Development of Project Based Learning Instrument to Increase Student's Reasoning Ability

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ABSTRACT : *This Study aims to developt a project based learning Instrument. The method used in this research is R & D with the ASSURE development model. The products produced are student pproject worksheet on based learning projects and semester learning plans. Product validation is carried out through expert assesment through a validation sheet. Based on expert validation, it was found that the resulting instrument was categorized as having high validation with an average 79,3 %.*
KEYWORDS : *instrument, project based learning*

I.   INTRODUCTION

One of the important competencies that need to be possessed in order to increase mathematical concepts is reasoning ability. Mathematical reasoning is needed to develop the potential of students to become creative and innovative human beings [1]. Furthermore [2] stated that as educators, it is necessary to design learning with innovative models, strategies and methods so as to provide opportunities for students to improve reasoning, think creatively and increase creativity. Because creative learning can increase students' interest in learning, including learning mathematics [3]. Improving the quality of learning both in terms of material, process, and evaluation is one of the main factors that must be carried out in academic excellence [4].

Problems found on the research in students who take analisis real course in academic year 2020. The results showed that 66,7 % of students were categorized having moderate reasoning ability [2]. Therefore, it is necessary to develop a valid project-based learning model design for real analysis material especially in limit and sequence topic, thus enabling students to study independently anytime and anywhere, and to support creativity.

Project based learning is a method that places the students as a central learning process, as a central and following the lesson plan, and in the PBL class teacher leads the students to the learning that they want or following the project's goal [5]. PBL increasing students' academic performance and give the opportunity to students to develop their knowledge that can change their behavior to the complexity and abstract concept positively [6]. Project-based learning brings students to make a plan and to execute the planned project while the teacher serves as a facilitator who evaluates the completed project on the basis of negotiated criteria as a result of the class discussion [7].

Project based learning focuses on the core concepts and principles of a discipline, facilitates to investigate, problem solving, and other meaningful tasks, student centered, and produce tangible products [8]. Project Based Learning model is a learning model that properly can be applied in the learning process, because project based learning model that is centered on the activities of learners during a learning process that will produce the product at the end of the lesson [8].

Grant (2002) in [8] defines project-based learning or project-based learning as a learner-centered learning model to conduct an in depth investigation of a topic. According to [9] the steps of the Project Based Learning learning model are as follow : (1) start with the big question; (2) design a plan for the project. ; (3) create a schedule. ; (4) monitor the students and the progress of the project. ; (5) assess the outcome; (6) evaluate the experience

The second section of this paper shows methods for develop learning instrument. The third section discusses the result of learning instrument and the aplication for students , and finally the conclusion is discussed in the fourth section.

II. METHODOLOGY OF RESEARCH

This research is an R&D research with the ASSURE Development model. The design model is developed in 6 stages, namely : 1) *analyze learners*, 2) *state objectives*, 3) *select strategi, technology, media, and materials*, 4) *utilize media and materials*, 5) *require learner participation*, 6) *evaluated and revise* [9]. Fig.1 shows the steps of ASSURE development model.

Fig.1 The steps of ASSURE Model

In this research, the development of a new model is carried out until the 4th stage, namely utilizing media and materials. The resulting product is seen as valid (feasibility). Product validity is carried out by expert's assessment. The expert's assessment data used a Likert scale with a range of 1-5 with very poor (1) to very good (5) criteria. Data from expert's assessment test results (product validation) were analyzed using percentage and categorical descriptive techniques to describe the feasibility of the model with the equation:

$$Percentage\ number = \frac{Actual\ Score}{ideal\ sore} \times 100\ \%$$

The percentage figures are further grouped into five categories as follows:

Table 1. Model Eligibility Category

Interval	Category
81 % - 100 %	Very high
61 % - 80 %	High
41 % - 60 %	Moderate
21 % - 40 %	Low
1 % - 20 %	Very low

III. RESULT AND DISCUSSION

Product development used the ASSURE model which is carried out in 4 stages of development : 1) *analyze learners*, 2) *state objectives*, 3) *select strategi*, *technology*, *media, and materials*, 4) *utilize media and materials*. The results of each stage of development can be explained below.

