Validity and practicality of calculus teaching materials based on integrated ict contextual problems to improve students problem solving skills

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Abstract. Most of the students in Calculus are not satisfactory. Some of the causes include: mathematics material has not been linked to contextual problems so that the learning process becomes less attractive, besides that students have not been able to utilize technological advancements to help understand the concepts of Calculus material, such as: graph making, derivative and integral calculations and their applications, and others other. The aim of the study was to determine the validity and practicality of Calculus Teaching Materials which are integrated ICT based contextual problems to improve students Problem Solving abilities. The research method used is R & D which is a method to produce a particular product and test the effectiveness of the product. Data collection instruments in the study included validity test sheets, practicality test sheets. The data analysis technique used is descriptive statistical analysis. The results of the study are the creation of an ICT-based calculus teaching material that integrates contextual problems to improve valid and practical student problem solving skills.

1. Introduction
Calculus is a compulsory subject for all first year students (TPB) at FMIPA UNP (majoring in Mathematics, Physics, Chemistry and Biology), because this course provides a basis of knowledge for the next course. Therefore, good mastery is needed by students, but in reality most of the students are still not satisfying (C, D, and E). Some of the causes include: mathematics material has not been linked to contextual problems so the learning process becomes less attractive, besides that students have not been able to take advantage of rapid technological advancements to help understand the concepts of [6] material, such as: graphic creation, derivative and integral calculations and their applications. and others. One way to overcome student problems in the Calculus is to develop Calculus teaching materials that are based on Information Commucation Technology (ICT) integrated contextual problems to improve students' problem solving abilities. By utilizing technology, some abstract material can be described more clearly and more quickly can be completed.

Several studies related to the use of ICT have been carried out in mathematics learning starting from elementary school level, to college level. In general, usage has increased students’ interest in learning and mathematical understanding. These studies include: [3] Hendra Kartika's research in the UNSIKA Education Journal (2014), namely "mathematics learning assisted by matlab software can improve mathematical communication skills and learning interest of high school students"; [7] Research by Wawan Setiawan and Bambang Priyo Darminto, which was published in the Journal of Information and
Communication Technology Education (2016), namely "improving the High Level of Mathematical Thinking Ability (KBMTT) of mathematics teacher candidates through computer-based mathematics learning using interactive multimedia application programs ;; [3] Isman M. Nur Research in the Delta-Pi Journal - Journal of Mathematics and Mathematics Education (2016) namely "Computer-assisted learning is very good to be integrated in learning mathematical concepts, one of which is GeoGebra"; [2] Research by Darmawijoyo (2011) namely "The availability of hardware and software as well as internet access makes teaching change the conventional teaching paradigm, that is from the teacher to a source of information to teachers and students sharing information. This change in paradigm makes the learning process more creative because learning resources no longer start in the classroom but start from outside the classroom and are jointly operated in class.

Furthermore [5] Shute and Grendell (1994) reveal "through experience (laboratory activity) knowledge will last a long time in students' minds, because experience can help develop cognitive structures"

From the existing studies can be seen that the learning media is very influential on the ability and success of students in receiving the subject matter, especially for students who do not like the material taught by the teacher. From the above research shows that the learning media is very influential on student achievement and can help students to succeed in learning. In connection with the above, the researcher felt the need to develop it to a higher level of education so that student learning achievement would increase and make the lesson more meaningful for students.

The appropriate use of computer software (one part of ICT) will help students understand the concept, in this case the use of Maple software is expected to make it easier for students to understand concepts in Calculus.

Based on these problems, the aim of this study is to develop ICT-based calculus teaching materials integrated valid and practical contextual problems.

Furthermore, this research problem can be formulated are: What is the validity and practicality of Calculus-based teaching materials on Integrated ICT Contextual Problems that can Improve the Problem Solving Ability of Students according to expert judgment ?

2. Research Method
In this study used Borg and Gall development models. In this model, what is needed in this development is a reference to the product procedures to be developed. [1] Borg and Gall stated that the development research procedure basically consists of two main objectives, namely: developing the product and testing the effectiveness of the product in achieving its objectives.

In this study directed to determine the validity and practicality of the use of ICT-based Calculus teaching materials that integrated contextual problems to improve students' problem solving abilities. In the initial activities four steps were carried out, namely: information gathering, planning, developing the initial form of the product, and initial field testing. The initial field test activity was carried out in one of the classes at FMIPA UNP's first level joint students (TPB). Data analysis technique used is descriptive statistical analysis.

