MICRO-LEARNING VIDEO BASED ON SIGNALING IN COMPUTER GRAPHICS COURSES

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Abstract: The use of video media has now spread to various levels of education. Video is an effective means of conveying information in the digital era. One of the less good video message designs is the dense content of the material, which can burden the cognitive burden of students. Students find it difficult to process information and find the core of a material, so it is difficult to understand its contents. For this reason, video design needs to pay attention to the right message presentation strategy with the principle of micro-learning so that the presentation of the material is more to the point and concise. In addition, applying the signaling principle will tell students important words in the visual display. The objectives of this study are to describe the validity and attractiveness of signaling-based micro-learning videos. This study is a development study that aims to produce videos by prioritizing innovation in the form of applying the principle of signaling-based micro-learning. Micro-learning provides a reference so that videos are presented in small and short units. Then, important words in the content are marked with color or animated. The video was developed using a 4D model consisting of defining, designing, developing, and disseminating. The validity test involved two experts: media and learning design experts. The attractiveness test involved 12 students. The validity test results showed that micro-learning videos have very good design and media validity. Likewise, the attractiveness of the media, according to students, is very good.

Keywords: video, *micro-learning*, *signaling*

INTRODUCTION

The development of information and communication technology has made the delivery process easier. The type of media that is currently quite popular in communication is video. Video media, since covid 19, has experienced quite significant growth in learning. On the other hand, few learning video message designs suit students' characteristics. As is known, students at the tertiary level today were born after 2000 or are known as Generation Z. (Cilliers, 2017). The tendency of Generation Z to think is to want everything fast. This generation also tends to depend on information and communication technology. Quoted from the *generationz.com.au site*, it is stated that Generation Z has the following characteristics: global thinking, digital communication, socializing, *mobile*, and liking visual things.

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Today's students need flexibility in learning. The Internet and laptops or smartphones allow students to learn anywhere and anytime. Through *Smartphones*, students can choose the material they are interested in, set the pace of learning, and access the material anytime and anywhere. The results of the study also show that *smartphone usage* in the current generation is 94%. The causes of the high level of *smartphone usage* include 1) *smartphones* and tablets as a means of introducing information and communication technology; 2) *smartphones* and tablets as educational media to increase insight; and 3) *smartphones* and tablets as a means of entertainment (Zaini & Soenarto, 2019).

The high use of *smartphones* is also closely related to the content accessed. Based on a survey (Saputra, 2019), YouTube is the number 3 social media that is often accessed by students. This means that the opportunity to use social media in learning, especially those containing videos, is very high. Several years ago, during the Covid-19 era, videos were massive in distance learning, both in the form of video *conferences* and learning videos sent via *links* or *files*. Although video is not a new media, there are not many learning videos that apply the right strategy in presenting messages or materials. For example, the duration of the video is too long, the presentation of dense text, the complexity of information in the video, and the unclear audio elements. The impact of these weaknesses is that students do not optimally process the information presented in the video. Students only watch videos but do not understand the information presented properly (Zheng, 2022). Students only watch videos but do not encourage learning. In addition, the use of Inappropriate learning videos can cause students' understanding to not increase significantly and waste learning time (Fyfield et al., 2022).

Videos that are often used by *students,* especially in computer graphics courses, are obtained from the Internet. The content of computer graphics courses is currently only in the form of textbooks. It turns out that the video content obtained by *students* has not been designed much by prioritizing pedagogical aspects, learning theories, information processing theories, or multimedia theories. For example, the presentation of material is too dense, which can burden the cognitive capacity of students (Albus et al., 2021). In fact, cognitive load is the main consideration when designing learning videos or multimedia (Mayer & Moreno, 2003). In addition, previous studies have only developed *video microlearning* without adopting pedagogical theory (Kusnandar, 2013). In addition, there are few learning videos that can activate *students*. Videos have yet to be designed to encourage students to be actively involved in learning. Learning should be better when the media is able to actively involve students in learning (Mayer et al., 2020).

