Jurnal Pendidikan Vokasi
Volume 12, No. 3, 2022 (293-301)
Online: https://journal.uny.ac.id/index.php/jpv

The effectiveness of media on distance learning based on Merrill's Taxonomy and CASR 147

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ARTICLE INFO

Article History
Received:
18 April 2022;
Revised:
12 June 2022;
Accepted:
19 August 2022;
Available online:
23 January 2023

Keywords
Aviation education;
Instructional media;
Merrill's Taxonomy

ABSTRACT

According to Merrill, there are two dimensions of learning objectives: content and performance. For learning to achieve its goals, suitable media is needed. Moreover, the Covid-19 pandemic situation since 2019 requires learning to be distanced. Teachers and students must work together to achieve learning objectives. Several media can support learning, including text formats, audio/video tutorials, interactive multimedia, and simulator software. Especially for Aviation Vocational education which has a learning level guide at CASR 147, further analysis is needed on how these media can effectively achieve learning objectives. So, this study aims to analyze the effectiveness of media in distance learning based on Merrill's Taxonomy and CASR 147. Quantitative research methods are used with data from questionnaires and several interviews for data triangulation needs. Based on its effectiveness, the following are suggestions of learning media that can be used: audio/video tutorials, simulators, interactive multimedia, and text formats. Furthermore, it is necessary to conduct research that discusses media preferences based on students' learning styles to know the reasons for the results of media selection by students through questionnaires.

How to cite:
Rifai, M., & Harini, N. V. (2022). The effectiveness of media on distance learning based on Merrill's Taxonomy and CASR 147. *Jurnal Pendidikan Vokasi*, *12*(3), 293-301.
https://doi.org/10.21831/jpv.v12i3.49144

INTRODUCTION

Since 2019, human activities have begun to be limited, especially those involving physical contact. This is done to suppress the broader spread of the Covid-19 virus. This pandemic has significantly impacted various factors, especially the world of education (Agu et al., 2021; Buheji et al., 2020; Fegert et al., 2020; Toquero, 2020). Onsite learning must be replaced with a distance learning mode so that schools do not become clusters of spreading viruses (Ali, 2020; Mulenga & Marbán, 2020; Simamora, 2020; Yulia, 2020). The challenge of this learning mode is how to create an effective learning system (achieving learning objectives), but an onsite activity must be implemented. Learning effectiveness factors include literacy, motivation, learning tools, and learning systems. However, the main factor that has the most influence is motivation (teachers and students have the same vision, namely knowledge transfer) (Ferri et al., 2020; Garrison, 1993; McConnell et al., 2013; Simonson et al., 2019).

From the side of students, as learners, must have a strong enough motivation to be able to learn independently. Strong motivation is needed to survive various kinds of online learning concentration disorders (Patricia, 2020; Wijaya et al., 2020). For example, signal interference, social

media, home environment, etc. From the side of the teacher/lecturer, there must also be enough ammunition to be able to inspire because the task of the teacher/lecturer is to facilitate students' independent learning (Aston et al., 2000; Bank & Bank, 2014; du Toit-Brits & van Zyl, 2017; Rahmawan, 2020). Facilitating means providing facilities (a good learning environment) so that it is sufficient to be able to transfer knowledge. For example, to study Social Arithmetic material, an online space is needed for students to apply the buying and selling process and calculate profit and loss.

According to Circular No. 15 of 2020 of the Ministry of Education and Culture of the Republic of Indonesia, there are several kinds of learning media, including text formats, audio/video tutorials, interactive multimedia, and simulator software. In their use, these media have advantages and disadvantages. Selecting suitable media will lead to the success of the learning process (Gagne, 1970; Omenge & Priscah, 2016; Peery, 2016). Learning media can aim to understand concepts or apply concepts. The suitable media is media that support cognitive and psychomotor learning objectives.

Learning objectives can essentially be synthesized into a two-dimensional matrix, namely the content dimension (what is being studied) and the performance dimension (what is being done) (Merrill, 1983). Content can be divided into four types: facts, concepts, procedures, and principles. The performance can be divided into three levels: remembering, using, and finding. According to Merrill (1983), the content and learning objectives dimensions can be seen in Figure 1.

