Duconomics Sci-meet Vol. 2
Juli, 2022
https://www.doi.org/10.37010/duconomics.v2

Development of Educational Statistics Teaching Materials Based Learning Cycle 5E and its Impact on Improving Learning Outcomes

Pengembangan Bahan Ajar Statistik Pendidikan Berbasis Learning Cycle 5E dan Dampaknya Terhadap Peningkatan Hasil Belajar

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Abstract

This study aims to determine the validity, practicality, and effectiveness of Educational Statistics teaching materials based 5E Learning Cycle. This research used Research and Development model. The average validation results from evaluation & curriculum experts and material experts are 3.64 and 3.69 (very valid). This means that the teaching material is said to be feasible. Practicality is obtained from the student's response to teaching material of 93.68% (very positive) and observations of implementation of teaching materials with an average of 1.73 (implemented entirely). Thus the teaching materials are said to be very practical. Furthermore, effectiveness of teaching materials was measured by using paired samples test. The results showed that there were significant differences in learning outcomes between before and after using the Education Statistics teaching materials that had been developed. In other words, the average student learning outcomes after using Educational Statistics teaching materials based Learning Cycle 5E have increased.

Keywords

Learning outcomes, 5E learning cycle, validity, practicality, effectiveness

Duconomics Sci-meet

2022

VOLUME 2
JULY

Page

234-247

DOI

10.37010/duconomics.v2.6079

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Abstrak

Penelitian ini bertujuan untuk mengetahui validitas, kepraktisan, dan keefektifan bahan ajar Statistika Pendidikan berbasis Learning Cycle 5E. Penelitian ini menggunakan model Research and Development. Rata-rata hasil validasi dari ahli evaluasi & kurikulum dan ahli materi adalah 3,64 dan 3,69 (sangat valid). Artinya bahan ajar dikatakan layak. Kepraktisan diperoleh dari respon siswa terhadap bahan ajar sebesar 93,68% (sangat positif) dan observasi keterlaksanaan bahan ajar dengan rata-rata 1,73 (terlaksana seluruhnya). Dengan demikian bahan ajar dikatakan sangat praktis. Selanjutnya keefektifan bahan ajar diukur dengan menggunakan uji sampel berpasangan. Hasil penelitian menunjukkan bahwa terdapat perbedaan hasil belajar yang signifikan antara sebelum dan sesudah menggunakan bahan ajar Statistika Pendidikan yang telah dikembangkan. Dengan kata lain rata-rata hasil belajar siswa setelah menggunakan bahan ajar Statistika Pendidikan berbasis Learning Cycle 5E mengalami peningkatan.

Kata kunci

Hasil belajar, siklus belajar 5E, validitas, kepraktisan, keefektifan

https://www.doi.org/10.37010

INTRODUCTION

Improving the quality of education includes learning models, learning resources, and learning media needed in the learning process. Where the teaching and learning process is essentially an interaction between lecturers and students. One way to improve student learning outcomes is to emphasize student understanding of the material (Prasetyono et al., 2018; Abdillah, 2017). The development of textbooks is expected to improve students' understanding of the Statistics subject. There are many types of teaching materials available such as books, modules, and textbooks. Learning will run effectively and efficiently if it uses teaching materials that suit student needs, supports the competencies to be achieved by students, has a systematic description, standardized tests and appropriate learning strategies for students (Madu &Amaechi, 2012). Therefore, a lecturer must be able to prepare teaching materials and learning strategies that are suitable in every lesson in class.

Based on the data the researchers collected by means of open interviews with students who had taken previous statistics courses, it was found that students still experienced difficulties in the learning process. Some stated that they had difficulty understanding the reference books used. Some students also stated that they needed a neat and ordered unity of material and assignments as described in the lecture contract. This is because the material, which is mostly presented in the form of power points or daily assignments, is not collected in one unit. In addition, it is stated that monotonous statistical learning is only about counting and not infrequently they also do not understand the meaning behind the "numbers" they compute or present. Furthermore, open interviews with lecturers, obtained information that lecturers need integrated and coordinated teaching materials between each lecturer who teaches the Statistics subject in each academic year. These materials include presentations on concepts / materials, examples of practice questions, quizzes, and test questions from year to year.

To meet the needs of both students and lecturers, meeting the learning process standards mandated by the Indonesian National Curriculum (KNI), namely scientific-based learning, it is very urgent that it is necessary to develop teaching materials for Statistics courses that are fun, meaningful, and integrated.

Learning Cycle 5E is a constructivist learning model which in the learning process equips students with new concepts or understanding in depth, incorporates higher-order thinking skills, stimulates students to explore, discover and gain experience (Bybee et al., 2006; Ergin, 2012).

The purpose of this study is to produce statistical teaching materials that are in accordance with the principles of the 5E learning cycle model; and produce Statistics teaching materials that meet valid and practical criteria, and the implications for improving student statistical learning outcomes. While the specific purpose of this research, after producing Statistics teaching materials, it is expected that the learning process is in accordance with the mandate of the Indonesian National Curriculum, namely scientific-based learning. This is because the learning process at the proposing researcher has been conventional. So that with the results of this study, later students and lecturers will be able to optimize technological developments, make the best use of learning media, and take advantage of the learning facilities they have in a positive direction that supports learning outcomes.

RESEARCH METHOD

a) Research Design

This type of research is a research development (Research and Development). The research and development method (Research and Development) is a research method used to

produce certain products and test the effectiveness of these products (Sugiono, 2016; Creswell, 2012). To be able to produce certain products used research that is needs analysis and to test the effectiveness of these products so that they can function in the wider community. The development model used as the basis for this research is a model from which consists of 3 (three) stages, namely Preliminary Research, Prototyping, and Assessment (Plomp, 2007).

This development research is at the prototyping and assessment stage. Activities carried out at the prototyping stage are developing teaching materials and research instruments (Hanggara & Agustyaningrum, 2018; Arikunto, 2015). The teaching materials developed are Statistics teaching materials based on the 5E Learning Cycle which will be called draft 1. Draft 1 is then validated by two expert validators. The validation process will be analyzed descriptively qualitatively. Furthermore, at the assessment stage, the draft that has gone through the validation stage is then carried out into draft 2 which is then carried out a limited trial until draft 3.Draft 3 is then carried out a wide-scale trial by observing the implementation of the use of teaching materials and distributing student response questionnaires to teaching materials developed to determine the practicality of teaching materials (Skalka, Drlik & Obonya, 2019; Sudjana, 2009). Learning in the classroom is carried out for four meetings and the last one is a learning outcome test. The test was conducted to determine the effectiveness of the teaching materials.

b) Population and sample

The population in this research were students of the Economic Education Study Program, Universitas Indraprasta PGRI Semester V academic year 2020/2021 which consisted of 31 classes with a total of 1175 students. The sample taken is class S5F (experimental class) as many as 42 people.

c) Instruments

The instrument used was the validation sheet instrument of teaching materials, both validation of material experts and validation of curriculum experts and evaluation of learning (Dewi et al., 2019). Furthermore, the instrument of validation of the observation sheet of the implementation of teaching materials, the validation sheet of the student response questionnaire, and the validation of the test sheet for learning outcomes (Fadzil & Saat, 2019).

d) Data Analysis Technique

The data analysis techniques in this study included validity data analysis with steps (Purwanto, 2010); Griffin and Care, 2012) recapitulate the results of the expert's assessment into the aspect table, namely the assessed aspects, the assessment criteria, and the results of the assessment, namely the validator's assessment interpretation, 2) find the average research results of all validators for each criterion, 3) look for the average of each aspect, 4) looking for the total average, and 5) determining the validity of each criterion or the average aspect or total average based on the validity category which has been determined as follows:

Table 1. Criteria for the Validity of Teaching Materials

Score	Criteria
$3.5 \leq M \leq 4$	Very Valid
$2.5 \leq M < 3.5$	Valid
$1.5 \leq M < 2.5$	Enough Valid
$M < 1.5$	Invalid

If the average value of validity for all aspects is in a fairly valid category and the average value of validity for each aspect is in the valid category, the teaching material has an adequate degree of validity. If it does not meet these criteria, it is necessary to revise it based on the

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advice of the experts / experts or to review the aspects whose value is insufficient and then re-validate again.

Next, the data analysis was practical. Practicality is measured based on assessments from lecturers and students as well as observation sheets on the implementation of teaching materials (Arsyad, 2016 p. 160). To state whether the product can be applied in the field. The first is the implementation sheet of teaching materials with steps to be taken, among others recapitulate the results of observations of the implementation of learning into tables which include aspects, indicators, and values, 2) determine the average value of the observation results n meetings and for each observation indicator, 3) determine the average value for each aspect of the observation, 4) determine the total average of the average scores for all aspects, and 5) determine the level of implementation of teaching materials by referring to the following:

Table 2. Determination of Implementation Level Interval

Score	Criteria
$1.5 \leq IO \leq 2$	Completely done
$0.5 \leq IO < 1.5$	Partially done
$0 \leq IO < 0.5$	Not done

Then calculate the reliability of the observation sheet on the implementation of the LC 5E-based teaching materials using the modified Percetage of Agreements Grinnel (Hobri, 2010). The implementation of Educational Statistics teaching materials based LC 5E is said to be reliable if the reliability value is (R) ≥ 0.75. In addition, the analysis of the results of filling out the student response questionnaire was used to determine the responses of students and lecturers to learning activities which were then analyzed using descriptive statistics in the form of percentages (Woo, 2011). The activities carried out to analyze student response data were counting the number of students who gave positive responses according to the aspect being asked, then calculating the percentage then referred to the intervals of the following student response questionnaire score interpretation scores:

Table 3. Interpretation Criteria for Student Response Questionnaire Scores

Interval	Criteria
$85\% \leq$ Score $< 100\%$	Very Positive
$70\% \leq$ Score $< 85\%$	Positive
$60\% \leq$ Score $< 70\%$	Pretty Positive
$50\% \leq$ Score $< 60\%$	Less Positive
Score $\leq 50\%$	Not Positive

Meanwhile, to determine the effectiveness of teaching materials, it is determined from the difference in the average student learning outcomes before and after the implementation of the 5E Learning Cycle-based Education Statistics teaching materials. The analysis used was using Paired sample t-test. If learning outcomes have increased after the use of teaching materials that have been developed, the teaching materials can be said to be effective. Vice versa.

RESULT AND DISCUSSION

Research Results in the Prototyping Stage

In the needs analysis, 12 chapters of the draft Statistics teaching materials have been agreed. The twelve chapters were reviewed and discussed by the research team before becoming a complete design containing an overview and main points that would be developed into Educational Statistics teaching materials. There were several chapters that were revised,

especially those related to the content, language, graphics, and presentation included, the curriculum used and also how it would be when a large-scale trial applied some of these statistical materials. During the discussion by the research team, several matters related to the Education Statistics teaching material were decided to be developed. The following are some of the results of the discussion; a) The statistical teaching materials that were developed were Educational Statistics teaching materials based LC 5E for undergraduate students, especially in the Economic Education Study Program. The teaching materials developed are adjusted to a scientific-based curriculum, b) In accordance with the results of the needs analysis and the analysis of learning difficulties in statistics on students they need learning resources / textbooks that focus on education, examples of questions / cases related to educational problems. So that there is no over leaping (Abdillah et al., 2020), c) In accordance with the input from the lecturers who taught the Statistics subject during the Focus Group Discussion (Hollander, 2004; Oluwatosin, 2005), the research team agreed to develop Educational Statistics teaching materials which consisted of the 12 most important chapters in the Statistics subject. The following are the 12 Chapters contained in the draft Education Statistics teaching materials:

Table 4. Chapters in the Education Statistics Book

List of Chapters	Contents
Chapter I	Introduction (Scope of Descriptive and Inferential Statistics)
Chapter II	Data Presentation (Frequency Distribution and Graphics)
Chapter III	Central Tendency and Value Grouping
Chapter IV	Dispersion, Skewness, and Kurtosis
Chapter V	Trend Analysis and Forecasting
Chapter VI	Probability
Chapter VII	Sampling Distribution
Chapter VIII	Estimating Parameters
Chapter IX	Hypothesis
Chapter X	Correlation and Regression
Chapter XI	Path Analysis
Chapter XII	ANOVA

Research Results in the Assessment Stage

a) Results of validation test of teaching materials

The resulting draft 1 teaching materials were validated by experts. Validation by experts is focused on, content, language, presentation and graphics that include all the teaching materials developed. The results of the validation from the two experts were in the form of corrections, criticisms and suggestions which were used as the basis for making revisions and improvements to teaching materials. The revised teaching material based on input from the two validators is called draft 2. Teaching materials that have been declared valid by the two validators are called draft 2. a) Validator At this stage the teaching material validation is carried out. Experts who validate teaching materials and research instruments are lecturers from FIP-UNJ who teach Curriculum and Learning Evaluation courses and Statistics courses.

The validity of the chapters has been tested based on aspects; material content, language, presentation, and graphics. Both material expert validation (validator 1) and evaluation & curriculum expert validation (validator 2). Especially for the evaluation & curriculum expert validation, the content aspect of the material is related to the 5E learning cycle syntaxes. This means that the content of the material has met the syntax such as; engaged, explore, explane, elaborate, and evaluation. Based on the results of the validation test by material experts and evaluation and curriculum experts on teaching materials, it can be seen in table 8 which shows that the draft teaching material as a whole can be said to be very valid because it is in the interval $3.5 \leq M \leq 4$. Except in Chapter 7 (Sampling Distribution) for Validator 1 (Curriculum and

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Learning Evaluation), only the average total assessment is 3.49. Thus Chapter 7 is categorized as Valid because it is in the interval 2.5 ≤ M <4.

Table 5. Validator Assessment Results

List of Chapters	Average Total Rating		Information	
	Validator 1	Validator 2	Validator 1	Validator 2
Chapter I	3.51	3.75	Very Valid	Very Valid
Chapter II	3.67	3.68	Very Valid	Very Valid
Chapter III	3.67	3.72	Very Valid	Very Valid
Chapter IV	3.56	3.55	Very Valid	Very Valid
Chapter V	3.55	3.70	Very Valid	Very Valid
Chapter VI	3.76	3.74	Very Valid	Very Valid
Chapter VII	3.49	3.74	Valid	Very Valid
Chapter VIII	3.66	3.92	Very Valid	Very Valid
Chapter IX	3.68	3.83	Very Valid	Very Valid
Chapter X	3.58	3.81	Very Valid	Very Valid
Chapter XI	3.74	3.66	Very Valid	Very Valid
Chapter XII	3.55	3.72	Very Valid	Very Valid
Total Mean	3.64	3.69	Very Valid	Very Valid

The assessment carried out by the validator includes the indicators in each chapter (content, language, presentation, and graphics). In making revisions, the researcher refers to the comments, suggestions of the validator and refers to the results of the discussion. Based on the results of the validator's assessment, corrections, criticisms, and suggestions were obtained as consideration for revising draft 1.The revision results for each of these chapters are described as follows:

a. First Validation

The results of expert validation carried out in the first validation process include suggestions from the validator.

Table 6. The results of the validation carried out in the first validation process include suggestions from the validator team

Validated Devices	Validation Results
Educational Statistics Teaching Materials (Chapter I to Chapter XII)	• For the purpose of needing additional information, so that students who will read the book understand the meaning • Emphasize the affective and psychomotor aspects • Instructions for using books need to be emphasized • For important points that must be understood and mastered by students, a clue must be made • For material that addresses important points, it should be more clearly marked. For example, given Bold • The use of terms needs to be emphasized • In general it is good • Subtitles that are on the right should remain on the left. Because if the subtitles are one word, readers tend to skip them • In every chapter, the explanation of the material should be put at the beginning, not behind. This is so that students engage more • Font of subtitles to be consistent in each chapter • Each formula is displayed as attractive as possible for easy reading

	• The curves should be enlarged again • Curves to be colored to attract more readers • Additional practice questions need to be added

b. Second Validation

The second validation process is carried out by submitting the revised results in the first validation process according to the notes / suggestions given in the first validation process to the validator team. After the revision is made, the results of the revision are shown back to the validator for re-examination.

Table 7. The results of the validation carried out in the second validation process include suggestions from the validator team

Validated Devices	Validation Results
Educational Statistics Teaching Materials (Chapter I to Chapter XII)	• Overall it is good • The practice questions are related to educational problems

In addition to the validation of teaching materials, validity tests were also carried out for assessment instruments, including; test the validity of observation sheet on implementation of teaching materials, and test the validation of the student response questionnaire. Data on the results of expert assessments on the observation sheet on the implementation of teaching materials, and student response questionnaires, and question sheets / learning result tests can be seen in table 8 below:

Table 8. Validation Results Against Assessment Instruments

Validated instrument	Indicators	Average Rating	Information
Observation Sheet of Teaching Material Implementation	Instructions	4.00	Very Valid
	Scope of Observation	3.67	Very Valid
	Language	3.50	Valid
	Average	*3.72*	*Very Valid*
Questionnaire for Student Responses to Teaching Materials	Instructions	3.75	Very Valid
	Fill in the Questionnaire	3.50	Valid
	Language	3.50	Valid
	Average	*3.58*	*Very Valid*
Question Sheet / Study Result Test	Fill in the questions	3.50	Valid
	Language	3.67	Very Valid
	Average	*3.58*	*Very Valid*
Total Instrument Validity Mean		3.60	Very Valid

In general that teaching materials, assessment instruments (observation sheets of teaching material implementation, and student response questionnaires to teaching materials) have met the validity requirements with the category "Very Valid". Thus the validator gives the decision that the Statistics teaching material is feasible to be tested. The findings of this study are also in line with several studies conducted by (Gazali, 2016; Amir & Arsyad, 2015; Hussain et al., 2019; Junaidah, 2012; and Lee & Kim, 2017).

b) Results of practicality test of teaching materials

At this stage, the use of products that have been made to be applied in the learning process that has been designed in such a way at the design stage is then developed. Revised teaching materials based on input from validators that have been declared valid are then tested on semester 5 students. The test was conducted to see the practicality and effectiveness of statistical teaching materials based LC 5E. In addition, in this trial the researcher also provided an observation sheet on the implementation of teaching materials to the observers who had been appointed. After all learning activities are completed, students are given a questionnaire to find

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out the student's response to the teaching materials that have been applied, this questionnaire is intended to see the practicality of the teaching materials that have been developed.

a. Practicality test results through student response questionnaires

This instrument is given to students after participating in the whole series of Statistics learning using Statistics teaching materials. The questionnaire was distributed to 42 students, the description of the results of the student response analysis can be seen in the following table:

Table 9. Frequency Distribution of Student Responses to Teaching Materials

Aspects	Strongly Agree		Agree		Disagree		Strongly disagree		% Positive Respons e	Information
	Fi	*%*	*Fi*	*%*	*Fi*	*%*	*Fi*	*%*		
Ease of Use of Teaching Materials	25	39.52	15	35.71	2	4.76	0	0.00	90.47	Very Positive
The attractiveness of the presentation of teaching materials	26	61.90	15	35.71	1	2.38	0	0.00	95.23	Very Positive
Benefits of Teaching Materials	27	64.29	14	33.33	1	2.38	0	0.00	95.34	Very Positive
Total Mean	26	61.90	15	35.71	1	2.38	0	0.00	93.68	Very Positive

Based on the table above, it can be seen that the average percentage of student responses to the implementation of learning activities using statistical teaching materials based LC 5E has a value greater than 80%. Based on the overall aspects stated, the average percentage of student responses is 95.23%. Thus the high percentage of student responses proves that the LC 5E-based Statistics teaching materials can be said to be practical to use.

b. Practicality test results through observation of the implementation of teaching materials

Data on the practicality of statistical teaching materials based LC 5E were also obtained through the observation sheet on the implementation of teaching materials. The results of the analysis of the implementation of the teaching materials were analyzed to see the level of practicality of the teaching materials. Analysis of the implementation of teaching materials includes components of syntax, social interaction, and reaction principles. The results of these components can be explained as follows:

1. Syntax aspects

The results of observations on the implementation of the syntax aspects during the trial, obtained an IO of 1.9. This shows that all aspects of the syntax components are in the fully implemented category ($1.5 \leq IO \leq 2$).

Table 10. Results of the Implementation of Teaching Materials on the Syntax Aspect

Syntax Aspects	Lectures to- / Observer to-																			
	1st Lectures					2nd Lectures					3rd Lectures					4th Lectures				
	P1	P2	$\bar{X}$	A	D	P1	P2	$\bar{X}$	A	D	P1	P2	$\bar{X}$	A	D	P1	P2	$\bar{X}$	A	D
•Student's engaged phase to be active in learning	2	2	2	1	0	1	1	1	1	0	2	2	2	1	0	2	2	2	1	0
•The phase of exploring students' minds to find knowledge	2	1	1.5	0	1	2	2	2	1	0	2	2	2	1	0	2	2	2	1	0
•The phase explains the	2	2	2	1	0	2	2	2	1	0	1	2	1.5	0	1	2	2	2	1	0

material in detail and meaningfully so that students can understand the material clearly •The material deepening phase is to encourage students to argue (elaboration)	2	2	2	1	0	2	2	2	1	0	2	2	2	1	0	2	2	2	1	0
•The phase of giving quizzes, practice questions or case studies to measure learning outcomes (evaluation)	2	2	2	1	0	2	2	2	1	0	2	2	2	1	0	2	2	2	1	0
Average	2	1.8	1.9			1.8	1.8	1.8			1.8	2	1.9			2	2	2		
Total Aspect Average	1.9																			
A&D Frequency				4	1				5	0				4	1				5	0
Percentage of Agreement (Reliability)				80%					100%					80%					100%	

2. Social interactions

The results of observations on the implementation of social interaction during the trial, obtained an IO of 1.66. This shows that all aspects of the social interaction component are in the fully implemented category ($1.5 \leq IO \leq 2$).

Table 11. Results of the Implementation of Teaching Materials on the Social Interactions Aspect

Social Interactions Aspect	Lectures to- / Observer to-																			
	1st Lectures					2nd Lectures					3rd Lectures					4th Lectures				
	P1	P2	$\bar{X}$	A	D	P1	P2	$\bar{X}$	A	D	P1	P2	$\bar{X}$	A	D	P1	P2	$\bar{X}$	A	D
• The interaction between lecturers and students, and between students and students.	2	2	2	1	0	2	2	2	1	0	2	2	2	1	0	1	1	1	1	0
• Activeness of students in understanding problems in teaching materials individually	1	1	1	1	0	1	2	1.5	1	0	1	1	1	1	0	1	1	1	1	0
• Student activeness in solving problems using	2	2	2	1	0	2	2	2	1	0	2	2	2	1	0	1	1	1	1	0

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Minitab software .																						
• The activeness of students in comparing or discussing answers or opinions with their group friends.	2	1	1.5	0	1	2	1	1.5	0	1	2	2	2	1	0	2	2	2	1	0
• Student activeness in presenting the results of group discussions to other groups.	2	2	2	1	0	2	2	2	1	0	1	1	1	1	0	2	2	2	1	0
• Student activeness in delivering answers and responding to questions from other groups.	2	2	2	1	0	2	2	2	1	0	2	2	2	1	0	1	2	1.5	0	1
• Activeness of students in making conclusions or summaries.	2	2	2	1	0	1	1	1	1	0	1	2	1.5	0	1	2	2	2	1	0
Average	1.9	1.7	1.8			1.7	1.7	1.7			1.6	1.7	1.6			1.4	1.6	1.5		
Total Aspect Average	1.66																			
A&D Frequency				6	1				6	1				6	1				6	1
Percentage of Agreement (Reliability)				86%					86%					86%					86%	

3. Principle of Reaction

The results of observations on the implementation of the reaction principle components during the trial, obtained an IO of 1.63. This shows that all aspects of the principle component of the reaction are in the fully implemented category ($1.5 \leq IO \leq 2$).

