

"E-LabSheet Project" 4Cs-Based Supplementary Media for Flexible Learning: Is it Well Implemented?

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Agariadne Dwinggo Samala^(✉), Ika Parma Dewi, Lativa Mursyida
Faculty of Engineering, Universitas Negeri Padang, Padang, Indonesia
agariadne@ft.unp.ac.id

Abstract—This research aims to design and develop a learning product named the "E-LabSheet Project." E-LabSheet is a supplement to the computer network practicum. This module contains the 4C's of 21st-century skills to practice critical thinking, problem-solving, creativity, communication, and collaboration, organized in materials, exercises, assignments and integrated with the video tutorials. Furthermore, this E-LabSheet is very simple to use because it can be read with a mobile device, which has become the daily life of 21st-century students known as Gen Z. In this study, the validity, practicality, and effectiveness of the product were tested. The development model used is 4D. For the validity test, the validation sheet consists of media aspects and material aspects by experts. To find out the practicality, we used a questionnaire with a g-form which was then filled out by students as users. Atrial was conducted on two classes to determine the effectiveness of the media. The first class (class A) was treated without E-LabSheet media, and the second class (class B) was treated by giving a supplement in the form of E-LabSheet. The results of this study stated that the developed e-LabSheet media was successfully categorized as valid, practical, and effective. This module is a complementary media for flexible learning that can improve student learning outcomes for the better, especially in 4C skills. The comparison of the learning outcomes of the two classes showed that class B, which was given supplementary media, obtained better learning outcomes than class A.

Keywords—E-LabSheet, 4Cs, supplementary media, flexible learning

1 Introduction

A good learning media has several criteria, including having an attractive appearance and being easy to use, providing a learning experience for students, and improving learning outcomes [1]. The media developed must be prepared as well as possible, especially in preparing content or learning materials to improve learning outcomes. This must follow the learning objectives to be achieved [2], [3]. Currently, along with technological developments, we can develop technology-based learning media, such as e-learning, electronic books, AR/VR-based media, etc. [4], [5]. Electronic books have become a learning resource we often use [6]–[9]. The simplest electronic book is a book that can be read using a mobile device as a PDF file.

Two years ago, during the COVID-19 period, learning in schools, both elementary and high school levels, had fully implemented distance learning or fully online [10]. The use of technology in the teaching and learning process is a must. The COVID-19 pandemic is a catalyst that encourages increased use of technology in various sectors of life. In the field of education, almost all activities in universities have used technology, for example, such as webinars, e-learning, and virtual meetings via zoom and google meetings, especially in the informatics engineering education study program, where students are the primary users of technology and the internet in their daily lives [11], [12]. Then currently, teaching materials and learning resources are very varied, such as video-based media, problem-based media, case-based media, AR-based media, and even VR-based media. Learning resources are also currently very open and expansive because of the internet [4], [13], [14] for example, we can learn almost everything through Google or videos from YouTube [15].

Currently, specifically for the computer network practicum course at the Universitas Negeri Padang, the learning process has been supported by facilities in the form of laboratories and all the equipment. However, the practicum module used needs an update in content and technology. For example, the current practicum module is paper-based, although some are digital (e-book), only in a file format converted from an existing document (PDF). The current condition is uncertain; the learning process can be done in class, at home, or virtual. Blended learning has also been applied in both theory and practice courses. The challenge of the previous practicum learning process was that the students faced some difficulties in online learning, such as poor internet connection, lack of motivation, and quick get distracted. In addition, the existing electronic modules are less attractive and less varied, so students are lazy to read [13], [16], [17].

