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Developing Mathematics Learning Strategy Module Based on Journal Review

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Abstract

Pre-service teachers need to know the variety of learning methods and they should have the ability to plan learning strategies as well. This study aims to develop a module of mathematics learning strategy based on the review of articles published from 2014–2018. This study was conducted using Borg & Gall development model and the quality criteria used referred to Nieveen (valid, practical, and effective). The result shows that the module has met the validity criteria of 3.4, practical criteria of 82%, and it also has fulfilled the criteria of effectiveness. This module is recommended as a reference to study about recent mathematics learning strategy. A further study is needed to develop such a module based on international journals.

Keywords: Borg & Gall development model; journal review; mathematics learning strategy; module.

INTRODUCTION

Education always develops and changes (Reiser & Dempsey, 2012). Mathematics education nowadays focuses on high order thinking skills with the use of technology. (Alhaddad, 2016; Ramirez, Chang, Maloney, Levine, & Beilock, 2016). Teachers need to design the most suitable learning strategies for each condition, especially in mathematics to help students reach the goal. A mathematics learning strategy is a plan designed for mathematics learning activities to achieve the desired goals. It chooses the right approach, method, model, media, technique, and learning tactic. Learning strategy is not only chosen based on which skill/ability assessed, but also by considering learning material, students' prior knowledge, time allocation and facilities, teachers' personality and experience. To design a good learning strategy, the teacher should know about various kinds of learning model along with advantageous and weakness for each model.

As a teacher training college, IKIP Veteran Jawa Tengah must provide infinite sources that help students follow the latest educational development. Various approaches, methods, models, and mathematics learning techniques learned in the Mathematics Learning Strategy course. Based on lectures that have been carried out, students looked for sources from books and journals. Books do contain learning theories, yet they don't explore the latest learning strategy. Many modified and new models of mathematics learning models that have developed in the last 5 years have not been included in these books. While journals contain the latest strategy, yet students got difficulties to determine which of them the recent concern. The study published in a journal can be proper literature for developing a learning strategy module as they are more applicable and meet the current trend (Peniati, 2012). References to the latest mathematics learning model can be obtained by reading articles in the journal published in the last 5 years. In Indonesia, there are several national journals that are highly indexed, including IndoMs, Infinity, JRPM, etc. These journals are often used as references for research in mathematics education in Indonesia.

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Semester evaluation that has been conducted by the lecturer shows that students' understanding of the Mathematics Learning Strategy course is not optimal. It's because students have not thoroughly discussed the various problems of learning mathematics in schools that are happening now as well as the strategies to solve these problems. They don't have any module which specifically explores the latest mathematics learning strategies. To help students learn mathematics learning strategies, a teaching material is needed that provides uptodate information about it. One type of teaching material that can be developed is a module (Rufii, 2015).

Among various individual learning methods, module assisted teaching can be considered the most recent method that combines the benefits of other individual learning methods. Using module can be interpreted as general patterns use of modules in teaching and learning activities to achieve predetermined learning goals (Dewi & Lisiani, 2015). Learning systems with module have been developed both national and international. It has been developed in various forms with various names, such as the Individualized Study System, Self-study course, and the Keller Plan. Each of these forms uses different planning and learning activities but has the same characteristics (Hening, Sudarmin, & Mustikaningtyas, 2013).

The module is an independent instructional material, students are given the opportunity to manage their learning time and understand learning materials independently (Hernawan, Permasih, & Dewi, 2012).Kejuruan(2008) formulates the characteristics that must exist in the module, namely: Self Instruction, Self-contained, Stand Alone, Adaptive, and Friendly/ Familiar (User-Friendly). LKPP UNHAS in (Pupitasari, Amin, & Lukiati, 2016) stated that the general characteristics of the module include: using simple language, containing knowledge in accordance with certain subjects or lessons referring to the learning objectives, and using a format commonly used as in textbooks. There are five criteria to develop modules; 1) help students prepare self-study, 2) have a lesson plan that can be responded to in the maximum way, 3) contain complete learning content and are able to provide learning opportunities to students, 4) can monitor student learning activities, and 5) can provide advice, instructions, and information on student learning progress (Irfan & Puput Wanarti, 2014).

There have been various modules developed, such as online learning modules (Aziz & Lee, 2017), mathematics (material) modules (Hudson et al., 2018; Newton, Gale, Alemdar, & Wind, 2018), active learning modules (Tripathi, Sarkate, Jalgaonkar, & Rege, 2015), yet there is no mathematics learning strategy module. The most related one is a study conducted by Peniati(2012) which develop module of science learning strategy based on research result. The study develops a qualified learning strategy module. We need that kind of module which focuses on mathematics learning strategy which has never been developed yet. Thus, it is necessary to develop a mathematics learning strategy module that is valid, practical and effective based on journal review.

