Validity of handout development of physics education statistics course using a cooperative problem solving (CPS) model

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Abstract. This research is a study of the validity of a teaching material in the form of a Physics Education Statistics handout. The purpose of this study was to determine the level of validity of the Physics Education Statistics handout in the UNP Physics Department from four aspects of feasibility namely content feasibility, presentation feasibility, language feasibility, and graphic feasibility. This type of research is Research and Development and was developed using the ADDIE model (Analyze, Design, Develop, Implement and Evaluate). The study of the validity of this handout is part of the Develop phase, which is done after the product in the form of a handout has been developed. The developed handout was then validated by four experts, two of whom were experts in Statistics and two others were experts in Physics Education. The data of this study were obtained from the results of the validator's assessment in the form of a validity assessment sheet containing the four aspects of the feasibility of the handout. The results of this study indicate that the Physics Education Statistics handout using the Cooperative Problem Solving model of the four aspects of feasibility has valid and feasible quality to use, this is based on the results of expert validation that reaches 85.10 with very valid criteria.

1. Introduction

Statistics Physics Education is a course that must be followed by students of the physics education study program at the Faculty of Mathematics and Natural Sciences (FMIPA) in the first semester. The expected results of this study are that students master the basics of statistics and are able to apply them for data processing purposes. This course is the basis of understanding for students before taking courses in the field of physics education, such as the Evaluation of Physics Learning and Research Methods.

Physics Education Statistics examines the basic concepts of educational statistics, descriptive and infrequent statistics coverage, and resolves problems related to making conclusions / decisions about the results of statistical education research, and describes them properly and correctly. Lecture material in Physics Education Statistics includes; Central Tendency, location size and deviation size; Frequency Spark Plugs; Probability; Distribution of random variables; Parameter estimates with Normal, t, χ^2 and F distributions; Testing a statistical Hypothesis; Analysis of Variance; Simple linear regression and simple linear correlation.

By referring to the purpose of learning based on the KKNI-based curriculum in Higher Education, the learning of Physics Education should require students to have the ability to meet the criteria in Attitude, work ability, knowledge and responsibility. To complete these four criteria, the right learning process is needed. This right learning is meaningful learning for students, produces a change of attitude

towards a better direction, is able to hone the ability to solve problems and teach students to take responsibility for making the right decisions.

However, the author's teaching experience in the Physics Education Statistics course for 2 semesters illustrates that there has not been a significant increase in the ability of students, both in terms of knowledge, attitudes and skills. The expected achievement in this course is not in accordance with what is found in learning. There are a number of problems encountered by students during the process of learning Physics Education Statistics. From the results of interviewing the author with students, it can be illustrated that the physics education materials are still abstract in nature for students, so that students have difficulty understanding and applying the knowledge they have learned to solve existing statistical problems.

Generally students complain that there are no Statistics teaching materials that are very relevant to the abilities they want to achieve but are easy to understand. In addition to obtaining Physics Education Statistics material from the explanation of lecturers in the class, students only use teaching materials in the form of textbooks. According to them the available textbooks contain statistical material that is still abstract and difficult to understand. In addition, examples of problems and tasks available in the textbook are not in accordance with the education sector. So, teaching materials used by students were not able to help students to understand statistics properly and correctly.

Based on interviews and observations that have been made, another problem that is also very important to be considered in the Faculty of Physics Education lecture is the ability to solve problems that are still very low. This can be seen from the low ability of students to analyze and complete the assignments given by the lecturer. In general, students find it difficult to carry out a proper analysis of statistical problems raised in structured assignments, so that structured tasks have not been able to help students understand the material and apply it.

The problems experienced by students greatly impact the low student learning outcomes in the subject of Statistics on Physics Education. From the analysis carried out on the question of the Semester Middle Examination and the Final Semester Examination it is known that most students have not been able to provide the right solution to the statistical problems given in the exam. Value data for UTS and UAS Statistics Physics Education for 2017 Physics Education students is shown in Table 1.

