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Development of ICT-assisted preprospec learning models

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Abstract. The main objective of this research is to develop an ICT-Assisted Preprospec Learning Model. This learning model was developed specifically for learning mathematics and consists of five stages, namely Prepare, Problem Solving, Presentation, Evaluation, Conclusion which at some stages use media based on Information and Communication Technology (ICT). The use of media based on ICT is intended to make learning more effective and efficient. In addition, abstract mathematical characteristics, using a lot of graphics and images and being applied in real life and other scientific disciplines are considered to use ICT-based media in learning. The ICT-Assisted Preprospec Learning Model is expected to improve mathematical problem solving abilities as the heart of mathematics and student's self-renewal capacity. The development of this ICT-assisted Preprospec Learning Model uses the ADDIE Model which consists of 5 stages, namely analysis, design, develop, implement and evaluate. The results of this study indicate that ICT-assisted learning model Preprospec valid and ready to be used for learning.

1. Introduction

One of learning outcomes in Mathematics Education Study Program is Mathematical Problem solving ability. Mathematical problem solving is the heart of mathematics and the main purpose of mathematics learning [1-4]. NCTM suggests that the problem-solving is defined as a teaching method that can improve the quality of teaching mathematics in schools [5]. Polya also asserted that solving mathematical problems is a way to solve mathematical problems using mathematical concepts that have been mastered before [6]. Problem solving is also one of the competencies that must be had in the industrial revolution era 4.0 [7-10]. If students have good problem solving skills, then the student is expected to have sufficient reliable ability in completing problems both inside and outside mathematics. This ability does not just appear in students, but needs to be developed.

The goal of learning mathematics is problem-solving, which also becomes the center of mathematics, and in its development, creative thinking, critical thinking, problem solving, mathematical reasoning can develop into higher order thinking skills [11-13]. Students who have a good ability to solve the mathematical problem will have a good ability to analyze problems and apply the solution in a range of conditions. The common indicators to discuss problem solving in mathematics understand the problem; selecting an appropriate way to figure the problem out; carrying the chosen way to solve the problem, and reviewing the process of problem-solving [14].

Besides being demanded to have mathematical problem solving abilities, students are also required to make improvements to their performance in learning. Students must try to explore and develop the capacity to renew themselves or Self-Renewal Capacity. The Self-Renewal Capacity must also be realized in the learning achievements based on the Indonesian National Qualification Framework listed in the description of level 6 qualifications (Higher Education for Bachelor programs in all majors). The

several learning outcomes for the Bachelor program in Indonesian National Qualification Framework are the ability to take appropriate decisions; able to provide guidance in choosing various alternative solutions; and responsible [15]. All of these things are in Self-Renewal Capacity.

To improve students' mathematical problem solving abilities and Self-Renewal Capacity, the lecturer is expected to be able to provide opportunities for students to be active in learning and be able to construct their own mathematical concepts learned. One way is to develop a learning model specifically designed to study mathematics.

The learning model is a whole series of presentation of teaching material that covers all aspects before being and after learning by the teacher and all related facilities that are used directly or indirectly in the teaching and learning process [16]. The model that will be developed in this research is ICT Assisted Preprospec Learning Model. The ICT-Assisted Preprospec Learning Model is a constructivism-based learning model.

The ICT-Assisted Preprospec Learning Model was developed specifically for mathematics learning and is a constructivism-based learning model. This model has 5 stages of learning, namely Prepare, Problem Solving, Presentation, Evaluation, Conclusion which at all stages are assisted by ICT. The use of media based on Information and Communication Technology (ICT) is intended to make learning more effective and efficient. In addition to the abstract mathematical characteristics, it uses a lot of graphics and images and is widely applied in real life and other disciplines that are considered to use ICT-based media in learning. In addition to ICT-assisted learning, learning with this Prepospec Model also uses Student Worksheets. This is in accordance with what was expressed by Petocz & Smith [17] that worksheets can overcome difficulties in learning mathematical concepts.

Prepare is the first stage in the ICT-assisted Preprospec Learning Model. In the Prepare stage, students have the opportunity to recall prerequisite material from the material to be studied. Next, students are given question exercises related to prerequisite material to verify their understanding. At this Prepare stage, learning achievements and concept maps of the material to be studied are also given. This is intended so that students know and are ready to do learning. The Prepare phase is carried out before learning takes place. Material at this Prepare stage can be given to students through the website, facebook, telegram or whatsapp.