THE RESEARCH METHODS

This research belongs to developmental research. The product in this study is a valid, practical and effective module that will be used in the Mathematics Learning Strategy course

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based on national journal review. This product research and development refers to the model developed by Borg & Gall (Gall, Borg, & Gall, 1996). Because of the limitations of the study, only steps 1 to 7 that will be implemented in this study, those are: Research and collecting information (need analysis), Planning, Developing preliminary forms of products, Preliminary field testing, Main product revision, Main testing fields, and Revision of product. The quality criteria of the product refers to Nieveen (Akker, Branch, Gustafson, Nieveen, & Plomp, 2012) with three quality aspects: 1) validity, the material should meet the requirement of content validity and construct validity; 2) practical, teachers and practitioners consider the material is easy to use;3) effective, students appreciate the learning program and the product helps them to get the learning objective.

This research was conducted at IKIP Veteran Semarang with research subjects were the fifth semester of Mathematics Education Study Program students. They were learning Mathematics Learning Strategy courses. Instruments in this study were validated before being used in research. Content validation and construct validation were carried out by 2 validators, the validators are mathematics lecturers with learning media expertise and mathematics education. The practical analysis was obtained from the observer's assessment of the feasibility of the module when used in classroom learning. Effectiveness analysis was obtained from the results of student response questionnaires and quiz, mid-test, and final test. The module is effective if the average student's final grade is more than the pass limit of 75 analyzed by using the T-test and the questionnaire score more than 3 from the Likert scale 1-5(Albaum, 1997).

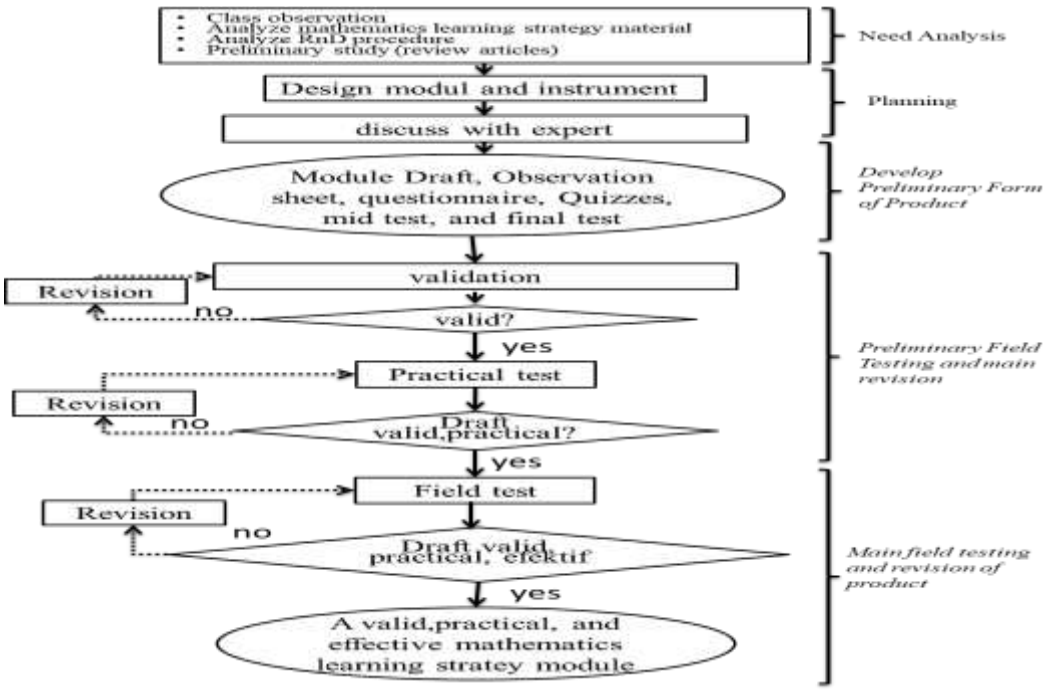

Figure 1. Module Development Procedure

THE RESULTS OF THE RESEARCH AND THE DISCUSSION

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The description of the stages of development research according to Borg & Gal that has been implemented in this development research are as follows:

Stage 1: Research and collecting information (need analysis)

Activities that were done in stage 1 were preliminary studies by giving questionnaires to students who had taken mathematics learning strategy courses. There were 15 students as respondents. Questionnaire results obtained that students have not mastered the approach and model of mathematics learning well. After conducting a preliminary study, a theoretical study of module development was carried out.