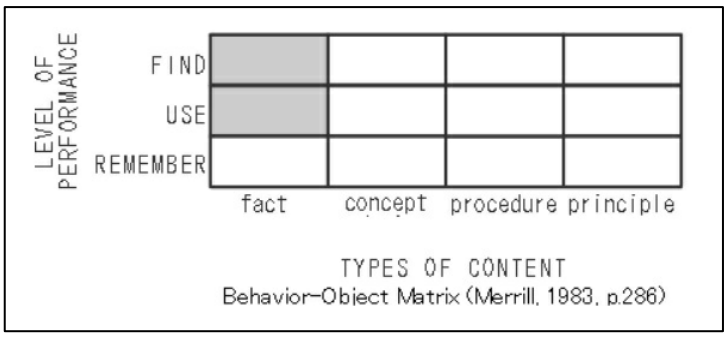
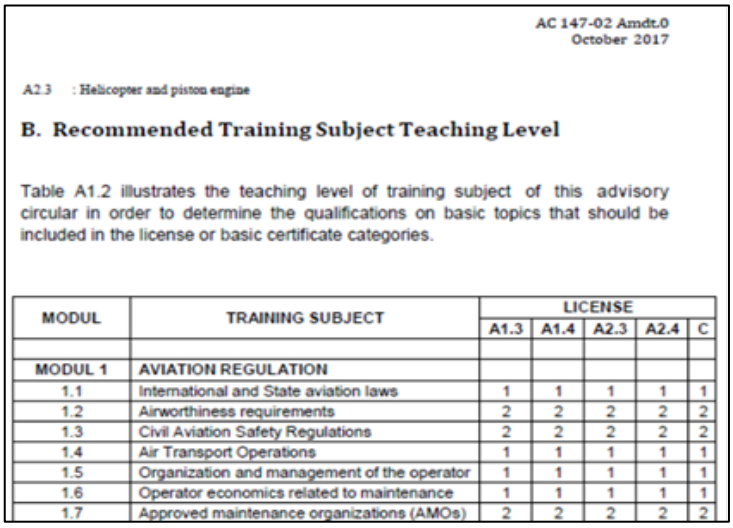


Figure 1. Behavior-Object Matrix of Merrill's

Aviation vocational education (with learning outcomes) can produce graduates who are competent in carrying out aircraft maintenance and repairs following predetermined procedures with Diploma level 3 guided by Civil Aviation Safety Regulation (CASR) 147 (Advisory Circular, 2017). The designed learning levels have a difficulty level, namely level 1, level 2, and level 3.

Level 1 includes knowledge of general principles (no practical application), no skill development, and instruction is done by lecture, demonstration, and discussion methods. Level 2 includes knowledge of general principles, limited practical application, skill development for basic operations, and instruction by lecture, demonstration, and discussion. Level 3 includes knowledge of general principles, the performance of high-level practical applications, the development of skills sufficient to simulate the acquired knowledge, and instruction using lectures, demonstration, discussion, and high-level practical application methods.

CASR 147 advisory circular 147-02 Basic Certificate Curriculum and Syllabus Development describe the depth of learning achievement in each subject (starting now referred to as teaching level) as shown in Figure 2. However, the CASR 147 document does not address the content dimension (what is learned) and the performance dimension (what is done), as categorized by Merrill in his taxonomy. Thus, this study aims to analyze the effectiveness of the media used in distance learning and compare it to onsite learning. Assessment of effectiveness based on learning objectives according to CARS 147 and Merrill's Taxonomy (since Component Display Theory is very close to the effectiveness of instructional media).



AC 147-02 Amdt.0
October 2017

A2.3 : Helicopter and piston engine

B. Recommended Training Subject Teaching Level

Table A1.2 illustrates the teaching level of training subject of this advisory circular in order to determine the qualifications on basic topics that should be included in the license or basic certificate categories.