Based on the previous year's study results, student learning outcomes in the computer network practicum course are still low due to the lack of student motivation to read the practicum module, which impacts learning outcomes. The previous year's study results are evidenced by the learning outcomes data from 3 classes: X, Y, and Z, as shown in Table 1. Then the existing modules have not been able to train 4C skills, which are now the skills needed to face the challenges of the 21st century. It is also supported by questionnaire data from students taking this course; 74% of students stated that the existing media is less attractive because it is dominated by text-based content and static images. As many as 72% of students stated difficulties in practicum because the modules used were less attractive and there were no video tutorials, so each student looked for their respective video tutorials on the internet and causing a practicum workflow that was not in accordance with the standards or learning plans that should be. In line with research conducted by Wibawa & Sunarsih [18] impact learning outcomes. This is also supported by the research of Chang & Hwang [19] who developed a game-based electronic module that has proven that selecting the right media will positively impact student learning outcomes.

Table 1. Class X, Y, and Z learning outcomes in 2021

Class	Total Students	Details	Final Score	Grade	Range	Rate
X	15	8	75–100	A, A–, B+	High	53%
		3	55–74	B, B–, C+, C	Mid	20%
		4	0–54	C–, D, E	Low	27%
Y	15	6	75–100	A, A–, B+	High	40%
		7	55–74	B, B–, C+, C	Mid	47%
		2	0–54	C–, D, E	Low	13%
Z	15	9	75–100	A, A–, B+	High	60%
		4	55–74	B, B–, C+, C	Mid	27%
		2	0–54	C–, D, E	Low	13%

In Table 1, we look at last year’s student learning outcomes. In this table, we divide the categories of student learning outcomes into 3 types: high, medium, and low. For the high category, the final score range is 75–100 with grades: A, A–, and B+. While the mid category, the final score range is 55–74 with grades: B, B–, C+, and C. Finally, the low category has a final score range of 0–54 with grades: C–, D, and E.

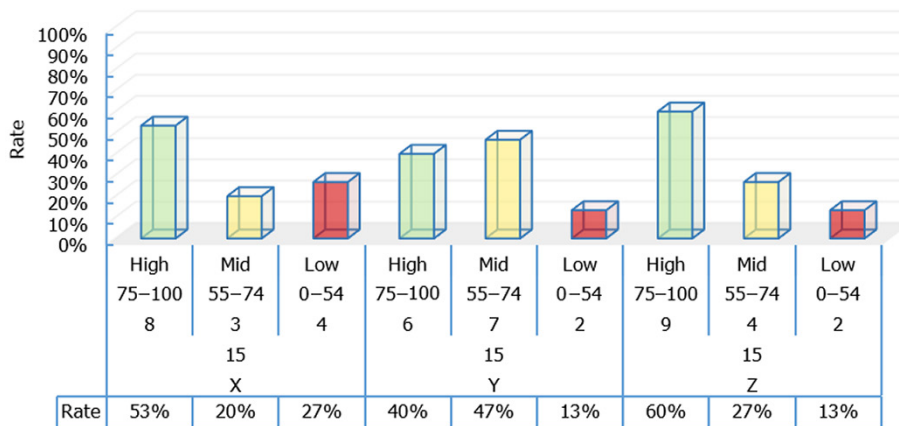


Fig. 1. Details of the distribution of students’ final grade

In Figure 1, it is clear that there are students with low category scores (red bars), as many as 27% from class X, 13% from class Y, and class Z. So, to overcome the problems that occur, we take the initiative to develop the media that students need to support learning. Based on our observations and interviews with students who have taken this course, they stated that they prefer interesting and interactive media, which is then equipped with video tutorials. In addition, they also choose mobile or paperless-based media because they are easier to carry and can be read anytime and anywhere. Therefore, we chose to develop learning media that can later be used as complementary media, namely the “*E-LabSheet Project*”. This E-LabSheet is prepared with a detailed

and easy-to-understand material explanation, then equipped with a practicum guide and integrated with learning videos so that it is possible to study independently. Then the composition of the material and practicum activities is compiled and packaged in its entirety; this E-LabSheet is also very easy to use and flexible with computers and mobile devices. The components that build E-LabSheet are also made as attractive as possible, with background sounds and interactive navigation. With this e-LabSheet, it is also hoped that students can learn according to their learning speed and style.

