ATLANTIS PRESS

Advances in Social Science, Education and Humanities Research, volume 178

1st International Conference of Innovation in Education (ICoIE 2018)

Design of Meta-inquiry Learning Model in Number Theory

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***Abstract*—Various efforts have been made by the government and the community in helping to improve education, this study aims to develop an inquiry model that adopts a part of metacognition ability, in order to be able to map all the cognitions in the minds of students, especially those used in number theory subjects. This research was developed by the type of research design with three stages; they are preliminary research, development or prototyping phase, assessment phase. The results of this study formed a new learning model; it is meta- inquiry learning model in number theory subjects, consisting of 6 stages; they are 1) reflection orientation, 2) formulating problems logically, 3) sub-hypothesis hypothesis, 4) calibration of conjuncture analysis, 5) evaluating progress, 6) finding formulate.**

Keyword—Design, Learning Model, Meta- Inquiry

I. INTRODUCTION

This study develops inquiry learning models combined with metacognition abilities of students in number theory courses in college. The effectiveness of number theory learning which includes students' cognitive, affective, and psychomotor aspects are still low. There are still many who apply conventional learning models. Cooperative learning models have not fully seen the level of how students think. Students` interest in problem solving is still low. Students`encouragement for understand more is still low and there is no learning model developed specifically for number theory courses.

The basic principle of learning is how to motivate students to learn and develop their potential optimally [1]. The learning process, students should be treated according to the characteristics that have been thinking adults. Adults are usually able to direct themselves, have diverse experiences, are ready to learn due to their needs. Obstacles to adults in the education process are entering a program with high motivation and readiness to learn, like a well- organized program, the elements are clearly explained [2].

The importance of the qualifications thinking of the graduates' abilities above, there are many problems and achievements obtained in both domestic and foreign research to overcome the gaps that occur. [3] It is said in an international journal that it is important to see how the learning model is used, because the learning model is a tool to improve or the key to attract students in learning. [4] Thus, the importance of choosing a learning model is adjusting the model to learning material as a tool to teach students and greatly support better learning outcomes. Students learned more when models were available. In terms of learning outcomes, model-based feedback was superior to verbal-feedback itself. Models served as a learning scaffold rather than a crutch, and learning with model-based feedbac was resilient over a 7-day delay [5].

Activities carried out by educators and students are the activities that reflect the results at the end of the lesson. The activity of a student does not come suddenly, but it is based on student` interest to learn. The development of interest in learning influences learning, because with interest in learning, learning activities will also increase. Learning interest greatly influences student learning conditions [6].

Based on above description it can be concluded that the main capital of success from learning depends on how the learning model is in line with the material being taught, on the other hand the impact can also be seen, such as how the attitudes, knowledge and qualifications of abilities obtained by the student.

Problem solving abilities are needed in every case of learning problems, successfully solving problems from simple to complex levels using the rationale to connect to several higher level methods [7]. One also creates more effective ways to solve problems and apply concepts in solving new problems.

The description of the international journal above can be concluded that there is a lot to be considered in learning. One of them is a learning model that has an impact on activities, interests, understanding, attitudes, and problem solving. These things are very helpful in improving learning in accordance with what is expected in the Indonesian Qualification Framework (IQF).

Learning in higher education highly upholds independence, students are required to actively read, search, analyze, problem independently. Learning independence must start from the first time a student enters college. A person must face different learning situations when entering college, i.e. independent learning. Many students were

overwhelmed by this situation; in the lecture room, only a few percent were proactive in considering their lecturers as facilitators during the discussion.

Realizing a learning process in higher education, it cannot be separated from the learning model used. The learning process that occurs in general is more students are required to listen than active or creative.

Constructivism is considered as the philosophical foundation in this study because student in number theory subject is invited to think about abstract things in the course that are constructed in the brain. Constructivism offers a new paradigm in the world of learning, especially mathematics education. As a foundation for learning, constructivism calls for the active participation of students in the learning process; independent student learning is needed, and students need to have the ability to develop their knowledge. Constructivism focuses on the nature of knowledge, the nature of learning, and how individuals learn; individuals are actively involved in the process of thinking and learning [3]. Learning as a process of composing or fostering experience continuously, emphasized the importance of involving students in every teaching and learning activity.

The importance of increasing the potential of students requires changing in the number theory learning process. It can be a new learning model to improve student competence, to overcome these problems, an appropriate learning model is needed to find and it can solve the above problems. In this case, researchers try to develop a learning models that are considered suitable in increasing student potential, especially for number theory courses. The learning model that is developed is the inquiry learning model that is tried to adopt a part of metacognition abilities named by the researcher meta-inquiry learning model.

The meta-inquiry learning model is considered able to improve students' metacognitive abilities, so far, students work on number theory, and results that are seen based on the results. With meta-inquiry, how students start planning, processing information, reaching the end result can be seen in each problem. Each step of this inquiry will adopt a part of metacognitive so that it can get a systematic planning arrangement. Thus, it is considered a good work arrangement will get good results.

Learning model as a systematic procedure in organizing learning experiences to achieve learning goals can also be interpreted as an illustration used in learning activities. Four teaching groups that have orientation to (attitude) humans and how they learn, they are:

1. The learning group processes information.
2. A group of social teaching models.
3. A group of personal teaching models.
4. A group behavioral system teaching model [8].

The dimension of the realization of the real learning atmosphere in students through the learning process is organized by educators [2].

Research into the development of mathematics learning at the college level is relatively new, and it has not yet been examined, including research on planning meta-inquiry learning models in number theory courses. Even though problems in mathematical at universities cannot be solved by only experimental research. Learning strategies or methods are importance of conducting research with the title "Planning the Meta-Inquiry Learning Model in the Number Theory Course".

II. METHODS

The meta-inquiry learning model uses a model development design consisting of three phases, Preliminary Research; Development or Prototyping Phase; and Assessment Phase [9]. The development stages carried out in this study arrived at designing prototyping (prototyping phase).

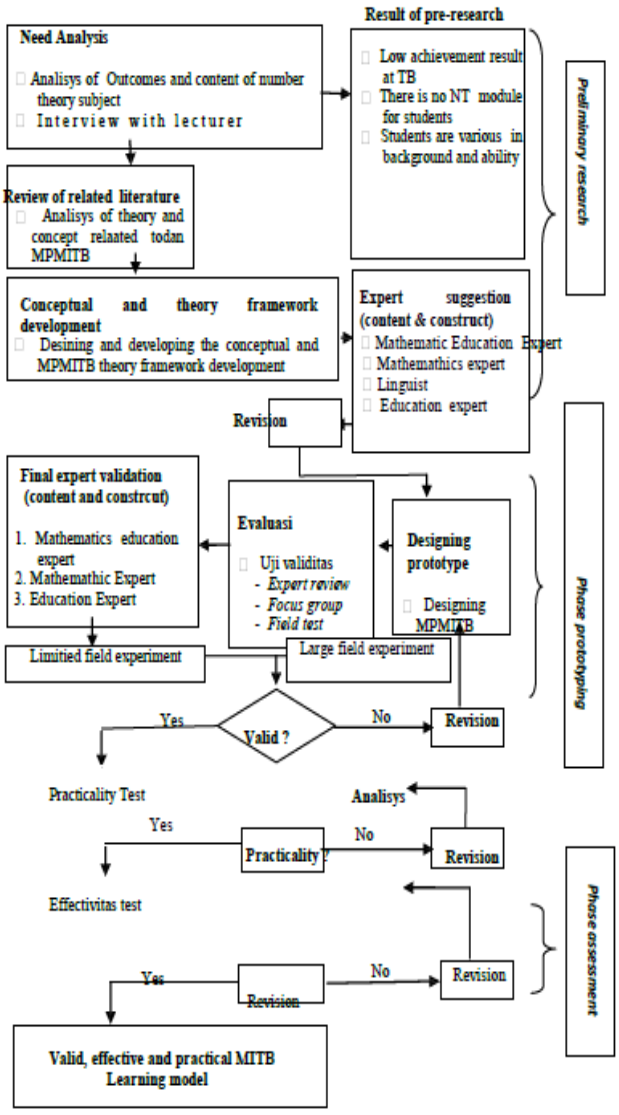

Fig.1. Stages in Research Development Design (Modification [9]

The development stages carried out in this study arrived at designing prototyping (prototyping phase).

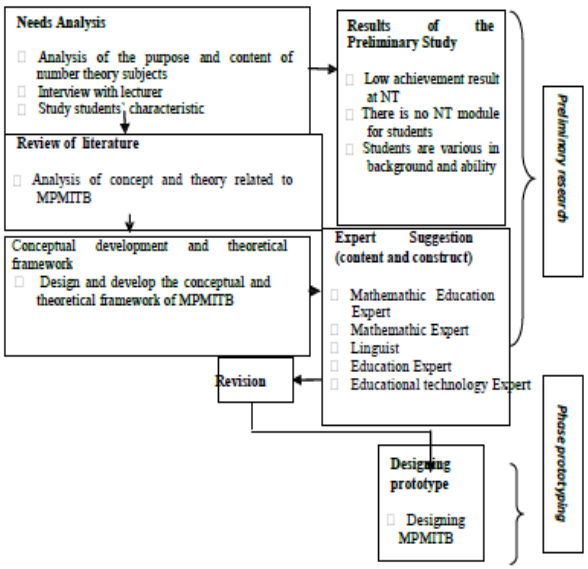

Fig. 2. Stages of Development Design to Phase Prototype (Modification [7]).