MODUL	TRAINING SUBJECT	LICENSE				
		A1.3	A1.4	A2.3	A2.4	C
MODUL 1	AVIATION REGULATION					
1.1	International and State aviation laws	1	1	1	1	1
1.2	Airworthiness requirements	2	2	2	2	2
1.3	Civil Aviation Safety Regulations	2	2	2	2	2
1.4	Air Transport Operations	1	1	1	1	1
1.5	Organization and management of the operator	1	1	1	1	1
1.6	Operator economics related to maintenance	1	1	1	1	1
1.7	Approved maintenance organizations (AMOs)	2	2	2	2	2

Figure 2. Teaching Level in CASR 147

RESEARCH METHOD

This research is quantitative descriptive research. The data collection technique was carried out using 45 closed questions in the form of a questionnaire developed with Google Forms. The sampling technique in this study was random sampling, where the number of respondents in this study was 925 cadets spread from various departments at the Surabaya Aviation Polytechnic. These departments are Air Traffic Controller, Aviation Communication, Air Transportation Management, Airport Electrical Engineering, Aviation Navigation Engineering, Building and Airport Engineering, and Aircraft Maintenance Engineering. Data triangulation was conducted through interviews with selected respondents using purposive sampling. The research instruments (questionnaires and interviews) were validated by learning expert lecturers. Data analysis was carried out with the help of Microsoft Excel software which was carried out to process quantitative data and make the presentation of research results more interesting.

RESULT AND DISCUSSION

CASR 147 divides the level of mastery of learning competencies into three categories of teaching level. Each category contains cognitive and psychomotor elements that cadets must master in each subject matter. This learning achievement does not refer directly to the level of performance and detailed learning content. Therefore, it is necessary to develop an integrated assessment of learning achievement according to CASR 147 combined with Merrill's learning theory. After analyzing each item in the Merrill Taxonomy and the difficulty level of CASR 147, the integration results can be seen in Table 1.

Table 1. Integration of Merrill's Taxonomy and CASR 147

Type of Content	CASR 147		
	Teaching level 1	Teaching level 2	Teaching level 3
	- Knowledge of general principles, but no practical application. - No Development of skill.	- Knowledge of general principles, and limited practical application. - Development of sufficient skill to perform basic operations.	- Knowledge of general principles, and performance of a high degree of practical application. - Development of sufficient skills to simulate return to service.
Principle			√
Procedure		√	√
Concept	√	√	√
Fact	√ √	√	

	Remember	Use	Find	Remember	Use	Find	Remember	Use	Find

Based on Table 1, teaching level 1 can be achieved when remembering facts, using facts, and remembering concepts have been fulfilled. Teaching level 2 can be achieved when finding facts, using concepts, and remembering procedures have been fulfilled while teaching level 3 can be achieved when the activities of finding concepts, using procedures, and remembering principles have been fulfilled. Teaching levels are in the form of stages that must be passed sequentially. It means that level 1 and level 2 are prerequisites for level 3.

To obtain data on the effectiveness of media in online and onsite learning, a questionnaire was compiled that explores the role of media in supporting learning objectives at each level of teaching according to the cadets' perceptions. Closed questions that are arranged provide three answer choices, namely low, medium, and high. The answers from each cadet will be grouped according to their teaching level and Merrill's taxonomy. Table 2 is a recapitulation of the effectiveness of media in learning at each level according to cadets' perceptions.

Table 2. Data Recapitulation

Media	Effective-ness	Teaching Level 1			Teaching Level 2			Teaching Level 3		
		Remem-ber Fact	Use Fact	Remember Concept	Find Fact	Use Concept	Remember Procedure	Find Concept	Use Procedure	Remember Principle
Hands on	Low	22	17	16	17	19	15	16	15	17
	Med	419	425	417	422	429	410	424	417	429
	High	484	483	492	486	477	500	485	493	479
Siulator	Low	16	22	16	21	16	15	19	15	18
	Med	464	446	456	459	445	464	446	473	463
	High	445	457	453	445	464	446	460	437	444
Interactive multimedia	Low	23	25	16	20	22	19	25	20	23
	Med	441	460	474	468	478	479	474	481	478
	High	461	440	435	437	425	427	426	424	424
Audio/video tutorial	Low	20	16	21	18	19	18	19	20	14
	Med	421	446	456	441	444	462	442	445	486
	High	484	463	448	466	462	447	464	460	425
Format text	Low	50	39	42	46	47	40	36	43	37
	Med	597	582	553	559	581	551	583	551	557
	High	278	304	330	320	297	334	306	331	331