Finally, the developed E-LabSheet also embeds 21st-century skills, namely 1) *critical thinking and problem-solving*; 2) *creativity*; 3) *communication*; and 4) *collaboration* [20], [21]. These four 4Cs skills will train a person to be creative, divergent thinking ability that can provide different solutions from others about a problem; have sufficient knowledge and relevant experience; have the ability to communicate so that they can exchange information with their colleagues; can think critically and have good analytical skills. With this supplementary media, it is hoped that it can improve student learning outcomes for a better computer network practicum. In addition to providing hard skills through practice, it also provides 4Cs soft skills. The development of this practicum module uses a 4D development model, which consists of 4 steps that will be explained in more detail in the method.

2 Methods

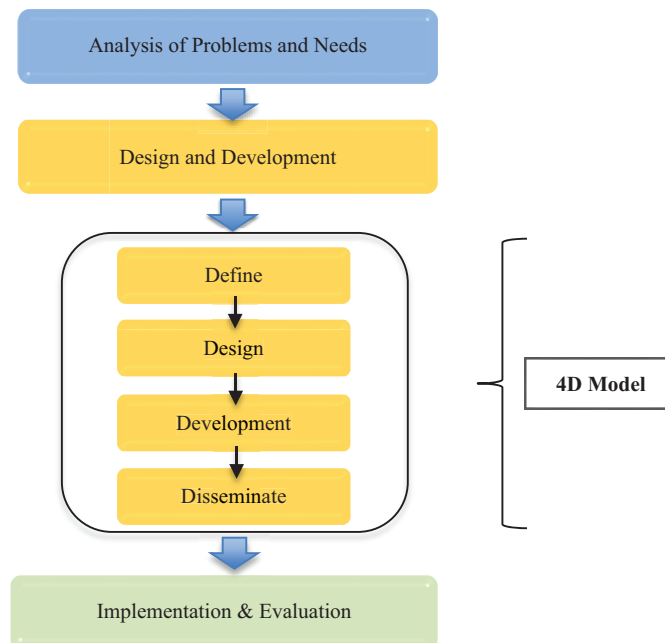


Fig. 2. Research and development procedures

This research is included in R&D research. This research and development procedure is divided into 3 main stages: 1) **analysis of problems and needs**; 2) **design and development**; 3) **implementation and evaluation**. In the second stage, we use a 4D development model consisting of 4 stages: *define*, *design*, *develop*, and *disseminate* [22] as seen in Figure 2. In the first stage, problem analysis is carried out to identify and determine the problems encountered in the learning process and then compile a list of needs needed in media development. This article explains the preliminary analysis, description of facts, and alternative problem-solving clearly in the introduction session.

The next stage is design and development. The 4D model starts to be implemented at this stage. First, perform an analysis of user needs. User analysis is an activity to identify the characteristics of students who are the target of developing learning tools. The characteristics in question are related to academic abilities, cognitive development, motivation, and individual skills related to learning topics, media, formats, and languages. Next is a concept analysis regarding the semester learning plan, which includes learning objectives, competencies, learning resources, practicum schedule, technology, and equipment.

Next is the 4D development process. First, the user interface design: colours, font size, layout, and background images, then proceed with compiling content, content, and navigation. This stage focuses on the product to be developed. The result of this stage is the initial product. The product will be tested for media validation by experts from both the media and material aspects. The validation test used an instrument in the form of a validation sheet filled out by 3 experts. Details of the aspects tested can be seen in (Table 2). A Likert Scale measured the test results of all aspects. A Likert scale is several positive or negative statements about an object or product. The basic principle of the Likert scale is to determine the position of a person on the continuum of attitudes toward an object of attitude ranging from very negative to very positive (Table 3).