For each validity indicator the module is searched for on average for each statement given by the validator. Then, the average is interpreted according to the following score interval.

\[ 1 \leq V_i < 2 \text{ is bad} \]
\[ 2 \leq V_i < 3 \text{ is not good} \]
\[ 3 \leq V_i < 4 \text{ is good enough} \]
\[ 4 \leq V_i < 5 \text{ good} \]
\[ V_i = 5 \text{ is very good.} \]

While indicators of practical achievement are 65%, it will be seen the number of students who answer: "more agree (4)" and "strongly agree (5)" about the practical use of integrated ICT-based Calculus teaching materials. If the amount is more than 65%, then it is said that the teaching material is practically used for calculus learning.
3. Results and discussion

3.1. Development of Initial Forms of Products

Based on the analysis of errors made by students in the preliminary research, ICT-based calculus teaching materials were designed which integrated contextual problems to improve students' problem solving abilities. Teaching materials The compiled calculus was tested twice in the starting material and twice in the final material. From the first two trials the teaching materials were improved based on the problems found during the trial, namely: a few sentences on questions that were poorly understood by students, some commands from the MAPLE software that were not yet able to run, some students were not yet proficient at using software.

3.2. Learning Material Validation Results

Validation assessment for ICT-based Calculus teaching materials that integrated contextual problems to improve students' problem solving abilities were carried out by three experts who mastered Calculus, Calculus learning, and classroom learning. These experts were three lecturers who had a lot of experience teaching Calculus courses including teaching teams in Calculus courses. The resulting data is data from the validity of teaching materials. Based on responses and input from experts, improvements were made to teaching materials. The results of the validation of teaching materials are determined from the instrument of validity of experts. Validity results by experts are used to determine the feasibility of teaching materials and guidelines in revising the product. Based on the instrument for assessing the validity of experts on teaching materials, four components of assessment were analyzed. The assessment component of teaching materials used is content, linguistic, presentation and graphic feasibility.

In the validity assessment instrument used, the assessment component of each component consists of six indicators, with the value of each indicator: 1 (very less), 2 (less), 3 (enough), 4 (Good) and 5 (very good). The results of the validation of three experts for each component in the questionnaire can be seen in Table 1, Table 2, Table 3, and Table 4.

| Table 1. Assessment of Experts on Teaching Materials in Accordance with Indicators on Components of Feasibility of Contents |
|---|---|---|---|---|
| Nu. | Indicators | Expert score to - | Average | Concl. |
|  |  | 1  | 2  | 3  |   |
| a. | Indicators in contextual mathematics teaching materials are in accordance with basic competencies | 5 | 5 | 5 | 5.0 | Valid |
| b. | Learning material in contextual mathematics teaching materials in accordance with indicators | 4 | 4 | 5 | 4.3 | Valid |
| c. | Learning material in contextual mathematics teaching materials is substantially correct | 4 | 5 | 4 | 4.3 | Valid |
| d. | Learning material in contextual mathematics teaching materials is in accordance with student development | 4 | 4 | 4 | 4.0 | Valid |
| e. | Contents in contextual mathematics teaching materials in accordance with student learning needs | 5 | 5 | 4 | 4.6 | Valid |
| f. | The content in contextual mathematics teaching materials is useful to broaden students' knowledge | 5 | 4 | 5 | 4.6 | Valid |

From table 1 it can be seen that each component of the feasibility component indicator is valid. So it can be concluded that "from the indicator of the content feasibility component" the questionnaire is valid.
Table 2. Assessment of Experts on Teaching Materials in Accordance with Indicators on Components of Linguistic

| No | Indicators                                                                 | Expert score to - | Average | Concl. |
|----|-----------------------------------------------------------------------------|-------------------|---------|--------|
|    |                                                                             | 1 2 3             |         |        |
| a. | The sentence used in writing contextual mathematics teaching materials is correct | 5 5 5             | 5.0     | Valid  |
| b. | The relationship between paragraphs in contextual mathematics teaching materials is clear and sustainable | 4 4 5             | 4.3     | Valid  |
| c. | Paragraph writing in contextual mathematics teaching materials is correct   | 4 5 5             | 4.6     | Valid  |
| d. | The use of punctuation in writing contextual mathematics teaching materials in accordance with EYD | 4 4 4             | 4.0     | Valid  |
| e. | The language used in contextual mathematics teaching materials is effective | 5 4 4             | 4.3     | Valid  |
| f. | The information presented in the contextual mathematics teaching material is clear | 4 4 5             | 4.3     | Valid  |

From table 2 it can be seen that each component of the Language component indicator is valid. So it can be concluded "from the Language component indicator" the questionnaire is valid.