Based on Table 2, it is then changed into low, medium, and high categories by using the mode (a statistical measure of central tendency) for each item. If the number of cadets who choose the medium category is more than those who choose the low and high categories, then the data is grouped into the medium category. Based on this approach, conversion data is obtained, as shown in Table 3.

Table 3. Data Conversion

Media	Teaching Level 1			Teaching Level 2			Teaching Level 3		
	Remem-ber Fact	Use Fact	Remember Concept	Find Fact	Use Concept	Remember Procedure	Find Concept	Use Procedure	Remember Principle
Hands on	High	High	High	High	High	High	High	High	High
Simulators	Med	High	High	Med	High	Med	High	Med	Med
Interactive multimedia	High	Med	Med	Med	Med	Med	Med	Med	Med
Audio/video tutorials	High	High	Med	High	High	Med	High	High	Med
Text formats	Med	Med	Med	Med	Med	Med	Med	Med	Med

Based on the results of filling out the questionnaire on the Google form and the interview session, the results were obtained, as can be seen in Figure 3, Figure 4, and Figure 5. In Figure 3, it can be seen that hands-on activities are still the favorite choice to reach teaching level 1 (remember the fact, use fact, and remember the concept). However, if distance learning is required, media with text format is sufficient in moderate portions, while media simulators, multimedia interactive, and audio/video tutorials can be medium to high.

Therefore, it is recommended when distance learning that material with learning outcomes in the use of facts and remembering concepts should use simulator media. Interactive multimedia

should be used for material with learning outcomes in remembering the fact. Meanwhile, for material with learning outcomes in remembering facts and using facts, it is recommended to use audio/video tutorial media.

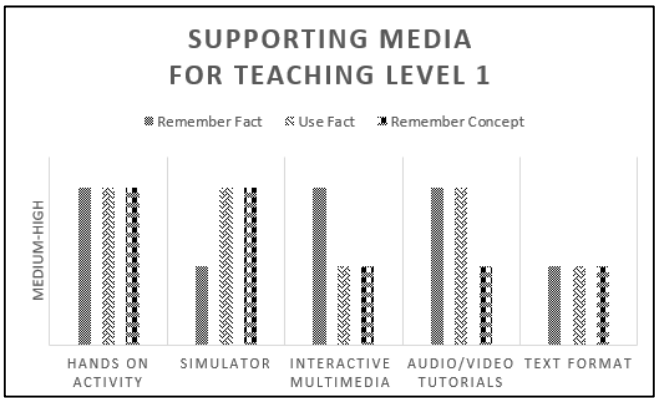


Figure 3. Supporting Media for Teaching Level 1

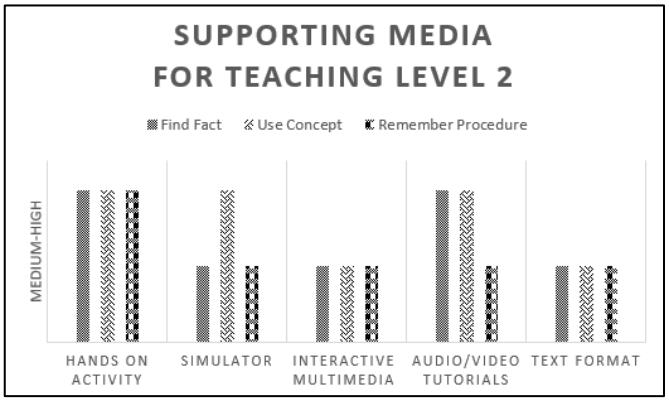


Figure 4. Supporting Media for Teaching Level 2

In Figure 4, hands-on activity remains the favorite choice to reach teaching level 2 (find facts, use concepts, and remember procedure). If distance learning is carried out, the media with text format is sufficient in medium portions, while the simulator media, interactive multimedia, and audio/video tutorials can be in the medium to high portions. Therefore, it is recommended that distance learning be more effective if the material with concept learning outcomes uses simulator media, and material with finding facts and use concept learning outcomes should use audio/video tutorial media.