Table 2. Media and material aspects

No.	Media Aspect	Material Aspect
1	Quality and Appearance	Content
2	Interactivity	Readability
3	Navigation	Material Presentation

Table 3. Likert scale classification

Scale	Classification
5	Excellent
4	Very Good
3	Neutral
2	Fair
1	Bad

The results from this expert assessment are calculated using the following formula (1), and then the percentage of results can be calculated using the following formula (2). In contrast, the classification of validation criteria can be seen in Table 4. In the classification of criteria, we divide it into 3 types: 81%–100% in the valid category, 61%–100% in the valid category, but revision is needed, and below 60% is declared invalid.

$$\bar{x} = \frac{\sum X}{n} \tag{1}$$

$$v = \frac{\sum x \text{ expert}}{\sum x \text{ max}} \times 100\% \tag{2}$$

Note:

- \bar{x} : average score
- $\sum X$: number of raters (expert)
- n : total score of each
- $\sum x \text{ expert}$: total exp score
- $\sum x \text{ max}$: max score

Table 4. Validation criteria

No.	Percentage	Criteria
1	81–100%	Valid
2	61–80%	Valid & Need Revision
3	0–60%	Invalid

The dissemination stage can only occur if the tested product is declared valid. In testing the effectiveness, we involved two different classes: class A and class B. Class A was not given special treatment, while class B was given special treatment (with E-LabSheet media). The implementation results will be used as evaluation material for future improvements.

3 Results and discussion

3.1 E-LabSheet project

The following results from the design of the developed E-LabSheet media are shown in Figure 3 below. Figure 3 is a preview of the E-LabSheet cover design. The selection of blue, black, and white gradations illustrates the value and impression of “technology.” E-LabSheet consists of material equipped with practicum videos that students can access via smartphone and the internet. For the media menu display, see Figure 4.



Fig. 3. E-LabSheet project: 4Cs-based supp. media



Fig. 4. E-LabSheet main menu

Then in Figure 5, we can see how the video tutorial process is played. Learning videos run very well on E-LabSheet, but the video quality is highly dependent on the quality of the user's device's internet network.

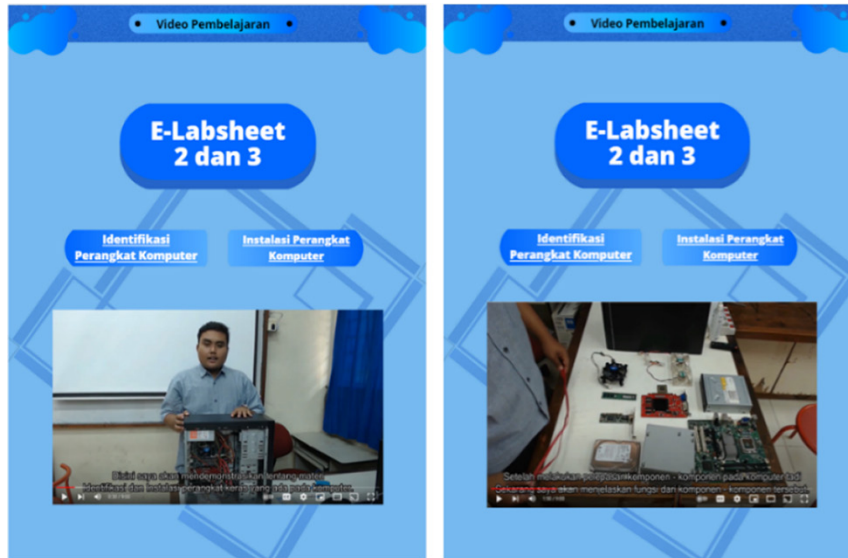


Fig. 5. E-LabSheet: playing videos

3.2 Validation

Media aspect. As explained in the method section, this media was validated by 3 experts. The media was validated from the media and material aspects using a validation test sheet. The following are the results of expert validation from the media aspect, which we summarize in Table 5 and Figure 6 below:

Table 5. Media aspect validation results

No.	Media Aspect	V1	V2	V3	Avg.
1	Quality and Appearance	32	31	32	31.67
2	Interactivity	34	34	33	33.67
3	Navigation	30	29	31	30.00
Total					95.33

Each media aspect consists of 20 positive and negative statements, with a maximum score of 5 and the lowest score of 1. The total maximum score of the three aspects is 100.