Table 1. Values of midle test and final test Statistics Physics Education of Student Physics Education TM 2017

| Average Test Results	Class			
	A	**B**	**C**	**D**
Result of middle test	59.50	73.03	63.84	61.13
Result of final test	65.67	73.31	46.51	49.28

(Source: Physics Education Lecturer, UNP)

Based on Table 1 it is known that the achievement of student learning outcomes for the Statistics Physics course has not met the Criteria. If seen from the results of the analysis of student exam answers, it is known that the ability of students to analyze a statistical problem is still low. Students were not skilled in determining the right solution to be used for the problems in the exam. In general, students' understanding of the use of statistical tables is still rare.

To overcome the problems in the lectures on Physics Education Statistics the writer wants to implement a solution that is considered to be able to help students understand the statistical material well. The solution is to develop a Physics Education Statistics teaching material which includes statistical concepts that are easy to understand, interesting to learn and according to students' thinking abilities. The teaching materials will also include assignments with problems relevant to the field of education and are expected to be able to improve students' problem solving skills. Teaching materials that will be made are also expected to guide students to solve statistical problems with the right steps in accordance with the problems faced by the students.

Teaching materials that will be developed include learning steps using cooperative problem solving models, so that it is expected to increase students' ability to solve problems correctly. According to Dewi (2018) Problem Solving is a step taken in learning to eliminate differences or discrepancies that occur between the results obtained with the desired[1]. In its implementation, there are several types of problem solving models, one of which is cooperative problem solving. CPS is the ability to solve problems according to systematic steps through group collaboration. CPS was developed by Keneth Heller. & Patricia Heller. According to Heller (2010), ways to support learning activities can be done through five steps to solving [2], namely:

a. Recognize the problem (visualization of the problem)
   Set a clear picture of the problems faced by CA:
   1) Visualize situations and situations by sketching pictures.
   2) Writing down known and unknown information that is relevant, giving each quantity of symbolic names and then adding that information to the image.
   3) Establish questions that will be answered in countable terms.
   4) Identify statistical approaches that might be useful for achieving solutions.

b. Describe the problem in terms of the field (description in statistics)
   This stage can be done by:
   1) Describe the necessary diagrams with a coordinate system that is consistent with the one chosen.
   2) Determine consistent and unique symbols for each quantity that are relevant to the situation.
   3) Identify the target quantity that will provide the answer to the question.
   4) Write down the equations that are appropriate for the problem solving plan.

c. Plan a solution (planned solution)
   The plan for this solution can be done by step:
   1) Build a logical chain of equations from those identified in the previous step. \
   2) Write down quantitative relationships that contain the target variable. Selecting a new equation for one that is unknown is the step taken at this stage.
   3) Write down all additional unknown variables.
   4) Write a verbal description of the steps of the solution you will take to complete this chain

d. Execute the plan (implementation plan)
   This stage can be done by:
   1) Following the completion of the solution plan by outlining the solution steps.
   2) Check the last unit of algebraic equations before entering numbers.

e. Evaluate the solution (checking and evaluation)
   This stage can be done through checking whether students can answer questions with appropriate steps, whether students' thinking processes make sense, and whether student answers are complete.

The following presents a diagram of the position of the cooperative problem solving steps towards the problem solving model steps in general.
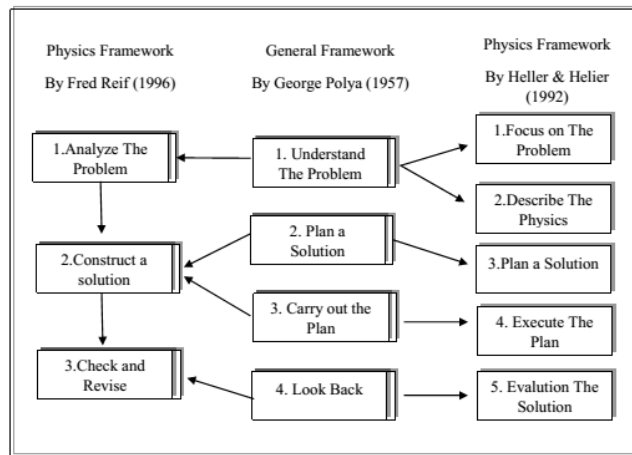
Figure 1. Problem solving based learning in the physics framework[2]

2. Research Methods

This research is a research and the development research. Sukmadinata (2009) states that, "Research and development is a process or steps to develop a new product or perfect existing products that can be justified". In this study, teaching materials will be developed for the Statistics Education Faculty subject using cooperative problem solving [3].