1. Analyzed Leaners

Characteristics of students seen from student's reasoning abilities in solving math problems based on *Higher Order Thinking Skill* (HOTS). Based on the tests conducted on 12 students who have taken real analysis courses, the following results are obtained:
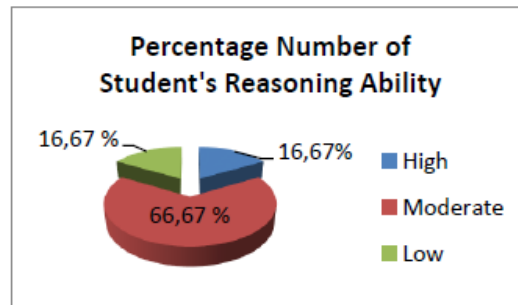

Fig.2 Percentage number of student's reasoning mathematical

The author also identifies the characteristics of students through the ability to use IT and internet in the learning process. Based on the observations during the online learning process conducted and interviews with students, information was obtained that almost all students have very good abilities in this regard. Students are able to access learning resources from the internet and are able to be creative, such as using applications in making learning videos.

State of Objective

After conducting an initial ability analysis, the next step is to determine competencies, make a description and formulate the objectives of the lecture. The following are descriptions and competencies that will be achieved in the topic of limit and sequnce.

Table 2. Competencies and Description of Limit and Sequence Topic

Basic Competencies	Subject Description
1. Explaining the definition of sequence and prove the limit of the sequence. 2. Proving the limit theorem 3. Explaining definition of monotone sequence and proving related theorem .	The topic of this course studies the concept of sequences and their limits, limit theorems, monotonous sequences and subsequences

TABLE 3. Formulation of Learning Oriented Objective

Online Learning Steps	Topic of Subject	Formulation of Learning Oriented Objective
1	- Definition of limit sequnce - Proving the limit of sequence	Students are given the opportunity to watch a video that explains the definition of the limit of a sequence and proves the limit of a sequence. Furthermore, the lecturer gave stimulus questions related to the content of the video with the aim of delivering and generating student's reasoning and thought processes in order to understand the definition of the limit of the sequence. Then students are given the opportunity in groups to discuss and make reports on the content of the video that has been given. Next, students discuss working on projects that have been prepared by the lecturer in the student project worksheets.
2	- Limit Theorems	Students are given the opportunity to watch videos that explain the limit theorems of a sequence and prove the limit theorem of a sequence. Furthermore, the lecturer gave stimulus questions related to the content of the video with the aim of delivering and generating students' reasoning and thought processes in order to prove the limit theorem. Then students are given the opportunity in groups to discuss and make reports on the content of the video that has been given. Next, students discuss working on projects that have been prepared by the lecturer in the student project worksheets.
3	- Definition of limit of sequnces - Proving limit's of sequence theorem	Students are given the opportunity to watch a video that provides an explanation of the definition of a monotone sequence and prove the theorem of a monotone sequence. Furthermore, the lecturer gave stimulus questions related to the content of the video with the aim of delivering and generating students' reasoning and thought processes in order to prove the limit theorem. Then students are given the opportunity in groups to discuss and make reports on the content of the video that has been given. Next, students discuss working on projects that have been prepared by the lecturer in the student project worksheet.
4	- Definition of subsequence - Proving subsequence limit.	Students are given the opportunity to watch a video that provides an explanation of the definition of a subsequnce and proves the subsequence theorem. Furthermore, the lecturer gave stimulus questions related to the content of the video with the aim of delivering and generating students' reasoning and thought processes in order to prove the limit theorem. Then students are given the opportunity in groups to discuss and make reports on the content of the video that has been given. Next, students discuss working on projects that have been prepared by the lecturer in the student project worksheets.

Select method, media and materials

The third step in designing this learning is to determine the methods, media, and teaching materials used in online learning. The method used in learning is discussion and group work in the form of group investigation which is integrated in project based learning. The media used in learning are in the form of power The third step in designing this earning is to determine the methods, media, and teaching materials used in online learning. The method used in learning is discussion and group work in the form of group investigation which is integrated in project based learning. The media used in learning are in the form of power points, videos, audio, pictures, and materials in online classes. The learning tools developed are in the form of lesson plans and project worksheets (LKP).