Analysis of learning strategy material is done by reviewing subject descriptions and studying learning strategy books. The results obtained are that the learning strategy course material are follows: (1) Learning Taxonomy; which contains the types of taxonomy of learning, differences between old and new taxonomic learning, (2) Learning Systems; consists of learning design, strategy, methods, techniques, and methods, (3) learning strategies; which consists of class organizing strategies, delivery of material and classroom management, (4) Learning Conditions; discuss about material characteristics, student characteristics, and student learning outcomes, and (5) Current Mathematics Learning; consists of an explanation of the learning approaches and methods used during the latest years documented in mathematics education journals. The stage was completed by identifying mathematics education journals comes from the data in the sinta website. It records 70 journals specifically publish mathematics education articles.

Stage 2: Planning

From 70 Mathematics Education journals, 5 journals were selected. The selected journals are: (1) IndoMs volume 4 number 1 in 2013 to volume 8 number 2 in 2017, (2) JRPM (Mathematics Education Research Journal) volume 1 number 1 in 2014 to volume 4 number 2 in 2017, (3) Kreano Journal volume 4 number 1 of 2013 to volume 8 number 2 of 2017, (4) Infinity volume 3 number 1 of 2013 to volume 7 number 2 of 2017, and (5) Didactic Journal volume 1 number 1 of 2013 to volume 4 number 2 in 2017.

The results of this preliminary study were presented at the XXI Mathematics National Conference in 2018. Data from the study of 314 articles of the selected journals in aspects of learning models and methods contained 99 models and methods. Analysis content was used to analyze the data(Mayring, 2015). Table 1. presents the 10 most frequently studied learning models and methods based on the preliminary study.

Table 1. Mathematics Learning Models and Methods

No	Model/method	Frequency	Percentage	No	Model/method	Frequency	Percentage
1	PMRI/ RME	46	14,9%	6	Guided Inquiry	12	3,9%
2	PBL	35	11,3%	7	Problem Posing	10	3,2%
3	CTL	18	5,8%	8	Open-ended	9	2,9%
4	Cooperative approach	13	4,2%	9	TPS	6	1,9%
5	STAD	12	3,9%	10	Jigsaw	6	1,9%

(Kusumawati & Nayazik, 2018)

Table 1 shows that RME (Realistic Mathematics Education) which involves students developing their understanding by engaging with problems set in contexts that engage their

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interest, with teachers scaffolding their re-invention of the mathematics that they encounter (Freudenthal, 2006) placed 1st as the most frequent learning method applied by teacher and practitioners. RME (Realistic Mathematics Education) is an approach to mathematics education that has the potential to increase student engagement with, and confidence in, mathematics (Bray & Tangney, 2016). While Project-Based Learning (PBL) emphasizes collaborate work on problems relevant to society and emphases the relation between theory and practice (Dahl, 2018) placed 2nd, and CTL (Contextual Teaching and Learning) engages students in significant activities that help them connect academic studies to their context in real-life situations(Johnson, 2002) placed 3rd. Those learning methods have similarity. The trend shows that teacher nowadays prefers to implement a learning model which focus on learning process than achievement score. Jacobs (2015) stated that Regardless of which of learning method they use, it should be seen as synonymous student-centric approaches that will vary the ways of their best learning environments. This also accords with our earlier observations, which showed that despite the recent emphasis on achievement, the focus of schools has been on learning procedures and concept, how to know more efficiently and effectively. While students are now ready to learn, it makes teachers should have the skill to enable their "learning sense" and increase the 'how to learn' proficiencies of students (Hattie & Donoghue, 2016). Those top-ten learning models explained elaborately and clearly in this module.

Stage 3: Develop a preliminary form of the product.

The activities that have been carried out in this stage are designing instruments and preparing material with the following results: 1st and 2nd meeting: Learning Taxonomy, which contains the types of taxonomy of learning, differences between the old and new taxonomy of learning; 3rd and 4th meeting: Learning system, consists of learning designs, strategies, methods, techniques, and learning methods; 5th meeting: Learning strategies, which consists of the strategy of class organizing, material delivery and class management; 6th and 7th meeting: Learning Conditions, discuss the characteristics of the material, the characteristics of students, and student learning outcomes; 8th until 14th meeting: Current Mathematics Learning, consists of explanation of the learning approaches and methods used during the last year documented in mathematics education journals. The instruments compiled are validation sheets, module practicality sheets, student response questionnaire sheets, observation sheets, quiz questions, mid-semester test, and final semester test.

Stage 4: Preliminary field testing

Table 2. