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Analyzing textbook requirements to create physics learning resources

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ABSTRACT

There are no textbooks for developing physics learning tools, the learning materials are not structured, and students independently collect lecture materials. This research aims to explore the need for teaching materials, especially physics learning device development textbooks. This study used the descriptive qualitative method. This study used an incidental sample of physics education students from four university representatives who had completed an online questionnaire. The respondents were 166 people, consisting of 30 students from University A, 27 from University B, 29 from University C, and 80 from University D. The results showed that the research sample required physics learning device development textbooks. The yearly need for physics learning device development textbooks was 57.07% in 2018, 59.78% in 2019, and 60.88% in 2020. The percentage of the indicator of the need for textbooks: 47.20% for learning resources, 37.98% for textbook availability, 84.64% for teaching material students need, and 67.16% for students interest in physics learning device development. Therefore, lecturers need to develop practice-based textbooks in the physics learning device development course.

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1. INTRODUCTION

Physics education is a study program that aims to produce qualified, professional, and highly skilled graduates of education (prospective physics teachers). The competence of prospective teachers substantially impacts students learning process [1]. Building the competence of prospective teachers is an urgent need for success in education [2]. In addition to having qualified academic competencies, prospective physics teachers must also have pedagogic [3], and social, professional, and personal competencies [4]. By fulfilling these competencies, prospective physics teachers are expected not only to be able to share knowledge with students [5] but also to be role models, inspire, see changes far ahead (visionary), and plan what is best for their students in the future.

Pedagogic competence is one of the competencies that prospective teachers must master [6] because this competency is the main requirement for organizing effective learning in achieving educational goals [7]. Pedagogic competence in managing, designing, and implementing learning [8], evaluating learning outcomes, and developing students to actualize their various potentials. Pedagogic competence is generally

considered something that can be learned [9], and tertiary education programs aim to improve prospective teachers' professional competence [10].

One of the steps several universities take to produce qualified, professional, and highly skilled prospective teachers is to provide them with the physics learning devices development course. So far, the physics learning devices development course has no specific reference book. Students collect information and lecture materials separately for each material. Some are collected from online references or books. In fact, for many years, textbooks have become an essential learning resource and are much needed by students [11]. This is a challenge for lecturers to prepare innovative learning resources [12]. Therefore it is necessary to develop a physics learning devices development textbook to help students overcome the scarcity of learning resources [13]. The physics learning devices development textbook will be practice-based and adapted to the Merdeka Learning Campus Merdeka curriculum, making it easier for students to understand the material and develop physics learning devices [14]. Textbooks can be used directly by lecturers and students to mediate educational content and help condition various learning situations [15]. Developing textbooks that follow the learning outcomes or objectives is an effective strategy for lecturers and teachers to improve the learning quality [16], [17].

2. RESEARCH METHOD

This research used a descriptive qualitative method. This study describes the need for a physics learning devices development textbook. This study used an incidental sampling method by taking four representatives of higher education institutions with physics education study programs. Incidental sampling finds samples by chance and matches the researcher's criteria [18]. The sample in this study was physics education students from four university representatives who had filled out an online questionnaire. The number of respondents is 166 people: 30 people from University A, 27 people from University B, 29 people from University C, and 80 people from University D. The instruments used in this study were non-test instruments in the form of observation sheets, interviews, and questionnaires [19], which were distributed digitally via google form to all respondents.

At the observation stage, the researcher observed the lecture process of the physics learning devices development course, such as learning strategies or models, teaching materials, and assessments lecturers have used for the last three years. Interviews were conducted with six physics learning devices development course lecturers at four different universities in Makassar. The indicators of the interview questions are about the teaching materials used by the lecturers for the last three years. The interview was an unstructured or open-type [20], [21]. In addition to interviewing the course lecturers, the researcher randomly interviewed five university a student. The researcher distributed questionnaires online to complete the acquisition of data on textbook requirements.