Teaching materials developed contain statistical material for physics education that is in accordance with the steps of cooperative learning problem solving and includes structured tasks that can be done by students to support understanding of the material. Thus, the purpose of this study is to produce Statistics Physics teaching materials that are valid, practical, and effective. Based on observations made, the model of development of learning tools suitable for use is the ADDIE model.

The ADDIE model stands for Analyze, Design, Develop or, Implement and Evaluation (Khoe Yao Tung: 2016). The ADDIE model was developed by Dick and Carry (1996) to design learning systems. The ADDIE model consists of 5 stages of activity, namely: analyze, design, develop, implement, and evaluate[4]. This design scheme can be seen in Figure 2.
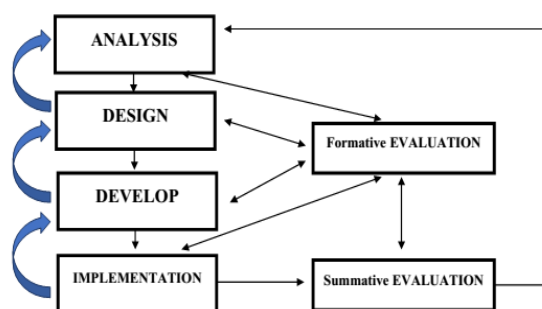
Figure 2. ADDIE model and its stages [5]

Of the five stages of the development of teaching materials according to the ADDIE model as in the scheme above, the stage of development (development) is a very important stage that must be done as an initial step in the development of Physics Education Physics handouts. This stage of development is carried out through feasibility tests in the form of validity and practicality tests, as well as testing the effectiveness of teaching materials. The development phase is carried out with several revisions in accordance with the results of the analysis until the Statistical Handout of Physics Education is produced using a cooperative problem solving model that is valid, practical and efficient. But this study only

focused on the feasibility test of the handout in the form of validity tests only. According to [1] The stages of this development towards the series of stages of development of teaching materials using the CPS model can be seen from the procedure of developing Statistics Education Physics teaching materials using the CPS model, as in Figure 3.
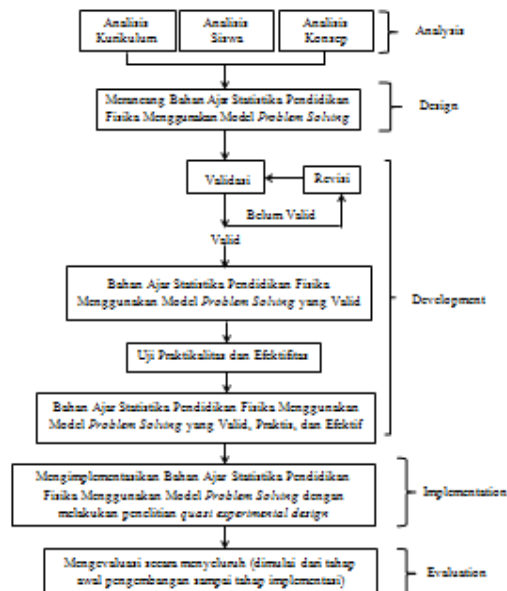
Figure 3. Procedure Diagram for Developing a Statistical Handout for Physics Education Using the CPS Model.

Based on Figure 3 above, it can be explained that the Statistics Education Physics handout uses the CPS model which was developed first validated by experts who acted as validators. Validation can determine the function or not of a product based on aspects of the feasibility of content, presentation, language and graphics. Validation is said to be complete, if the validator states that the learning device developed has been valid, so that it is ready to be tested. Input from the validator is used to correct or revise the developed handouts.