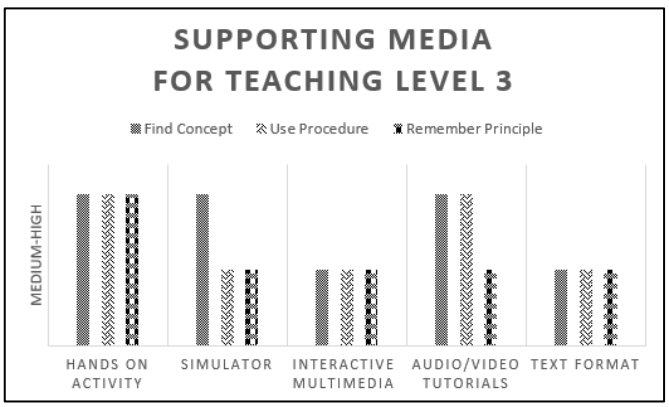


Figure 5. Supporting Media for Teaching Level 3

In Figure 5, hands-on activity is still the favorite choice to reach teaching level 3 (find the concept, use the procedure, and remember the principle). However, if distance learning is necessary, media with text format is sufficient in moderate portions, while simulator media, interactive multimedia, and audio/video tutorials can be in medium to high portions. Distance learning will be more effective if the material with the learning outcomes of finding concepts uses simulator media or audio/video tutorials. Meanwhile, for materials with learning outcomes, use procedure is recommended to use audio/video tutorial media.

From the three reviews above, onsite learning (hands-on activity) is the favorite choice of cadets. This is in line with research (Anggrawan & Jihadil, 2018; Bali & Liu, 2018; Gherheș et al., 2021; Louis-Jean & Cenat, 2020) that onsite learning is still more effective than online learning. There are difficulties in its application, especially on campuses that incidentally are vocational education that requires field practice. When field practice is replaced with simulation activities, the results will not be as good as if carried out directly. If directly, all limbs can help in remembering the procedures/concepts being taught. As John Dewey said, learning will bring more understanding or learning by doing (Ord, 2012).

If learning must be carried out online, it is necessary to pay attention to the following composition: media with text format is sufficient to use in moderate portions, while media simulators, multimedia interactive, and audio/video tutorials can be used with medium to high portions. If the portion is too much, text format media will make students bored (Ismaili, 2013; Martin & Bolliger, 2018; Mayer, 1997), in contrast to multimedia. Meanwhile, other media, such as simulators, interactive multimedia, and audio/video tutorials, can be used according to the character of facts, concepts, procedures, and principles of the type of subject to be taught. This is in line with Wiana et al. (2018) and Apoki et al. (2020) because selecting suitable media will lead to successful learning.

Another point of view, content, and performance can be interpreted as follows: Audio/video tutorials are practical for learning to remember, use, and find facts. This is in line with Turner et al. (2015) and Torfi et al. (2017) that to teach concepts (remember, use, and discover), simulators and audio/video tutorials can be used. This fact follows Ibáñez and Delgado-Kloos (2018) and Laurillard (1995), who revealed that procedures and principles would be more effective if taught directly. This is also in line with previous research by Rayner et al. (2001) and Kong et al. (2017).

CONCLUSION

Based on this study, onsite learning has higher effectiveness than distance learning. However, if conditions are not possible, distance learning needs to be implemented with the following instructional media suggestions: audio/video tutorials, simulators, interactive multimedia, and text formats. In the learning process, media with text format should be used in moderate portions. In contrast, simulator media, interactive multimedia, and audio/video tutorials can be used in medium to high portions. It can help achieve teaching levels 1, 2, and 3 in Merrill's Taxonomy and CASR 147.

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