Table 12. Results of the Implementation of Teaching Materials on the Principle of Reaction Aspect

Principle of Reaction Aspect	Lectures to-/ Observer to-																			
	1st Lectures					2nd Lectures					3rd Lectures					4th Lectures				
	P1	P2	$\bar{X}$	A	D	P1	P2	$\bar{X}$	A	D	P1	P2	$\bar{X}$	A	D	P1	P2	$\bar{X}$	A	D
• Lecturers create a comfortable atmosphere and motivate students to learn.	2	2	2	1	0	2	2	2	1	0	1	1	1	1	0	2	2	2	1	0
• Lecturers provide and manage teaching materials in	2	2	2	1	0	2	2	2	1	0	1	1	1	1	0	2	1	1.5	0	1

accordance with the basic competencies to be achieved.																					
• Lecturers take into account the rationality of time allocation in solving problems contained in teaching materials.	2	1	1.5	0	1	2	2	2	1	0	1	2	1.5	0	1	1	1	1	1	0	
• Lecturers guide students / student groups to work in solving problems in teaching materials.	2	2	2	1	0	2	2	2	1	0	2	2	2	1	0	1	1	1	1	0	
• Lecturers provide positive reinforcement to students	1	1	1	1	0	2	2	2	1	0	2	2	2	1	0	1	1	1	1	0	
Average	1.8	1.6	1.7			2	2	2			1.4	1.6	1.5			1.4	1.2	1.3			
Total Aspect Average													1.63								
A&D Frequency				4	1				5	0				4	1				4	1	
Percentage of Agreement (Reliability)				80 %					100 %					80%					80 %		

Overall, the average observations of the implementation of teaching materials are in the fully implemented category, namely at the interval ($1.5 \leq IO \leq 2$). This shows that at the trial stage it has met the practical criteria. Thus it can be concluded that the statistical teaching materials based LC 5E that have been tested meet practical criteria.

c) Analysis of Effectiveness of Teaching Materials (Learning Outcomes Test)

Teaching materials can be said to be effective if they meet the criteria. One of them is an increase in student learning outcomes. Therefore, in this study, the effectiveness of teaching materials was tested using the Paired sample t-test. The results of the analysis can be seen in the following table:

Table 13. Paired Samples test

		Paired Differences					t	df	Sig. (2 tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Before using teaching materials - After using teaching materials	-11,24	2,8095	0,43351	-12,11	-10,36	-25,92	41	0,000

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In table 13 above, it is obtained $t_{count} > t_{table}$ (25.923 > 2.020) or $Z_{count} > Z_{table}$ (25.923> 1.645). Thus, it can be concluded that the hypothesis (H_0) is rejected and H_a is accepted because of Sig. < (0.000 < 0.05). It can be concluded that there are significant differences in student learning outcomes before and after using LC 5E-based statistical teaching materials. In this case there is an increase in learning outcomes, namely the average learning outcome increases. Thus, it can be concluded that the LC 5E-based Educational Statistics teaching materials are very effective to be applied or effectively used in learning. The results of this study can be strengthened by previous studies, among others (Retnowati & Aqilla, 2017; Winarno *et al*., 2015; and Shufiana, 2015).

CONCLUSION

This research and development results in Education Statistics teaching materials that have been validated by material experts, as well as evaluation and curriculum experts with the "very valid" category. Then based on the practicality test of teaching materials, namely through a questionnaire on student responses to teaching materials and observation sheets on the implementation of teaching materials, it shows that the LC 5E-based Educational Statistics teaching materials that have been tested meet practical criteria. Furthermore, in the test of the effectiveness of teaching materials, through the Paired samples test, there were significant differences in student learning outcomes before and after using LC 5E-based Educational Statistics teaching materials. In this case there is an increase in the average learning outcomes. So it can be concluded that the LC 5E-based Educational Statistics teaching material is very effective in its use in learning.

ACKNOWLEDGEMENTS

Research and writing of this article is funded by Ministry of Research and Technology / National Research and Innovation Agency of the Republic of Indonesia based on decree Number: 25/E1/KPT/2020 and Agreement/Contract Number: 092/LL3/PG/2020 with "PKPT" scheme. Therefore, the authors thank the infinite. This is a pride for the author and an opportunity for authors to develop capacity. The authors express their sincere appreciation to all structural officials, administrative staff, lecturers, and all students who have been pleased and participated until the research is completed.

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