At the Problem Solving stage in the ICT-assisted Preprospec Learning Model students are given problems related to the material being studied. This problem is presented in Student Worksheets and its contents to contain questions that lead students to construct their own concepts learned. This Student Worksheets is in the form of PowerPoint which can be accessed by students through the website, facebook, telegram or whatsapp. Students solve problems in Student Worksheets by discussing in groups. Lecturers monitor student performance and provide assistance if there are students who need it. Provision of assistance by lecturers is done carefully and carefully

2. Methods

Development of the ICT Unified Preprospec Learning Model follows the ADDIE Model which consists of 5 stages, namely analysis, design, develop, implement and evaluate [18]. The development phase can be seen in the image below.
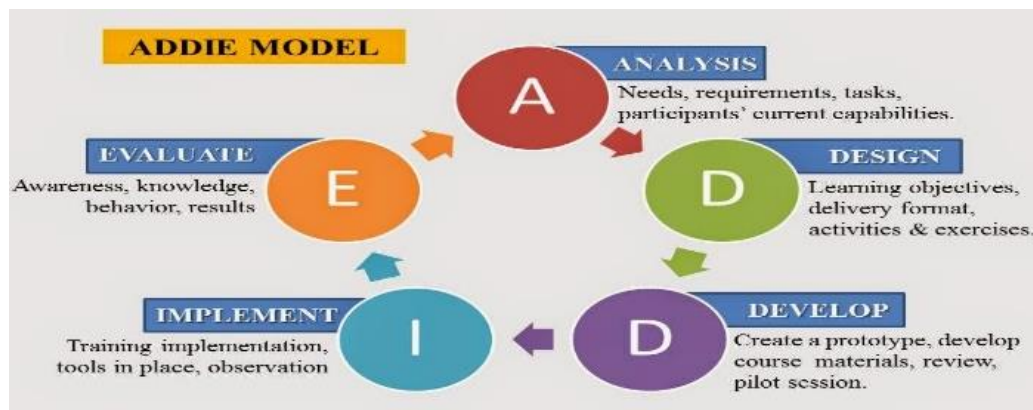
Figure 1. ADDIE Model

In this article the development of an ICT-assisted preprospec learning model was carried out to the stage of develop, namely creating a prototype and review.

3. Results and discussion

3.1. Analysis stage

At this stage an analysis of needs, material, learning objectives and media was carried out. The results show that a learning model is needed that can facilitate mathematical characteristics (Abstract, using many graphics, images and symbols). In addition this learning model must also be able to develop mathematical problem-solving abilities and Self-Renewal Capacity, so that stages are needed to facilitate it. Another thing that needs to be analyzed is the selection of media that makes learning materials accessible anytime, anywhere and by anyone, so ICT-based learning is chosen.

3.2. Design stage

At this stage the design of the learning model is based on the previous analysis stage. The result is a Preprospec Learning Model consisting of 5 stages, namely Prepare, Problem Solving, Presentation, Evaluation, and Conclusion. At the Prepare stage, prerequisite materials are given, learning objectives and concept maps of the material to be learned. At the Problem Solving stage, given problems that must be resolved in discussion in small groups so that students can construct the material being studied. The third stage is the Presentation stage, where students who have different discussion results in one class, present the results of their discussion in class. At the Evaluation stage, students are given questions to see the understanding of the material being studied. The questions are arranged in sequence from simple to complex. The last stage is Conclusion, where students together with the teacher / lecturer make conclusions about the material that has been learned. All stages of this ICT-Assisted Preprospec Learning Models.

3.3. Develop stage

The Learning Model that was designed at the design stage (Draft 1) was developed at this stage. Through expert validation and testing in small classes. The results of expert validation are used to revise the learning model into Draft 2. The results of the validator's assessment are as follows.

From this table, It can be seen that the average results of the validator assessment of ICT-Assisted Preprospec Learning Models are 92.31% and are included in the excellent category.

Table 1. The Results of Validation

No	Aspect	R1	R2
I	**Theory**		
	1. The learning theory used is sufficient to be the basis in the preparation of ICT-Assisted Preprospec Learning Models	4	4
	2. Learning steps support the theory about mathematical thinking skills developed	4	4
	3. Learning steps support the theory of Self Renewal Capacity developed.	3	4
II	**Structure of ICT-Assisted Preprospec Learning Models**		
	4. The background to developing the model is clearly stated	3	4
	5. The purpose of developing the model is clearly stated	4	4
	6. Model description is clearly stated	4	4
	7. The principles of reaction in learning are clearly stated	3	4
	8. The social system in learning is clearly stated	3	4
	9. The support system in learning is clearly stated	4	4
	10. The use of the learning approach is clearly stated	3	4
	11. The steps of learning are clearly stated	4	4
	12. Evaluation and assessment are clearly stated	3	3
III	**Thinking Abilities are developed**		
	13. Mathematical Thinking Ability developed clearly stated	4	3
Total		46	50
%		88,46%	96,15%

4. Conclusion

From this study, it can be concluded that the ICT-assisted Preprospec Learning Model is valid and can be used for classroom learning.

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