Table 3. Assessment of Experts on Teaching Materials in Accordance with Indicators in the Presentation Components

| No | Indicators                                                                 | Expert score to - | Average | Concl. |
|----|-----------------------------------------------------------------------------|-------------------|---------|--------|
|    |                                                                             | 1 2 3             |         |        |
| a. | The formulation of objectives in contextual mathematics teaching materials is clear | 5 5 4             | 4.6     | Valid  |
| b. | Structure of contextual mathematics teaching materials according to systematics | 5 4 5             | 4.6     | Valid  |
| c. | The order of presentation in contextual mathematics teaching materials is good | 4 4 5             | 4.3     | Valid  |
| d. | The presentation of material in contextual mathematics teaching materials is easily understood by students | 5 5 4             | 4.6     | Valid  |
| e. | Contextual mathematics teaching materials can motivate students             | 4 4 5             | 4.3     | Valid  |
| f. | Submission of information in complete contextual mathematics teaching materials | 4 5 4             | 4.3     | Valid  |

From the Table 3 it can be seen that each component of the Presentation component indicator is valid. So it can be concluded "from the Presentation component indicator" the questionnaire is valid.
Table 4. Assessment of Experts on Teaching Materials in Accordance with Indicators in Graph Components

| Nu. | Indicators                                                                 | Expert score to | Average | Concl. |
|-----|-----------------------------------------------------------------------------|------------------|---------|--------|
|     |                                                                             | 1    | 2    | 3    |        |
| a.  | The use of fonts in contextual mathematics teaching materials in accordance with the rules of scientific writing | 5    | 5    | 5    | 5.0   | Valid |
| b.  | The layout on the cover of balanced and harmonious contextual mathematics teaching materials | 4    | 4    | 5    | 4.3   | Valid |
| c.  | Illustrations in the form of drawings of contextual mathematics teaching materials are interesting | 4    | 5    | 4    | 4.3   | Valid |
| d.  | The appearance of the cover of contextual mathematics teaching materials is interesting | 4    | 4    | 4    | 4.0   | Valid |
| e.  | The appearance of each part of the contextual mathematics teaching material is interesting | 5    | 5    | 4    | 4.6   | Valid |
| f.  | Binding of contextual mathematics teaching materials is good and strong      | 5    | 4    | 5    | 4.6   | Valid |

From the Table 4 it can be seen that each component of the graph of component indicator is valid. So it can be concluded that "from the Integrity component indicator" the questionnaire is valid. And for the entire validator indicator, the validator gives only 4 or 5, it can be concluded that the integrated ICT-based Calculus Teaching Materials are Contextual Problems are Valid.

3.3. Practical Test Results for the Use of Teaching Materials

Validation results from the three validators are used to revise or improve teaching materials according to the input provided. After being repaired, a practical test of the use of the teaching material was applied to students of the Mathematics Department of the Faculty of Mathematics and Natural Sciences, Padang State University registered in 2017/2018. In accordance with practical achievement indicators of 65%, it will be seen the number of students who answered: "more agree (4)" and "strongly agree (5)" about the practical use of integrated ICT-based Calculus teaching materials. If the amount is more than 65%, then it is said that the teaching material is practically used for calculus learning.

The assessment instrument for practicality testing of teaching materials contains four assessment components. The assessment components used are: ease, feasibility, efficiency, and the benefits of using teaching materials. In the practicality assessment instrument used, the assessment component of each component consists of five indicators.

The results of the practicality test on teaching materials from students for each component can be seen in the Table 5 to the Table 8.

Table 5. Number of Students Providing Assessment of Teaching Materials According to the Ease of Use Indicator

| No | Indicators                                                                 | Percentage students on a score |
|----|-----------------------------------------------------------------------------|-------------------------------|
|    |                                                                             | 1    | 2    | 3    | 4    | 5    |
| a. | Teaching materials make it easy for me to associate math material with the real world | 0.00 | 0.00 | 0.27 | 0.37 | 0.37 |
| b. | Teaching materials make it easy for me to associate material with other fields of science | 0.00 | 0.03 | 0.20 | 0.37 | 0.40 |
| c. | Teaching materials                                                          | 0.00 | 0.03 | 0.20 | 0.37 | 0.40 |
| d. | let me solve problems related to the real world                              | 0.00 | 0.03 | 0.33 | 0.37 | 0.27 |
| e. | Teaching materials make it easy for me to discuss material related to the real world | 0.00 | 0.00 | 0.33 | 0.40 | 0.27 |
| f. | Teaching materials make it easier for me to master learning material related to the real world | 0.00 | 0.18 | 0.26 | 0.38 | 0.34 |
From the Table 5 it can be seen, the average indicator of ease of use of teaching materials, the number of students who give grades 4 and 5 is above 65%, namely: 72%, which means that the teaching materials used can be understood by students.