Utilize media and materials

The design that has been made in step 3 is then compiled in a learning plan both face-to-face and online lectures. The tools needed include the Learning Implementation Plan (RPP). RPP was developed based on the KKNI Curriculum Based on MBKM OBE. The learning activities developed are adapted to the syntax of the learning model used in this study, namely Project Based Learning. The learning steps in this lesson plan are aimed at directing the improvement of students' mathematical reasoning skills and abilities.

The preparation of the LKP is adjusted to the principles of the Project Based Learning model. LKP is one of the teaching materials that serves to help students carry out learning. LKP is arranged in a systematic, detailed, and clear manner so that it can assist students in implementing project-based learning.

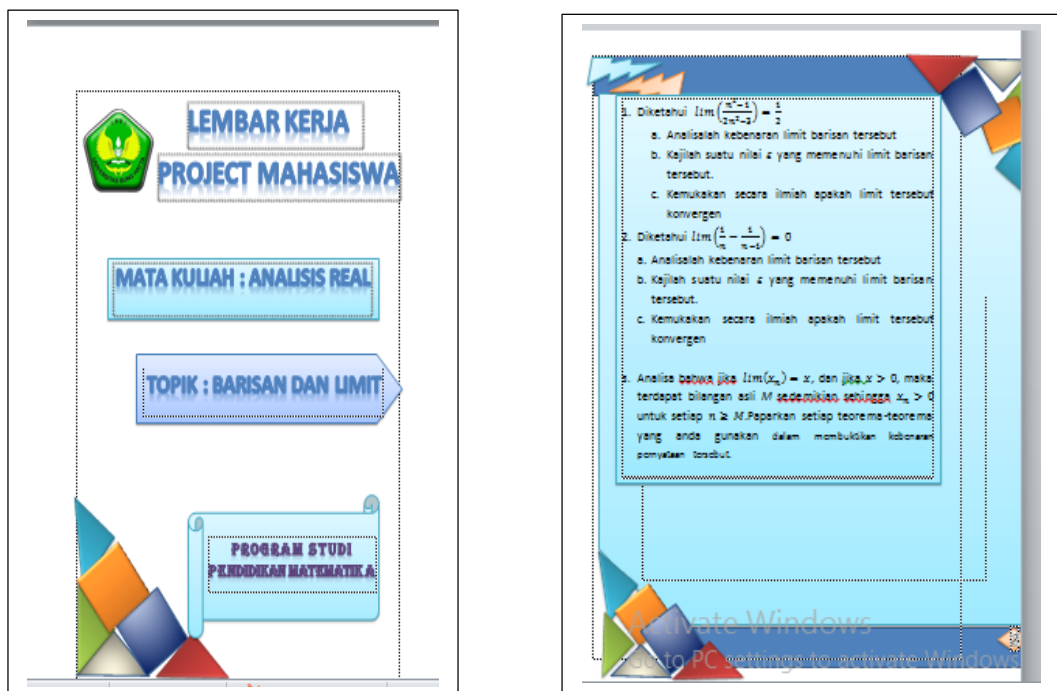The following is an example of a project listed in the LKP.

Fig. 3 Design of Student's Project Sheet

The devices that have been prepared before being used are tested by experts, including learning experts, media experts, and teaching materials/materials experts. In detail the results of the tests carried out are presented in table 4 below.

Table 4. Validation result of instrument

No	Indicator	Percentage	Category
1	Online learning activity/daring	80%	High
2	Learning Implementation Plan	78%	High
3	Project Worksheet	80%	High

Based on the feasibility criteria of the developed model and seen from the design and the developed devices are in the high category. Therefore, the next step can be to test the design product on students. However, in this study, the research phase is limited to device development.

IV. Discussion

Through the development of learning tools in the form of project worksheets, students are given broad opportunities to discuss with their teams, finding information and data that are sufficient and not limited by time and place as well as the role of the lecturer directly [10]. This is in accordance with the opinion of [11] that learning must be able to stimulate student interaction, facilitate their learning process, and encourage an affective learning climate. Using project based learning instrument, students can improve their critical thinking, and creative thinking. Then, because of that their reasoning ability also can be created in solving mathematical problem.

V. Conclusion

Based on the results of the research and discussion carried out, it can be conclude that project-based learning instrument is valid in terms of the learning aspects of learning media and teaching materials. The lecturer can use that instrument when teach their lesson in class. Project based learning instrument can increse students reasoning ability because with a mathematic project, students improve their logic thinking, creative thingking and critical thinking.

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