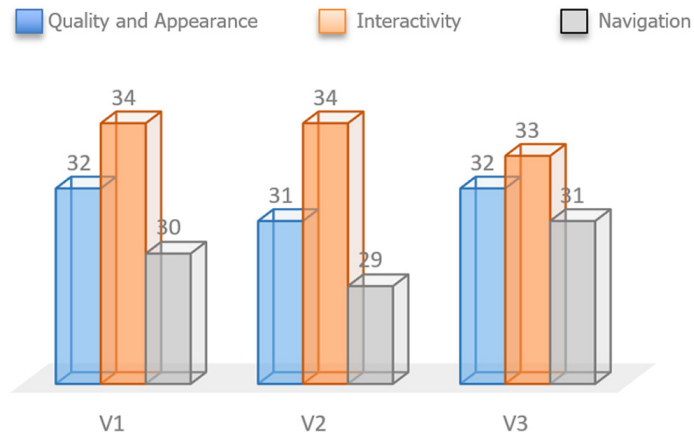


Fig. 6. Media aspect validation results

Material aspect. In Table 6, we can see and interpret that the material aspect is the same as the previous media aspect, which is categorized as valid with a total validation score of 90.67.

Table 6. Material aspect validation results

No.	Material Aspect	V1	V2	V3	Avg.
1	Content	31	30	31	30.67
2	Readability	30	31	30	30.33
3	Material Presentation	30	30	29	29.67
Total					90.67

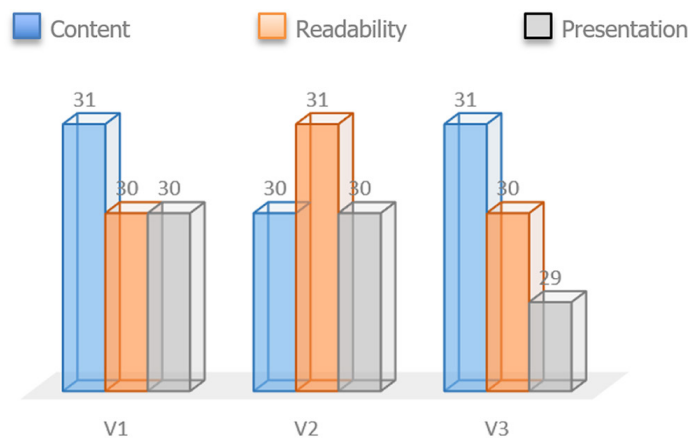


Fig. 7. Material aspect validation results

In Figure 7, it can be seen that there is no significant difference in the assessment of the assessment by 3 experts on the 3 aspects of the material being assessed.

3.3 Media practicality

To be able to measure the practicality of the media, previously valid media were distributed to users, namely students, then an assessment questionnaire was distributed about the practicality of using media, then also measured how students responded to the media that had been developed. Here, the questionnaire is distributed online using a google form to all students who have taken the computer network practicum course. A total of 134 students filled out the questionnaire. In this study, we calculated everything to find out how the responses and responses from users to the media we developed. The following are student responses regarding the E-LabSheet media in Figure 8:

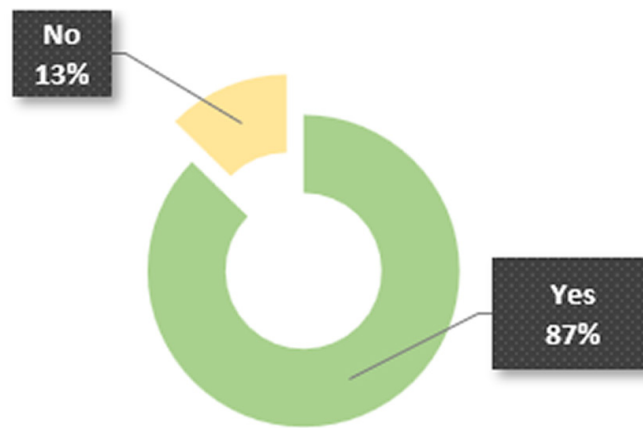


Fig. 8. The results of student responses

From the data obtained, it is known that 87% of students answered yes or agreed about some positive statements in the questionnaire. These results mean that the development of the E-LabSheet media received a good and positive response from students. However, there were some inputs given by students through comments and suggestions, including 1) More varied practice questions, not multiple choice; 2) The video size is reduced so that the video playback process can be better and smoother.