Student characteristics , multimedia theories, learning theories, and information processing theories it is considered essential to develop learning videos using *micro-learning theory* and *signaling principles* so the video innovation proposed as a solution is *signaling*-based *micro-learning videos*. The developed *micro-learning* videos are designed so that students can select information quickly and then organize the information in working memory. Furthermore, the information is integrated into long-term memory or can also be applied to performance. With the *micro-learning* method, videos can be made based on the characteristics of students with various combinations of forms ranging from text, audio, video, and animation briefly in small or short units (Nugraha et al., 2021). Applying the *signaling principle* also facilitates students in quickly finding important words or main points from a visual display. The study results showed that the

application of material broken down into smaller, shorter parts requires less cognitive load because it presents less information (Mayer & Moreno, 2003; Moreno, 2007). *Micro-learning* videos play an important role in helping educators and students solve problems and increase autonomy and collaborative learning. (Chang & Dong Liu, 2015). Students will find it easier to understand important information in a video and remember it easily. In addition, the change from printed content to digital content is a demand in the era of the Industrial Revolution 4.0. Content that is realized in digital form is more effective than printed form (Torkar, 2021). Based on the problems described and the study's results, research was conducted by developing learning videos using the principle *micro-learning* and *signaling principles* to improve learning outcomes in computer graphics courses.

RESEARCH METHODS

This type of research is development research using the 4D model. The development of *micro-learning* videos is preceded by needs analysis, script design, production, and product implementation. Evaluation activities are carried out at each step of development. The explanation of each stage is as follows.

1. *Define* stage is formulating the product concept, which includes the following activities: a) determining objectives, b) analyzing material in the form of topics and sub-topics, and c) analyzing student characteristics.
2. *Design* stage is to create detailed specifications regarding the architecture of *microlearning video* . Activities in the design stage are: a) mapping the types of *microlearning videos*, b) creating *video storyboards,* and c) integrating the principles of *micro-learning* and signaling.
3. *Developing* is to realize *the storyboard* into *a micro-learning video*. *Microlearning videos* such as text, images, animations, sounds, and videos are arranged according to their respective roles. At the development stage, *microlearning video testing is also carried out* using formative evaluation techniques (Dick, Carey, L, & Carey, J. O, 2005). The evaluation stages are evaluation by experts (3 experts: 1 design expert, 1 media expert, and one content expert), three students in individual evaluation, and 12 students in small group evaluation.
4. *Disseminate*. This research has yet to be conducted due to the limited time and cost required.

As a result of development, micro-learning videos must go through a series of trials to determine the level of validity and attractiveness. The validity and attractiveness *of microlearning videos* can be known through the results of expert *review analysis*, individual tests, and small group tests. Data were collected using a questionnaire method to obtain data from experts and *students* during individual and small group trials. Efforts were made to ensure the validity of the questionnaire by making a grid table and writing the instrument. The grid of the validity and attractiveness test instrument for micro-learning videos is presented in Table 1.

Table 1. Product Validity Test Instrument Grid

No.	Stages of Formative Evaluation	Aspect	Number of Items
1	Media Aspect Validation	1. Typography	11

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		2. Graphic 3. Audio 4. Systematics	
2	Validation of learning design aspects	1. Learning design 2. Message delivery strategy 3. Display design	12
3	Individual test	1. Clarity 2. Attraction 3. Legibility 4. Language 5. Ability to motivate 6. Technical Quality	7
4	Small group test	1. Clarity 2. Attraction 3. Legibility 4. Language 5. Ability to motivate 6. Technical Quality	7

Source: Adapted from(Branch, 2009)

The data that was collected using the questionnaire method was then analyzed using descriptive statistical analysis. The formula used to calculate the percentage of each respondent is as follows.

$$\frac{\Sigma x}{SMI} x100$$

Table 2 shows the scores obtained from expert validation and student trials converted using a 5-point scale benchmark assessment.

Table 2 Guidelines for Conversion of Achievement Levels with a 5-point Scale

Achievement Rate (%)	Qualification	Information
90-100	Very good	There is no need to revise
75-89	Good	Slightly revised
65-74	Enough	Revised as needed
55-64	Not enough	Many things were revised
0-54	Very less	Repeatedly making products

Source:(Tegeh, I M. & Kirna, 2010)

RESEARCH RESULT

The development of *micro-learning videos* uses the 4D model, namely *define, design, develop, and disseminate.* The first stage is to define. At this stage, several activities are carried out, namely: (1) determining learning objectives and (2) analyzing types of knowledge. The results of the first stage are presented in Table 3.

Table 3. Results of Content Analysis of Computer Graphics Course

No	Learning Outcomes	Learning objectives	Micro Video Count	Types of Knowledge
1.	Understanding the concept and	• *Students* examine the concept of visual communication design	3	Conceptual

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	design terminology visual communication	• *students* examine the concept of computer graphics • *Students* conduct discussions about graphic design principles		
2.	Understanding layout design	• *Students* study layout design concepts • *students* study the principles of layout • *students* discuss design elements	3	Conceptual and Principles
3.	Practicing simple image creation techniques using vector image processing software	• *Students* practice installing graphics processing software • *Students* create patterns using vector graphics software	2	Procedural
4.	Practicing coloring techniques	• The concept of color in the computer world • Solid color technique • Brush technique • How to apply color effects	3	Procedural
5.	Presenting learning messages through graphic media	• *Students* practice making graphic media layout sketches • *Students* practice implementing graphic media using software	2	Procedural

Design Stage. At this stage, detailed specifications of the *micro-learning architecture are made*. The focus of the design stage is to create a micro-learning *storyboard*. At the *development stage, activities are carried out to realize the storyboard into a micro-learning* form. *The storyboard*, which comes from the design stage, is used as the basis for creating *micro-learning products. Micro-learning* uses various media, including text, images, animation, sound, and video, according to their function. The microlearning videos that have been produced are presented in Figure 1.

Figure 1. Microlearning Front View

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Figure 2. Excerpt of the Application of the Signaling Principle in the text

Disseminate is the stage of testing the validity and attractiveness of *micro-learning videos*. The expert validity test consisted of 2 experts, individual tests involving three students, and small group tests involving 12 students. The assessment results from each expert and student are presented in Table 4.

Table 4. Content/media expert assessment results

No	Statement	Score (1-4)
1.	interesting *microlearning video* topics or titles	4
2.	Operational learning objectives	4
3.	Materials are in accordance with the curriculum/learning objectives	3
4.	Scope or extent of the material	4
5.	Update of materials	3
6.	Match between text and images	4
7.	The suitability of the narrator's narrative or explanation of the topic/sub-topic/material description	4
8.	The appeal of *video microlearning*	3
9.	Easy-to-understand *video microlearning* messages	3
10.	*students'* curiosity	4
11.	Suitability of *generative activity* in *microlearning video*	4
	Amount	36
	Score	90

Based on the assessment of content experts, the validity of the developed media aspect is 90, which is a very good category. The results of the assessment of learning design experts are presented in Table 5.

Table 5. Results of Expert Assessment of Learning Design Aspects

No	Statement	Score (1-4)
1.	Clarity of topic or title of *microlearning video*	4

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2.	Learning objectives are stated clearly	3
3.	Proportional text and image position	4
4.	Clear and attractive images	4
5.	Legible font type and size	4
6.	Accuracy of character and intonation of the narrator's voice	3
7.	The attractiveness of the background used	4
8.	Animation accuracy	4
9.	Accuracy of color use	3
10.	Clarity of application of the principle of *generative activity*	4
11.	*video microlearning* duration	4
12.	Serving variations	4
	Amount	41
	Score	93.18

Based on expert assessment, the validity of the design aspect is 93.18 which is in the very good category. The experts provided input that *microlearning videos* in order to expand the scope of the material through varied examples, need to be added contextual trigger questions. The suggestions provided by the experts were used as a reference for revising *the microlearning video* . Furthermore, *the microlearning video* was tested on *students* as users of learning. The results of the individual trials are presented in Table 6.