Table 6. Number of Students Providing Assessment of Teaching Materials in Accordance with the Indicators of Implementation

| No | Indicators                                                                 | Percentage students on a score |
|----|---------------------------------------------------------------------------|-------------------------------|
|    |                                                                           | 1    | 2    | 3    | 4    | 5    |
| a. | I can master contextual learning material well                           | 0.00 | 0.03 | 0.30 | 0.33 | 0.33 |
| b. | I can associate mathematics learning material with everyday life         | 0.00 | 0.07 | 0.43 | 0.33 | 0.17 |
| c. | I can do good problem solving exercises in teaching materials            | 0.00 | 0.03 | 0.17 | 0.40 | 0.40 |
| d. | I can carry out contextual activities in teaching materials well         | 0.00 | 0.03 | 0.37 | 0.43 | 0.17 |
| e. | I can do evaluations in teaching materials to assess my mastery          | 0.00 | 0.00 | 0.27 | 0.37 | 0.37 |
|    | **Average**                                                              | **0.00** | **0.00** | **0.31** | **0.37** | **0.29** |

From the Table 6 it can be seen, the average indicator of the use of teaching materials, the number of students who gave grades 4 and 5 were above 65%, namely: 66% which means that the teaching materials used can be understood by students.

Table 7. Number of Students Providing Assessment of Appropriate Teaching Materials Usage Efficiency Indicator

| No | Indicators                                                                 | Percentage students on a score |
|----|---------------------------------------------------------------------------|-------------------------------|
|    |                                                                           | 1    | 2    | 3    | 4    | 5    |
| a. | I am more efficient in learning with contextual mathematics teaching materials | 0.00 | 0.00 | 0.47 | 0.37 | 0.17 |
| b. | With the practice of problem solving in teaching materials, I was faster at mastering learning material | 0.00 | 0.00 | 0.47 | 0.40 | 0.20 |
| c. | Contextual activities make me more efficient at linking material with the real world | 0.00 | 0.03 | 0.33 | 0.40 | 0.20 |
| d. | Evaluation in contextual teaching materials is more efficient in increasing my mastery of mathematics | 0.00 | 0.00 | 0.43 | 0.27 | 0.30 |
| e. | With contextual teaching materials, planned learning targets can be achieved well | 0.00 | 0.00 | 0.33 | 0.47 | 0.20 |
|    | **Average**                                                              | **0.00** | **0.01** | **0.40** | **0.38** | **0.22** |

From the Table 7 it can be seen, the average efficiency indicator of the use of teaching materials, the number of students who gave a score of 4 and 5 is not 65%, namely: 60%, but 40% have stated enough, which means the teaching material is used efficiently enough by students.

Table 8. Number of Students Who Provide Assessment of Teaching Materials in Accordance with the Indicator of Benefits of Use

| No | Indicators                                                                 | Percentage students on a score |
|----|---------------------------------------------------------------------------|-------------------------------|
|    |                                                                           | 1    | 2    | 3    | 4    | 5    |
| a. | Contextual teaching materials can activate me in learning mathematics  | 0.00 | 0.00 | 0.30 | 0.40 | 0.30 |
| b. | Contextual teaching materials can motivate me in learning mathematics  | 0.00 | 0.10 | 0.10 | 0.53 | 0.27 |
| c. | Contextual teaching materials can make mathematics learning more interesting | 0.00 | 0.04 | 0.20 | 0.33 | 0.43 |
d. Contextual teaching materials can make mathematics more real 0.00 0.07 0.17 0.43 0.33

e. Contextual teaching materials can improve my insight in mathematics 0.00 0.03 0.10 0.57 0.30

Average 0.00 0.03 0.18 0.45 0.33

From the table it can be seen, the average indicator "benefits of the use of teaching materials", the number of students who gave grades 4 and 5 was above 65%, namely: 78% which means that the teaching materials used can be understood by students.

Because the number of students who answered "more agree" and "strongly agree" about the practicality of using instructional materials ICT-based calculus integrated contextual problems on each indicator was more than 60%, it can be concluded that ICT-based integrated calculus teaching materials generated contextual problems are practically used. Apart from the items above, from the free entries in the questionnaire, students' responses to the use of integrated ICT-based calculus material contextual problems were obtained. In general their responses are as follows:

a. Increasing students' knowledge of calculus such as various forms of graphics and they become more skilled at using software
b. Learning is more interesting so it doesn't waste.
c. Assist in mastering Calculus material.
d. More knowledge in using computer media.
e. Can test the results of manual completion with the correct results on the computer
f. Having examples of problem solving that are solved systematically so that it can help me in solving contextual problems

4. Conclusions

Based on the results of the research that has been done, the following conclusions are obtained: "Integrated ICT-based calculus teaching materials contextual problems to improve students' problem-solving abilities produced are valid and practical.

Suggestion

Based on the results of the research and input it is suggested that the lecturer should be able to set a special time for the implementation of the practicum so that students use ICT-based calculus teaching materials to integrate contextual problems to the maximum. It is expected that students can be skilled at using software on a computer.

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