the context of learning, as it received high

ratings based on the assessment indicators mentioned. This aligns with what Leong mentioned in his journal (Leong, 2021), where he explained that microlearning has several significant benefits. First, it enhances the retention of microlearning concepts. Second, students are more engaged in the learning process. Third, it can increase student motivation. Fourth, it allows students to engage in collaborative learning. Finally, microlearning can also improve students' learning abilities and performance.

A high internal consistency coefficient indicates the microlearning videos' excellence, making the assessment results reliable (Gregory, 2015). Furthermore, the positive responses from students and teachers affirm that this video media can enhance interaction and understanding in the learning process.

Based on the explanation above, the background of this research has been achieved. Here is the summary: Before being widely used, microlearning video media has undergone validation by experts in the field. This validation ensures that the media meets quality and effectiveness standards in supporting learning. With satisfying validation results, the microlearning video media is considered suitable and reliable for use by teachers and students as a high-quality learning tool.

This research aims to develop microlearning video media as a learning aid. By using microlearning video media, students can access learning materials outside of class hours. Additionally, they have the flexibility to learn at their chosen times, allowing them to adapt the learning process to their individual needs and schedules.

The microlearning video media developed in this study benefits students and teachers. With microlearning video media as a learning aid, teachers can use videos to support and reinforce the delivery of materials in the classroom.

This aligns with the work of (Amri & Rohman, 2013).

This advantage enables teachers to capture students' attention more engagingly and interactively. This conclusion aligns with the findings of (Nugraha et al., 2021). With these explanations, the background of this research is considered to have been achieved. Furthermore, this research can provide a positive and effective contribution to the field of education by utilizing microlearning video media.

CONCLUSION

Based on the research, it can be concluded that the developed microlearning videos are suitable for learning because instructional media experts have validated them. However, experts note improving the content covered in the microlearning videos to better achieve the learning objectives.

The microlearning videos implemented to gather student responses received very positive feedback based on the Likert scale table. However, this research does not analyze students' learning outcomes before and after using microlearning videos to support the learning process.

The implementation of microlearning videos received very positive responses from teachers. Some notes from teachers and experts regarding using microlearning videos as a learning medium. The input from teachers includes the need to improve access to microlearning videos on various social media platforms. The suggestion from experts for future researchers is to develop microlearning videos that are more straightforward so that teachers can create, replicate, and modify the media to align with the instructional plans they have prepared.

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