Validation is done by using a device validation sheet filled in by the validator. Validation was carried out by 2 Statistics experts (statistics lecturers), and 2 physicists (physics lecturers) at the Faculty of Mathematics and Natural Sciences, Universitas Negeri Padang. Validity analysis uses descriptive statistics based on the Likert scale value used, namely:

4 = strongly agree
3 = agree
2 = disagree
1 = strongly disagree

The percentage of the final value of the validation results is obtained using the formula:

$$V = \frac{T}{U} \times 100\% \tag{1}$$

Information:
V = value of validity
T = score obtained
U = maximum score
(Modified from Riduan,[6])

After obtaining the percentage of the final validation value, then the percentage of the final value of the validity is carried out with the following provisions:

0 - 20% = invalid
21% - 40% = less valid
41% - 60% = quite valid
61% - 80% = valid
81% - 100% = very valid
(Modified from Riduan,[6])

3. Results and Discussion

3.1. Results

The results of this study provide a clear picture of the level of feasibility of handouts in terms of handout validity. The results of the study were obtained based on an analysis of the validity sheet. The results of this study cover four aspects, namely aspects of service, content, presentation, language and graphics, where each aspect consists of several statements.

3.1.1. Results of the feasibility of the content of the handout. The results of the feasibility assessment of the contents of the handout are obtained with details of the values as follows: 1) the compatibility between the objectives of learning with learning outcomes with a value of 94; 2) the scope of the material presented in the handout has supported the achievement of learning outcomes with a value of 88; 3) the quality of the material presented is in accordance with the truth of science with a value of 88; 4) The scope of material presented is not multiple interpretations with a value of 81; 5) Problems presented are actual with a value of 75; 6) Teaching materials designed can stimulate the curiosity of students with a value of 81; and 7) designed handouts can develop problem solving skills with a value of 75. The results of the content feasibility aspects can be seen in Figure 4.
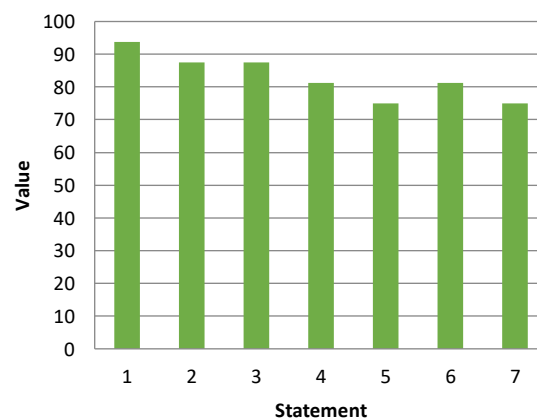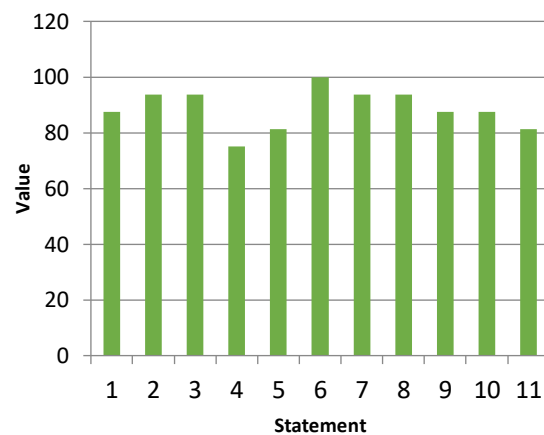

Figure 4. Test Results for the Validity of the Layout Aspect

Based on the graph in Figure 4, the average value of the components of the contents of the Statistical Handout of Physics Education using the CPS model is 83.03.