3.4 Learning outcomes

Class A. Learning outcomes are measured by calculating the final score (combined mid-exam with final exam scores). Class A is a class that is not provided by E-LabSheet. Class A consists of 15 students. The students' mid and final exam results are shown in Figures 9 and 10. It is known that there are still 7% of students whose scores are low. Most of the students' scores were in the mid-range.

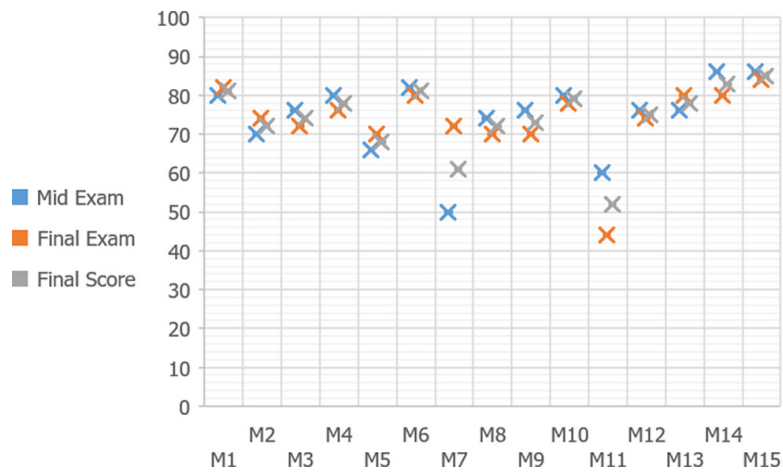


Fig. 9. Student exam results (Class A)

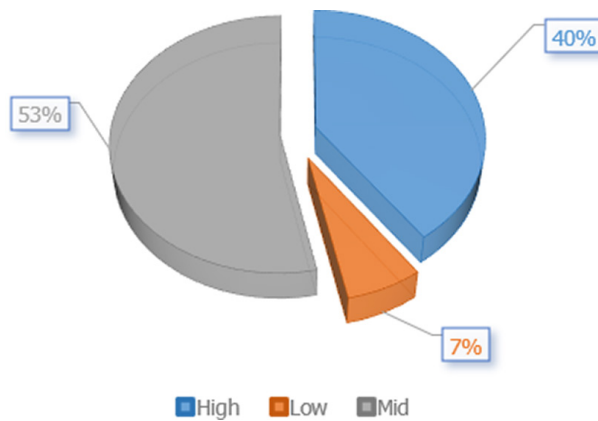


Fig. 10. Student exam results (Class A) by the range

Class B. Class B learning outcomes show different results from class A. In class B, students are given E-LabSheet to support practicum activities. Based on the results of the mid and final exams, the results of class B are as follows:

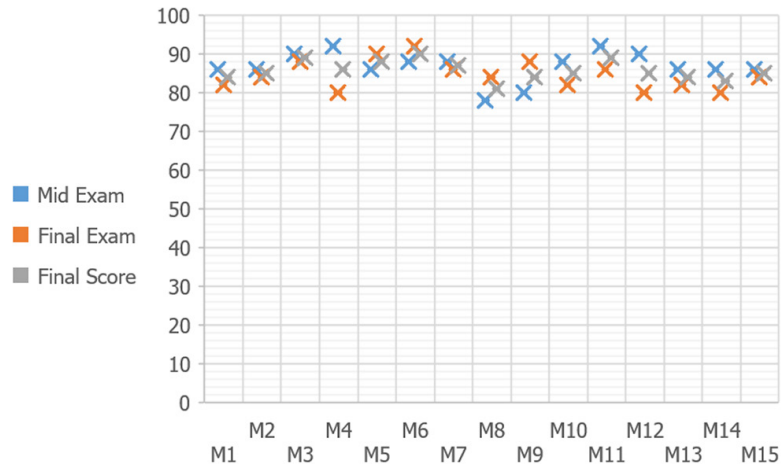


Fig. 11. Student exam results (Class B)