III. Results and Discussions

The results of the research in the first phase of preliminary research, and the two prototyping phases can be explained as follows:

A. *Preliminary Research*

1) *Needs and Context Analysis*

The need for a meta-inquiry learning model in number theory subjects is carried out by preliminary study by analyzing needs and context.

a) *Objective and Context Analysis*

Analysis of the learning objectives of number theory based on the last three years based on the list of students' academic values have not been achieved, as the table below:

TABLE I. List of Academic Values Course Numbers Theory 2012 - 2015.

Academic Year	Student Value Distribution									
	A		B		C		D		E	
	sum	%	sum	%	sum	%	sum	%	sum	%
2012/2013	4	8,7	21	45,7	8	17,4	4	8,7	9	19,6
2013/2014	5	7,8	26	40,6	29	45,3	-	-	4	6,3
2014/2015	14	23	22	36	25	41	-	-	-	-

Number theory courses in lectures obtained module information/teaching material does not yet exist; there are many theories proven in handbooks. Students are always invited to think creatively to solve a problem. There are many terms in number theory the properties of numbers must be memorized.

b) *Interview With Peers, Lecturers Who Hold Courses.*

The results of informal interview are how the learning system is used by lecturers, what are the supporting tools, how do they think about the supporting tools used, the lack of laptops that have, the wifi network already exists but the quota for students is still limited, as well as the ability to use computers, the absence of learning modules results in less discipline, attitudes, interests, activities, motivations, and awareness of students. While at the time of lectures, they still use conventional learning models

c) *Studying Student Characteristics.*

Students are also lack interest in reading lecturematerials. Lectures conducted so far have not been able to run smoothly. There were limited handbooks in attending lectures; wifi available on campus is not yet sufficient; not all students can use computers, because the average student comes from schools that lack of school infrastructure.

2) *Literature Review*

Mathematical learning includes everything related to logical thinking from everyday life constructed in mathematics in abstract form. This model is based on constructivism theory. Students are invited to think about the abstract things in the subject that is being constructed in the brain, calling for the active participation of students in the learning process, the need for independent student learning development, and the need for students to have the ability to develop their knowledge.

3) *Theoretical Development*

The development of a theoretical framework is based on needs analysis and literature review. The theories that underlie the meta-inquiry learning model are complemented by relevant theories, nationally and internationally.

B. *Prototyping Phase*

The results of the research in the prototype were obtained until the initial product revision stage; the results of the model design obtained at this stage consisted of five aspects; 1) design of syntax, 2) design of social systems, 3) design of reaction principles, 4) design of supporting systems, 5) design of instructional and accompanying effects

[5]. Feedback and suggestions from the 9 validators (5 mathematics education experts, 1 linguist, 1 education expert, 1 education technology expert, 1 education science expert) who need to be improved according to the initial draft that has been designed can be seen in the table below this;

TABLE II. INPUTS AND SUGGESTIONS FOR THE INITIAL DRAFT MITB LEARNING MODEL

No	Draft of The Model	Validator's suggestion
1	Syntax	a. The designed syntax must be clear, what are the theories that underlie and support it, its advantages and disadvantages, so that it can support actually made a learning model. b. The syntax that is made must have a pattern against the other syntax. c. Syntax must be in line with the plot.
2	Social Systems	a. Every syntax must clearly show its social system. b. The social system to be built must be based on the opinions of experts.
3	Reaction Principles	a. Every syntax of the reaction principle seems clear in accordance with the PMITB model. b. The principle of reaction must be in line with the learning objectives.
4	Supporting Systems	a. The support system must indeed be able to support the PMITB model. b. Differentiate the support system between students and students.
5	Language	a. Distinguish language for students and students. b. Don't use too many conjunctions.
6	Design	a. Display the contents of the product according to the character of the student b. The product cover is more tailored to its name.

IV. CONCLUSIONS

The results of the model design in the initial validation obtained 5 components; they are 1) syntax in the form of reflection orientation, formulating problems logically, sub-hypothesis hypothesis, calibration of conjecture analysis, evaluating progress, finding formulate, 2) social system in the form of roles between lecturers and students, 4) system supporters will be in the form of lecturer guidebooks, student activity sheets, number theory teaching materials, 5) instructional impacts in the form of increasing comprehension, problem solving and accompanying effects of increased discipline, interest, motivation, collaboration, effective thinking in lectures.

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