3.1.2. Results of the Feasibility of Presentation of the Handout. Assessment of the feasibility of presenting a handout is based on the results of the sheet analysis, the validity of each statement as follows: 1) the system presents the teaching material according to the principle with a value of 88; 2) presentation of material in accordance with the lines of deductive or inductive thinking with a value of 94; 3) the presentation of material starts simple material into complex / concrete to abstract ones with a value of 94; 4) presentation of illustrations in accordance with the description of the material with a value of 75; 5) summary of material can generate learning motivation to obtain a value of 81; 6) study material can help strengthen understanding of concepts with 100 points; 7) structured assignments given

can train the ability to apply concepts and problem solving related to material with a value of 94; 8) the references used are up to date with a value of 94; 9) Presentation of material is interactive which motivates students in achieving learning outcomes with a value of 88; 10) Presentation of material places students as subjects of learning with a value of 88; and 11) The presentation of learning is directed to a problem solving model with a value of 81. The plot of the results of the analysis of the aspects of service presentation can be seen in Figure 5.

Figure 5. Test Results for Validity of Service Aspects Presentation

Based on the graph in Figure 5, the average value for the component of the presentation of the Statistical handout is obtained. Physics using the CPS model is 88.64.

3.1.3. Results of the Handout Language Feasibility Assessment. After the assessment of the feasibility of presentation, an assessment of the feasibility of the language of the handout is carried out with details of the statements and values as follows: 1) the language used is in accordance with the level of development of students with a value of 81; 2) language that is used logically and allows students to communicate with the author with a value of 69; 3) the language used is easy to understand and does not mean bro with the value 88; 4) the language used in teaching materials is in accordance with the rules of the Indonesian language with a value of 81; 5) the spelling used refers to Enhanced Spelling (EYD) with a value of 88; and 6) consistent in using terms and symbols with a value of 81. The result plot for each statement can be seen in Figure 6.
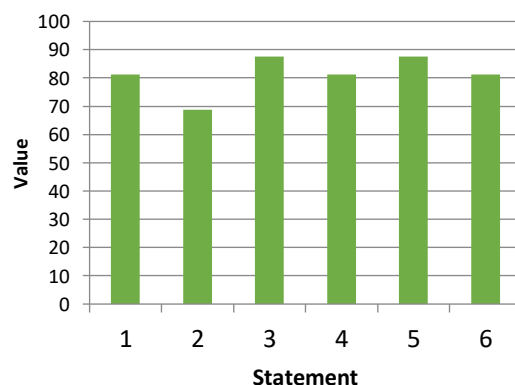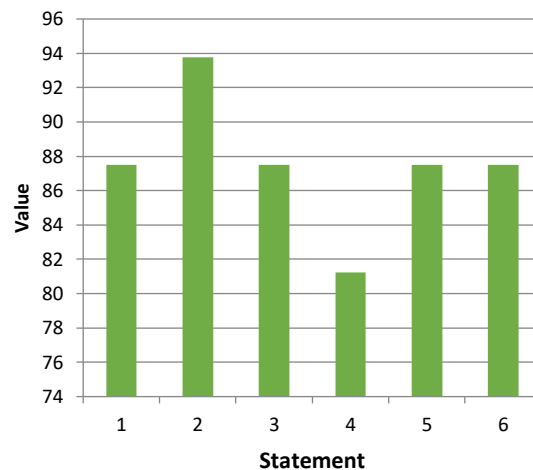

Figure 6. Test Results Validity Aspects of Language Feasibility

Based on the values of each statement in Figure 6, the average value for the component of the statistical feasibility of hand-out statistics for Physics using the CPS model is 81.25.

3.1.4. Results of Assessment of the Feasibility of the gravity of Handouts. The last aspect is the assessment of the feasibility of the gravity of the handout. Assessment is carried out on the following

statements: 1) Illustration and font size in a number of teaching materials are more dominant than the size of teaching material content with a value of 88; 2) Illustration and size of the contents of teaching materials proportional to the value of 94; 3) Illustration on the skin describes the contents of the teaching material with a value of 88; 4) The placement of elements of the layout (title, subtitles, text, images, details, page numbers) is proportional to the value of 81; 5) Colors used in teaching materials are clear and interesting with a value of 88; and 6) The use of non-excessive variations of letters with a value of 88. Plot the results for each statement can be seen in Figure 7.