Table 6. Individual Trial Results

No	Aspect	R1	R2	R3
1.	Attraction	4	4	4
2.	Message can be understood	3	4	4
3.	Easy-to-remember message	4	4	4
4.	Text readability	3	4	4
5.	Clarity of audio elements	4	4	4
6.	Clarity of visual elements	4	3	4
7.	Clarity of conclusion	3	3	3
	Friday	25	26	27
	Score	89.29	92.86	96.43
	Average Score	92.86		

Based on the data in the table above, the average score obtained was 92.86, which is in the very good category. This means that the microlearning video was considered interesting by *students* and *students* responded that there were some writings that were difficult to read and some parts that were difficult to understand. Input from *students* was then used as a reference for revising the media before continuing to small group trials. The results of the small group trials are presented in Table 7.

Table 7. Small Group Trial Results

No	Aspect	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12
1.	Attraction	4	4	4	4	4	4	3	3	4	4	4	3
2.	The message can be understood	4	3	4	4	4	4	2	4	4	4	4	4
3.	Easy-to-remember message	4	4	4	4	4	4	2	2	4	4	4	3

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4.	Text readability	4	3	3	4	2	4	4	4	4	4	3	4
5.	Clarity of audio elements	4	4	2	4	4	4	4	4	4	4	4	3
6.	Clarity of visual elements	3	3	3	3	3	3	3	4	3	3	4	4
7.	Clarity of conclusion	4	4	4	4	4	2	4	3	4	3	4	3
	Friday	27	25	24	27	25	25	22	24	27	26	27	24
	Score	96.43	89.29	85.71	96.43	89.29	89.29	78.57	85.71	96.43	92.86	96.43	85.71
	Average Score	90.18											

Based on the data in the table above, the average score of *microlearning video* is 90.18 which is in the very good category. The response from *students* is that they enjoy learning through videos, and the material presented can be understood. There are *students* who comment that the video is too fast, and *students* feel left behind when watching the video, some video sounds are unclear, and the text on the video is unclear. Suggestions from students are also used as a reference for revising the video.

DISCUSSION

The validity of video microlearning from the aspect of media and learning design obtained a very good category. Reviewed from the aspect of media, including content video, microlearning has been developed by referring to the latest studies in the field of computer graphics. The study makes the content of microlearning more up-to-date in accordance with the development of current graphic technology. The content standards are then developed into several indicators. These indicators contain factual, conceptual, and procedural knowledge types. Media experts assess that the characteristics of the content are very appropriate to the principles of presentation through video microlearning. This will certainly make it easier for students to understand computer graphics material because it is very suitable to be presented with video. In terms of media, microlearning is considered to have been able to combine visual and auditory media well and harmoniously. Visual media is presented in the form of images and videos. Dynamic visuals are a form of media that experts consider appropriate for explaining concepts, principles, and procedures in computer graphics. Likewise, videos are very appropriate for use in presenting a procedure in computer graphics techniques. Including the duration of video microlearning, it is very appropriate to be used to present material in short durations or in units. The duration of the developed video microlearning is around 3-5 minutes. The choice of duration is reinforced by research conducted by Yu & Gao, (2022) regarding the effectiveness of video duration, which shows that students who learn with short videos (>5 minutes) have better language proficiency, engagement, and satisfaction scores than students who learn through medium-length videos (>10<20 minutes) and long (>30 minutes). In addition, research conducted by (Kamal Afify, 2020) regarding the effect of interactive video duration on cognitive load, cognitive learning outcomes, and memory. The results of the study showed that videos with a short duration of less than 6 minutes have a better impact on cognitive learning outcomes, retention, and reduced cognitive load.