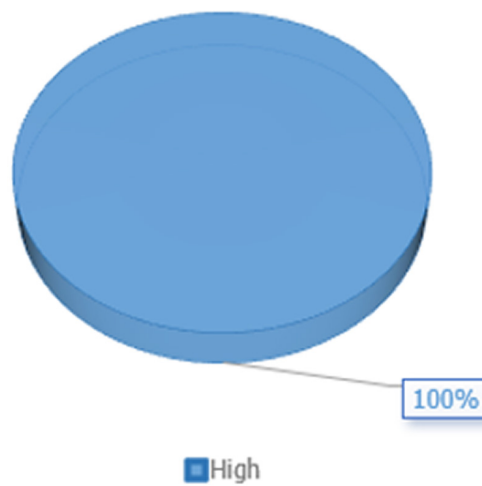


Fig. 12. Student exam results (Class B) by the range

In Figures 11 and 12, we can see that the final scores of all class students are above 75. This means that, as explained at the beginning, scores above 75 are categorized as high. Class B is the class that was given the treatment, and the results were in line with what was expected. It is proven that the student scores are much better.

3.5 Discussion

To measure the effectiveness of this medium, we compared the learning outcomes of two different classes, A and B. In detail, the comparison of the two can be seen in Figures 13 and 14 where from 15 students from each class, there is a very significant

difference. It can be interpreted that the use of E-LabSheet based on 4Cs is able to give better results in class B. The average learning outcomes of class B are better than class A, with an average final score of class B reaching 85.67, while class A is 74.13. There is a difference of 11.54. So, it can be said that this media, as a complement to learning, is able to increase learning outcomes by 16%.