The textbook needs questionnaire has four indicators: learning resources, textbook availability, teaching materials students need, and students interests in physics learning device developments. The research instruments (observation sheets, draft interview questions, and questionnaires) were validated before the use [22]. Apart from being validated, the research instrument was also tested for reliability [23]. The research instrument is a questionnaire using a rating scale of 1 to 4. Data analysis uses the Aiken formula to test content validity, Cronbach's alpha, and intraclass correlation coefficients (ICC) to test reliability between raters. Apart from being validated, the research instrument was also tested for reliability. The result of Aiken's coefficient measurement is 0.786. These results indicate that the Aiken score is above 0.76, so the research instrument is declared valid. The reliability value obtained from the Cronbach and ICC alpha calculations is 0.875, so this instrument can be trusted (reliable). Thus, it can be concluded that the instrument for measuring textbook requirements for developing physics learning tools has a quite strong Aiken validity and fairly inter-rater solid reliability.

The data obtained from the respondent's questionnaires were then analyzed descriptively by collecting the acquisition data according to the indicators for the need for textbooks in the table. After that, the researcher classifies the data according to the indicators and descriptions of the sub-indicators, analyzes the data, and makes conclusions to describe and see the relationship between variables. Data classification results will be analyzed using descriptive statistical analysis in the form of percentages for each research indicator. The data from the analysis became the basis for making research conclusions, which is the importance of developing textbooks for physics learning devices development. The data obtained from the data classification stage is then analyzed using a percentage calculation with (1), according to previous studies [24], [25].

$$P = \left(\frac{n}{N} x 100\ \%\right) \quad (1)$$

3. RESULTS AND DISCUSSION

From the physics learning devices development learning process observations, no textbook specifically designed by the lecturer is under the learning objectives. So far, students independently search for and download lecture material online. This is in line with research conducted, which states that if no textbooks follow the learning objectives in lectures, some students will independently download relevant material from the internet. However, only a few university students do this [26]. The material is matched with the details presented by the supporting lecturer at the beginning of the lecture (lecture contract).

From the results of interviews with lecturers and students, information was obtained that textbooks for the development of physics learning tools, both printed and digital versions, were not yet available in the physics education study program or department, students used learning resources from the internet by downloading material one by one. For example, next week's lecture material is learning media at the meeting, so students are looking for material related to learning media on the internet. There is no complete, structured material that students or lecturers can easily download online. Apart from the textbook availability, some students also said that they needed lecture modules, textbooks, and student worksheets in lectures.

In addition to observation sheets and open interviews with lecturers and students, the researchers distributed online questionnaires through the google form application. The questionnaire has four indicators: learning resources, textbook availability, teaching materials students need, and students interests in physics learning device developments. The results of the analysis of calculating the percentage of textbooks needed for the physics learning devices development course are presented in Table 1.

Table 1 provides an overview of the need for the physics learning devices development textbooks at four universities in Makassar, represented by three private and one state university. Data on the need for the physics learning devices development textbook were collected during the last three years (class). Table 1 shows that physics education students need for the physics learning devices development textbook are increasing yearly (2020). The average percentage score obtained at each university for each batch of textbook needs is 59.25%. This score shows prospective physics teachers still need the physics learning devices development textbook. The importance of the position of textbooks in lectures is not only felt in Indonesia. One study also revealed the vital role of textbooks in lectures at one of the universities in America. Lecturers are challenged to develop digital versions of textbooks [27].

In detail, the need for textbooks can be broken down into four indicators of the need for textbooks. These indicators are learning resources, textbook availability, teaching materials students need, and students interests in physics learning device developments. The data are presented in Table 2.

Table 1. The percentage of needs analysis for physics learning devices development textbook

University category	University	Percentage (%)/batch			The average for each generation
		2018	2019	2020	
Private university	A	56.44	59.28	62.24	59.32
	B	55.47	57.29	57.18	56.65
	C	56.46	59.85	61.20	59.17
Public university	D	59.92	62.71	62.92	61.85
The average for each university		57.07	59.78	60.88	59.25

Table 2. Students learning resources in the physics learning devices development course

University	Percentage (%)/batch			The average for each generation
	2018	2019	2020	
A	46.97	47.73	48.96	47.89
B	42.71	47.50	48.15	46.12
C	45.00	46.21	46.88	46.03
D	46.67	48.33	51.33	48.78
The average for each university				47.20

Based on Table 2, the percentage of learning resources used by students is still deficient, below 50% at Universities A, B, C, and D. The highest percentage of total learning resources in the physics learning devices development course is in University D (48.78%). The most dominant learning resource students use is the internet. These learning resources are downloaded individually (part by part) and are not yet fully available for one complete course material. There are no student learning resources in the form of printed textbooks available in study programs or departments. In addition, there is no digital version of textbooks prepared by the course lecturers. Henderson researched the difficulty and lack of textbooks to cover the course's needs. Based on a survey of 1,658 undergraduate students, 97% stated that they really needed teaching materials in lectures, and 86% needed digital teaching materials for easy access [28]. The availability of textbooks in lectures on the development of physics learning tools is shown in Table 3.

Table 3. Textbook availability in the physics learning device development course

University	Percentage (%)/batch			The average for each generation
	2018	2019	2020	
A	29.55	32.58	37.50	33.21
B	34.38	37.50	37.96	36.61
C	36.67	39.39	39.58	38.55
D	38.67	48.61	43.33	43.54
The average for each university				37.98

From the results of online questionnaires, the textbook availability for the physics learning device development was still lacking in the four universities. The lowest percentage of textbook availability was found in University A (33.21%), and the highest was in D (43.54%). However, the average percentage of textbook availability was only 37.98%, which is still lacking. Of the four universities used as research samples, there are no physics learning device development textbooks specifically designed by the course lecturers. Then the teaching materials needed by students in physics learning device development lectures can be seen in Table 4.

Table 4 shows the percentage of teaching materials students need in the physics learning device development course. Of the four research samples, students needed teaching materials for lectures on physics learning device development. The percentage of student needs tends to be high, above 50%, with an average percentage of needs of 84.64%. From the open interviews, the teaching materials needed by students, especially at University C, were teaching modules that contained brief lecture material and practical examples. University A stated that most students needed teaching materials in the form of textbooks that were per the objectives of the lectures in the physics learning devices development course, so students no longer needed to download material one by one from the internet. This can also make it easier for students to study independently. Likewise, at University D, most students want course textbooks structured according to learning objectives. This finding is also in line with research conducted by Bhimasta and Suprapto [29] at the Faculty of Economics at Atmajaya University, Yogyakarta, which found an increase in learning activities and positive responses from students after developing teaching materials in the form of lecture textbooks [29], [30]. With lecture textbooks, students can learn more easily and efficiently using time [31]. Students no longer need to look for material in the library or on the internet if there are textbooks that can cover student needs. At University B, it is stated that the type of teaching materials students need are student worksheets or textbooks equipped with student worksheets that can guide students in independent study. An overview of students learning interest in lectures on developing physics learning tools can be seen in detail in Table 5.

Table 4. Teaching material students need in the physics learning device development course

University	Percentage (%)/batch			The average for each generation
	2018	2019	2020	
A	81.06	87.12	88.54	85.57
B	86.46	82.50	86.11	85.02
C	81.67	87.12	87.50	85.43
D	76.33	83.61	87.67	82.54
The average for each university				84.64

Table 5. Student's interests in the physics learning device development course

University	Percentage (%)/batch			The average for each generation
	2018	2019	2020	
A	68.18	68.70	73.96	70.61
B	58.33	61.67	56.48	58.83
C	62.50	66.67	70.83	66.67
D	78.00	70.28	68.33	72.54
The average for each university				67.16

Table 5 maps students' interests in Physics Learning Device Development. Students' interest is included in the medium (intermediate) category in attending lectures on Physics Learning Device Development, with an average percentage in each university of 67.16%. The highest student interest was at University D (72.54%), while the lowest was at University B (58.83%). The sub-indicators for students' interest in learning are the importance of lectures on the Development of Physics Learning Devices for students, the learning difficulties of the Development of Physics Learning Devices, and learning models and teaching strategies for lecturers in the Physics Learning Devices Development lectures. An analysis of the need for Physics Learning Device Development textbooks for each indicator at University A is presented in Figure 1.

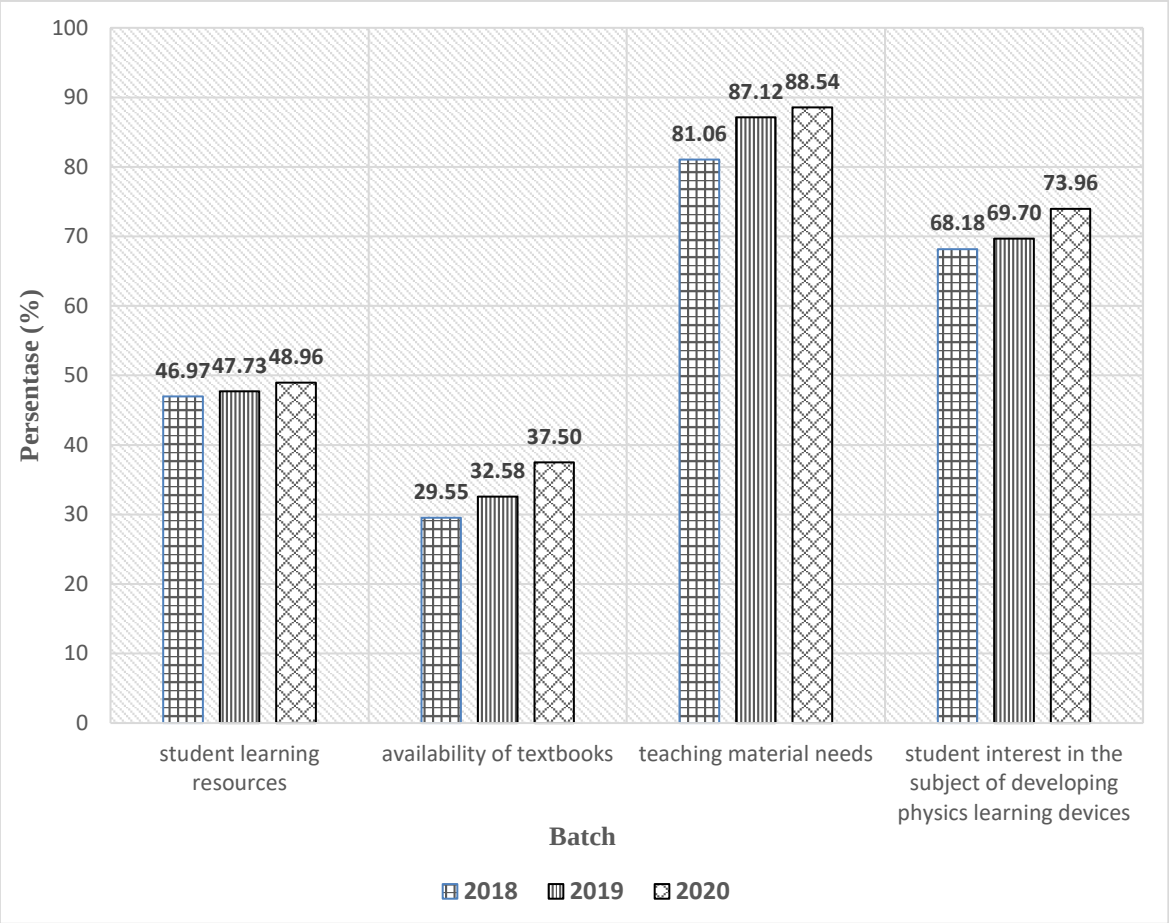

Figure 1. The need for physics learning device development textbooks in university a for the last three years

Based on Figure 1, the learning resources students use have increased yearly, although the percentage was insignificant. The dominant learning resource used by students is the internet. Similar research also explains that students in the digital era are currently using or looking for learning resources more from the internet. The percentage of using the internet as a learning resource has increased since the pandemic hit, and learning must be done online [32]. Learning resources for learning device development courses are not yet available in print or digital versions, study programs, or the physics education department. The second indicator, textbook availability, has also increased every year. However, the percentage increase is still below 50%. At University A, there are no textbooks designed by course lecturers under the learning outcomes of the physics learning device development course. The third indicator, teaching materials students need, also increases yearly, although the increase is relatively small. Students at University A need textbooks that provide lecture material in a sequential and structured manner and examples in each material [33], for example, in the annual learning program material. In addition to brief materials related to the preparation of the annual learning program in high schools, it is also equipped with several examples of annual programs made in high schools. It can make it easier for students to practice compiling an annual learning program at school. The next indicator is students interest in physics learning device development. Figure 1 shows that students interest in learning each year also tends to increase. According to student admissions, it was influenced by the learning strategies carried out by the course lecturers. During a pandemic, lecturers in charge use interesting online learning applications that can increase students learning interest [34].

Learning resources have increased in lectures for students in batch 2019. Then the need for textbooks for the development of physics learning tools at University B over the last three years is presented in Table 2. The table shows that students learning resources in physics learning device development courses have increased over the past three years.

Figure 2 shows that students learning resources in physics learning device development courses have increased over the past three years. Learning resources have increased in lectures for students in batch 2019. From the interview results, this increase occurred because the lectures were fully online, resulting in

increased online learning resources (from the Internet) used by students. Physics learning device development courses for the class of 2020 also experienced an increase, but not as significant as the class of 2019 to 2020. A similar phenomenon occurred in China. Since the development of the internet and students smartphone use, the percentage of learning resources from the internet has also increased [35]. In the second indicator, textbook availability increased for each generation, but with a relatively small increase. Students used no subject reference books. Students seek separate material under the lecture contract delivered by the lecturer. The percentage of needed teaching materials decreased in the 2019 class and then increased slightly in 2020. The teaching materials that most students expect to organize are student worksheets. According to students, structured worksheets can help students understand lecture material. This finding aligns with research on the development of science, technology, engineering, and mathematics (STEM)-oriented student worksheets. The research explains that having student worksheets oriented to the STEM approach helps students in learning and can activate learning, efficiently allocate lecture time, and improve students critical thinking skills [36]. Students interest in physics learning device development fluctuated at University B due to the pandemic, as seen from students attendance and delays in online lectures. However, during the new normal period in the class of 2020, students interest in learning slowly increased.

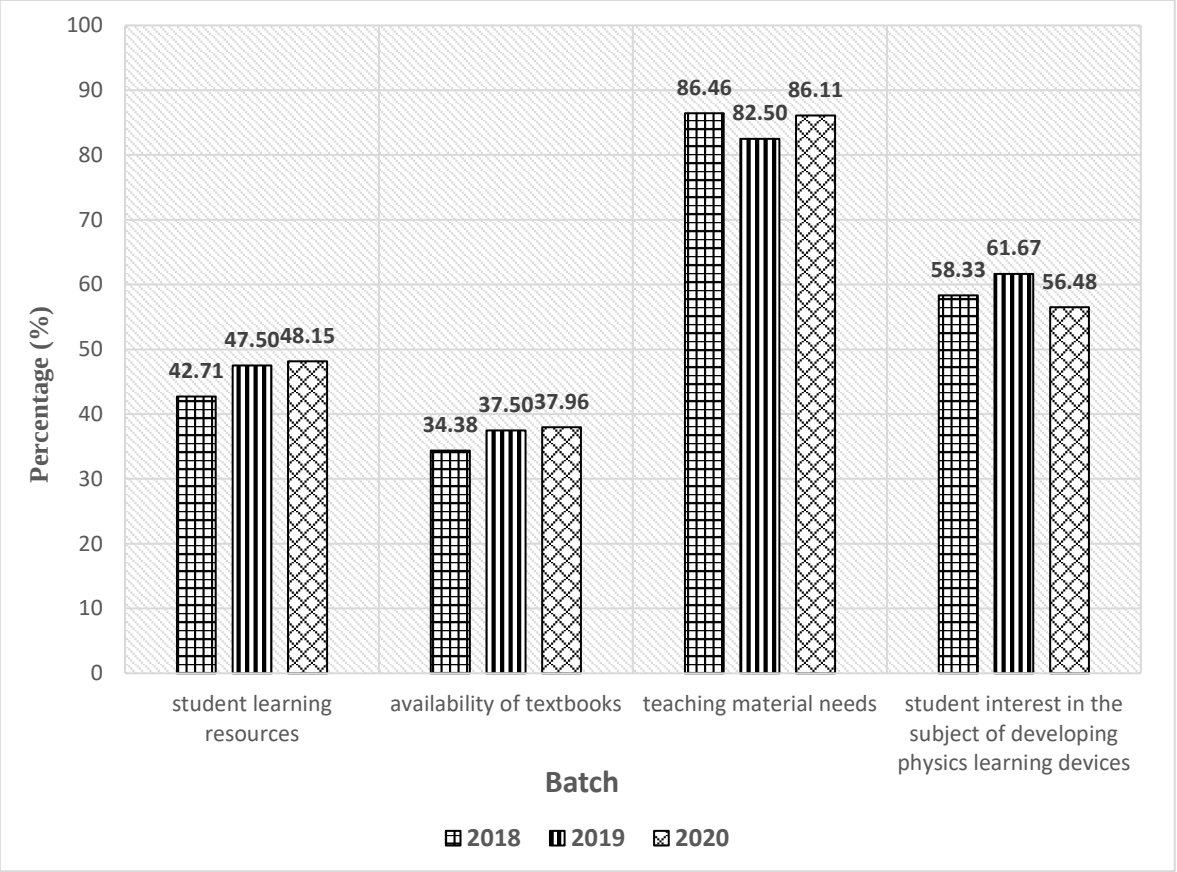

Figure 2. The need for physics learning device development textbooks in university b for the last three years

An overview of the need for textbooks at College C over the last three years is presented in Figure 3. The description of textbook needs includes four indicators, namely student learning resources, availability of textbooks, teaching material needs, and student interest in the subject of developing physics learning devices.

Figure 3 shows the percentage of the need for physics learning device development textbooks in University C for the last three years. There was a relatively small increase in the learning resources indicator, only around 0.67% in the class of 2019 to 2020. On the textbook availability indicator, the percentages were almost the same. In the class of 2018 to 2019, there was a slight increase of around 2.72%. The increase from the class of 2019 to 2020 is 0.19%. At University C, students in each generation also need teaching materials in the physics learning device development course. Teaching materials that students need are teaching modules. This is supported by research conducted by McIntyre *et al.* [37], which explains that the

development of printed and digital lecture modules can guide students in independent learning [37]. Apart from that, other parallel studies state that having lecture modules can overcome students boredom with learning. Furthermore, lecture modules can motivate students [38]. Meanwhile, the fourth indicator, students interest in physics learning device development, is excellent. There has been a significant increase in each class. An overview of the need for textbooks at College D for the last three years, namely in 2018, 2019, and 2020 is presented in Table 4. Table 4 shows the need for textbooks for the indicators of student learning resources, availability of textbooks, teaching material needs, and student interest in the subject of developing physics learning devices.

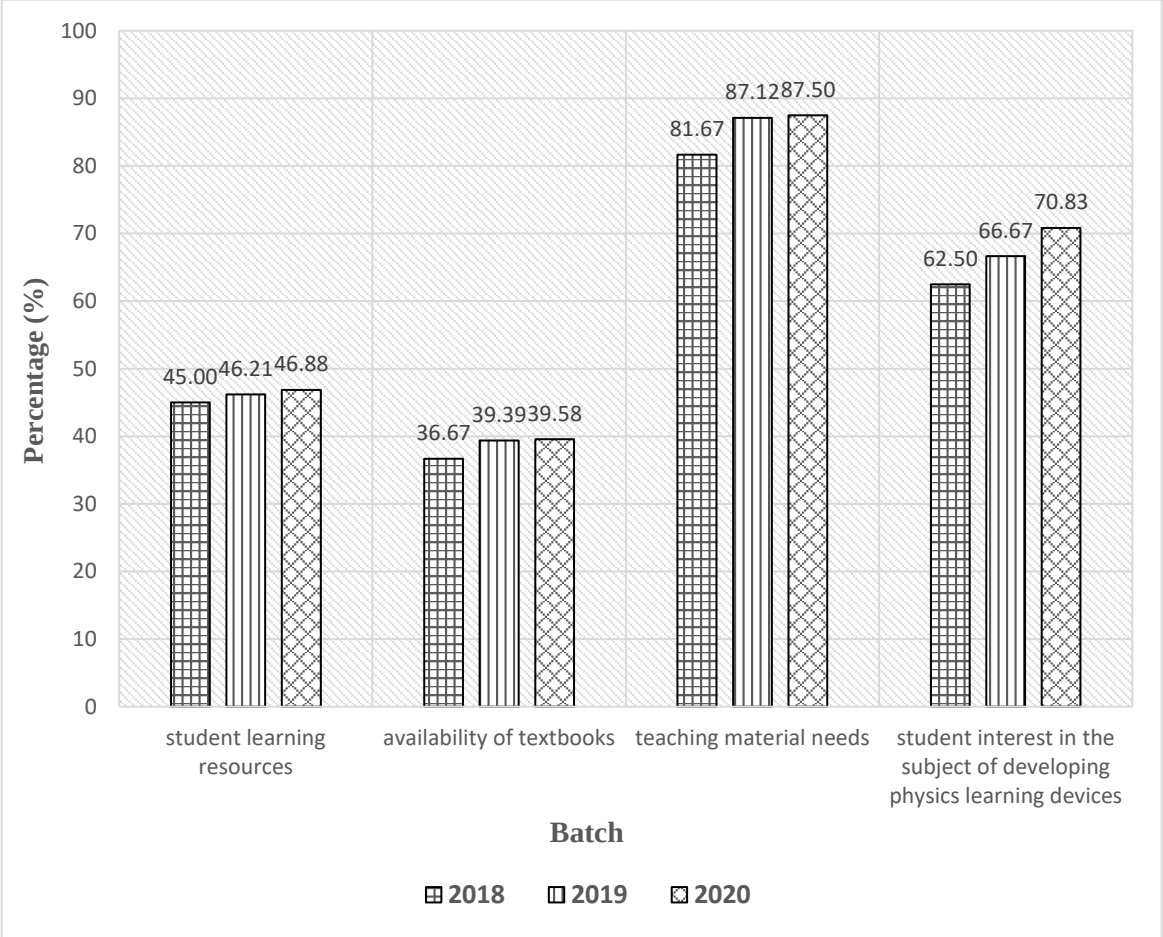

Figure 3. The need for physics learning device development textbooks in university c for the last three years

Figure 4 shows the need analysis for physics learning device development textbooks in University D for the last three years. In the first indicator of learning resources, there was an increase in the percentage. This increase came from the use of Internet learning resources in lectures. There is no use of specific learning resources from lecturers who teach the subject yet. However, from interviews, some use books in the D campus library. However, these books are not physics learning devices development course textbooks. Some of these books are textbooks for learning media or textbooks on assessing learning outcomes and evaluating learning. There is also a book on making good and correct question instruments for middle schools. The indicators of textbook availability fluctuated in the class of 2020. The indicators of students interest in physics learning device development decreased over the last three batches. research by [39] which explains the recent decline in student interest in basic physics courses [39] and mechanics courses [40].

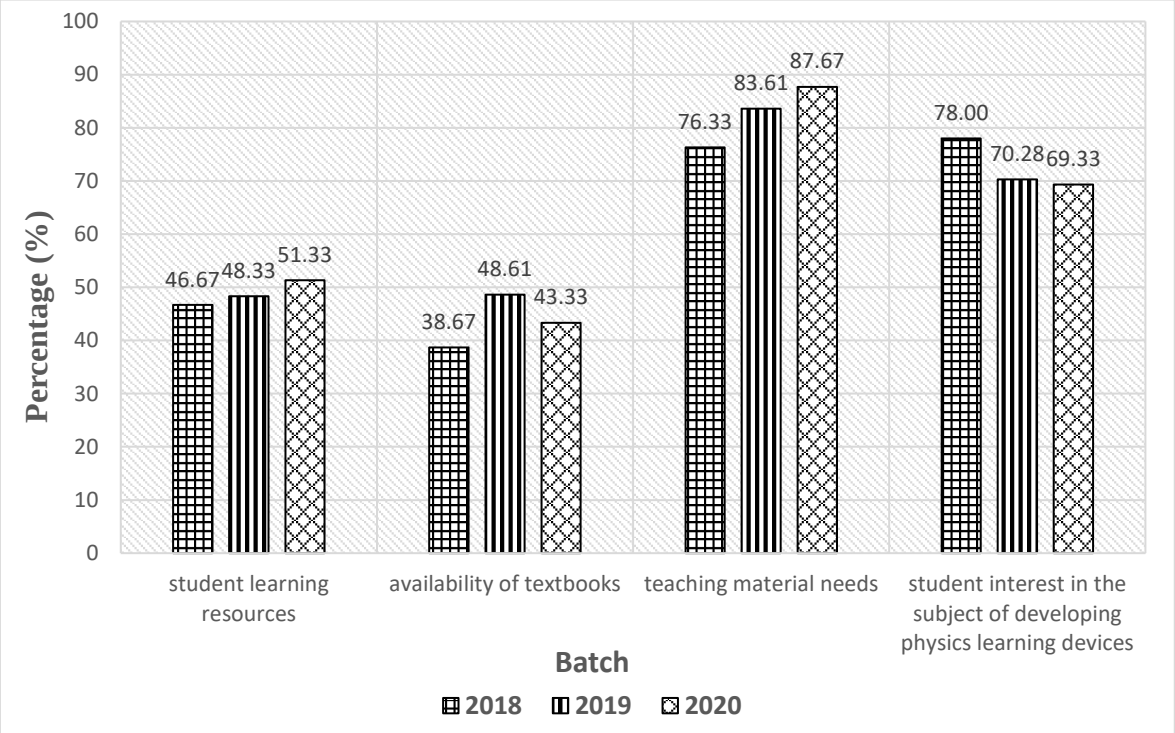

Figure 4. The need for physics learning device development textbooks in university d for the last three years

4. CONCLUSION

Based on the need analysis for physics learning device development textbooks, the four universities used as research samples needed textbooks or specific reference books. In general, the percentage of the need for textbooks in the last three years is 59.25%, while the yearly need for physics learning device development textbooks was 57.07% in 2018, 59.78% in 2019, and 60.88% in 2020. The percentage of the indicator of the need for textbooks: 47.20% for learning resources, 37.98% for textbook availability, 84.64% for teaching material students need, and 67.16% for students interest in physics learning device development. Therefore, it is necessary to develop physics learning device development textbooks under the course's learning outcomes. To accommodate independent learning, the textbook should be practice-based with various examples of the material application for secondary schools.

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