The use of text types and colors in micro videos has also been assessed as appropriate by experts. In general, the font used in micro videos is the *sans serif* f type. This font gives a solid impression because all sides of the letters have the same thickness so that they can meet the elements of readability. The font will make it easier for students to read and provide comfort. This is in line with the results of research showing that the *sans serif font* can make it easier for prospective buyers to read, remember, and recognize the product (Rosita, 2022). The use of color is also considered to be in accordance with

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the characteristics of students and text colors. The characteristics of students tend to like bright colors such as light blue, green, and yellow. This is also applied in micro-videos by emphasizing the use of blue, green, and yellow. The use of background colors also contrasts with the text color. This has a very positive effect on the readability of the text because the text will be clearer to read. For example, the use of a white background color with black text, a dark green background color with white text. The selection of background and text colors is closely related to the principles of unity, contrast, and emphasis. By implementing these principles, it is hoped that *the audience* can more easily understand and perhaps also easily remember the message conveyed (Listya, 2018).

The design aspect of the micro-video learning developed has met the learning principles with the formulation of objectives to be achieved, presentation of material in the form of text, audio, images, learning instructions, and evaluation. The components of the learning design are the implementation of the learning design stated by (Patricia L. Smith & Tillman J. Ragan, 1993). The material in the micro video has been delivered with the right strategy by presenting easy things first to more difficult things. The presentation of the material also varies with various types of media. Conceptual material is presented with animated visual displays accompanied by text. Research shows that animation is able to present dynamic visuals that can make it easier for students to understand a concept (Twozia, 2021). Evaluation of the micro-video is presented in the form of assignments. In the learning design aspect, the important thing is the application of the signaling principle. Experts assess that the application of the signaling principle is appropriate for information that is considered important and that is the focus of the audience. Experts assess that by applying the signaling principle, students can quickly find important things in the micro video.

The attractiveness of micro video is assessed by students as end users. The attractiveness test was conducted by students who had taken computer graphics courses. Students who were involved as respondents in individual and small group trials gave the micro video a very good rating. Microvideo is quite easy to use and can be accessed anywhere. Students assessed that micro video is able to facilitate students in quickly understanding the contents of computer graphics courses. The very good assessment obtained by trial respondents in individual and small group tests cannot be separated from several things. First, micro video is designed using a clear and easy-to-read font. The font used is sans *serif*. Students assessed that micro video is able to attract attention and motivation. Students can learn more easily because the material is presented in the form of small units with a duration of no more than 5 minutes. In several studies, presentation by dividing material into several units is known as presentation segmentation. The results of the study showed that this principle makes it easier for students to understand the material (Soicher & Becker-Blease, 2020). Second, micro video was assessed by respondents as being able to provide a concrete explanation before doing computer graphics practice. Visualization of concepts using both image and video media is considered by students to be able to provide a clear understanding of the concepts, principles, and procedures for creating graphic works. Some presentations in the form of graphics in the media are made moving or dynamic so that they are easier to understand. This is in line with research that shows that graphics that move by themselves tend to be more interesting and motivating (Morrison & Tversky, 2001). In addition, as research results show, animated media has an influence on conceptual understanding (Afandi et

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al., 2021). Third, micro-videos can be accessed by students anytime and anywhere. This gives them the flexibility to learn without having to wait for examples from lecturers. Research results also show that learning that can be done mobile *with* the concept of *mobile learning* has a positive impact on learning outcomes (Haryati et al., 2021; Rahmat et al., 2019). Students can not only watch simulations via Micro videos but can also read materials and do exercises on their respective work computers while studying via micro videos.

CONCLUSION

Based on the assessment of media experts and design experts, the product in the form of a microlearning video has very good validity in terms of media and learning design. Based on the assessment of students as trial subjects, both at the individual and small group test stages, they gave very good assessments. This means that microlearning video in computer graphics courses has very good appeal. The suggestion given to students is that this research product in the form of microlearning can help accelerate students in understanding the contents of the message, and to master the contents of the learning message as a whole, it is necessary to understand all the content presented through microlearning.

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