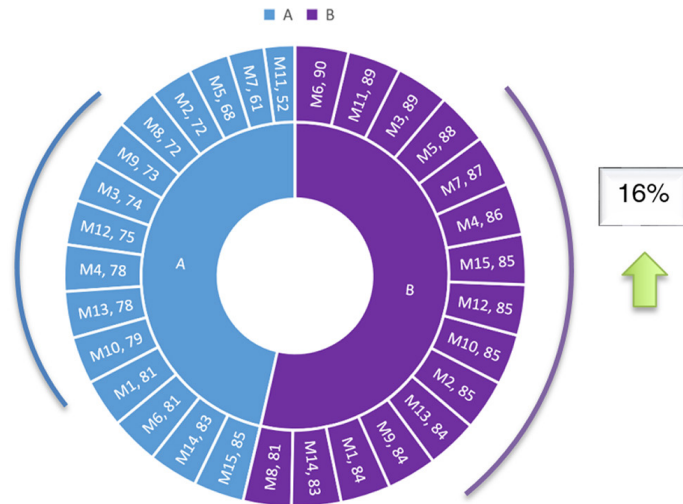


Fig. 13. Comparison of learning outcomes for class A and class B

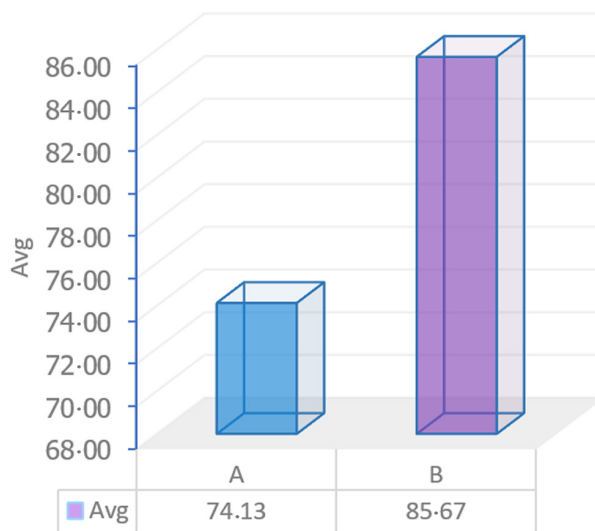


Fig. 14. Comparison of the average final scores of class A and class B

The results of this study prove that learning media is a tool that can help the teaching and learning process so that the meaning of the message conveyed becomes clearer and the goals of education or learning can be achieved effectively and efficiently [23]–[25]. Effective learning certainly requires good planning, also supported by good learning facilities and media. Likewise, the selection of media to be used in learning must consider the characteristics of the course, learning styles, learning objectives, facilities, and infrastructure. Of course, various types of media will not be used simultaneously in learning activities. For this reason, it is necessary to select the media. As mentioned by Arsyad, the criteria that need to be considered in the process of selecting learning media include: a good learning media must be clear and neat in appearance; Includes text, images, sound, and video. Unattractive media will reduce students' motivation in the learning process; Learning media must be adjusted to the number of targets; relevant to the topic being taught; In accordance with the learning objectives; practical, and flexible [26].

4 Conclusions

From the results of the research we obtained, we can conclude that learning media can clarify the presentation of messages and information so that they can simplify and improve learning processes and outcomes. Learning media can increase and direct students' attention so that it can lead to learning motivation, more direct interaction between students and their environment, and the possibility of students learning independently according to their abilities and interests. We have also succeeded in developing E-LabSheet media that can support computer network practice activities by loading 4C's skills which are implemented in problem-based practice where students practice analyzing, evaluating, and designing their own computer networks. So that students, before entering the laboratory, already have better knowledge. The results we obtained are also very good, where the developed E-LabSheet is valid, practical, and effective, proven to be able to improve student learning outcomes with an average percentage of 16%. It is evident from the results of the comparison between class A and class B in the results and discussion it is clear that learning outcomes B, which were given special treatment, gave better learning outcomes than class A. It is hoped that the results of this study can be used as a reference for further research for the development of media that will be better in the future. The weakness we encountered in the development of this E-LabSheet is that this media is very dependent on the quality of the internet as responded by students as users, especially when playing high-quality videos requires a stable and fast internet connection. We also conclude that learning media will be effective if used in the right environment, right on target, then teachers or lecturers, and students are also expected to use the media well.

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6 Authors

Agariadne Dwinggo Samala is a lecturer at Universitas Negeri Padang (UNP) in Indonesia. In 2015, he received his Bachelor of Computer Engineering from Universitas Andalas. In 2018, he completed a Master's degree in Technical and Vocational Education Training with a concentration in the field of Information & Computer Engineering Education at UNP 2018. He is currently pursuing a Doctorate in Technical and Vocational Education Training at UNP. His research interests include technology-enhanced learning, digital learning, virtual learning environments, TVET, open education, computer engineering, and programming. (e-mail: agariadne@ft.unp.ac.id).

Ika Parma Dewi graduated from Universitas Negeri Padang with a Bachelor of Electronic Engineering in 2009. Received a master's degree in Information Education at Universitas Negeri Padang in 2013. Now, she is a Doctoral Candidate in Technology and Vocational Education at Universitas Negeri Padang. She is currently working as a lecturer in the Informatics Education Department of Electronics Engineering, Universitas Negeri Padang; her research interest includes educational technology, digital learning, TVET, and multimedia. (e-mail: ika_parma@ft.unp.ac.id).

Lativa Mursyida is a lecturer in the Informatics Education Department of Electronics Engineering at Universitas Negeri Padang (UNP). She was appointed as a lecturer in 2015. She completed her Master's degree in Technology and Vocational Education at Universitas Negeri Padang in 2014. Her research passion includes educational technology, multimedia, blended learning, digital learning, virtual learning environments, and TVET. Apart from being a lecturer, she is also an assessor of the Sekolah Penggerak Programme at the Ministry of Education and Culture and an assessor at the National Accreditation for Schools and Madrasa (BANSM) of West Sumatra. (e-mail: mlativa@ft.unp.ac.id).

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