Figure 7. Test Results for Validity of the Feasibility Aspects of the graphics

Based on the details of the questionnaire analysis results in each statement, the average value for the feasibility component was obtained. The statistics handout of Physics Education using the CPS model was 87.50. The feasibility value in each aspect can be classified into several criteria, where the value 0-20 means invalid, 21-40 means less valid, 41-60 means quite valid, 61-80 means valid and 81-100 means very valid. The value of the validity test results can be seen in Table 2.

Table 2. Validity Test Results

No	Feasibility Aspect	Value	Criteria
1	Feasibility of the Contents	83.03	Very valid
2	Feasibility of the presentation	88.64	Very valid
3	Feasibility of Language	81.25	Very valid
4	Feasibility of the graphics.	87.50	Very valid
	Average	**85.10**	**Very valid**

Table 2 shows that the average value obtained from several aspects, namely: 1) the feasibility aspect of the content with an average value of 83.03 with very valid criteria; 2) the feasibility aspect of the presentation is 88.64 with very valid criteria; 3) language feasibility aspects with an average value of 81.25 with very valid criteria; and 4) the feasibility aspect of the graft obtained an average value of 87.50 with very valid criteria. So as a whole the Statistics Handout of Physics Education using the Cooperative Problem Solving model can be said to be very valid.

3.2. Discussion

The validity tested in this study is content validity and construct structure validity. The validity of the contents here has been declared valid by the validator because the handouts developed are in accordance with the material that should be presented. The content validation is seen from the accuracy of the content which is the validation or the truth of the content in scientific and content alignment based on the value system adopted by a society. Thus the Statistical Handout of Physics Education using the

Cooperative Problem Solving model can be scientifically justified. Whereas to test the validity of the constructs (construct validity), the opinions of experts are used (judgment validity) "[6].

Based on the results of the validation of the Medical handout Physics Education uses the Cooperative Problem Solving model, from the four aspects of validity stated to be very valid. Based on the aspect of content eligibility, the handout is in accordance with the standards of teaching materials used by students. The feasibility aspect of the presentation is said to be very valid. This means that the handouts prepared are in accordance with the steps of the Cooperative Problem Solving model. The feasibility aspects of this presentation are the strengths and characteristics of the handouts developed. Among these advantages, among others, the developed handouts have been presented in a systematic, easy to understand and principle-compliant manner. In addition there are study materials that contain issues that can help students strengthen conceptual understanding. Structured tasks presented in the handout can train the ability to apply concepts and problem solving related to statistical material.

From the language aspect it has been stated to be very valid where the language contained in the handout is in accordance with the Indonesian language rules. The language used in the handout is in accordance with the level of student development. Furthermore, from the aspect of the graphics in general it has been stated that it is very valid which means that from the appearance (graphic) the handout is in accordance with the standard or standard rules. The illustration and size of the contents of the handout are already proportional.

According to the Depdiknas (2008: 7) teaching materials are a set of materials that are systematically reviewed, both written and not so as to create an environment or atmosphere that allows students to study. This is related to the stages in the selection of teaching materials: a) learning materials support the achievement of competency standards and basic competencies; b) identification of aspects contained in standard competencies and basic competencies; c) identification of types of teaching material; d) choose teaching materials that are relevant to the standards of competence and basic competencies; e) choose the sources of teaching materials[7].

4. Conclusion
Based on the results of the research and explanation, it was concluded that the Statistics Handout of Physics Education using the Cooperative Problem Solving model is very valid according to the validation results of the four educational validators and the statistical field. Based on the four aspects of the feasibility of the handout, it is stated that it is very valid, namely in (1) the feasibility aspect of contents; (2) the feasibility aspect of presentation; (3) the feasibility aspect of culture; and (4) feasibility aspects of graphics.

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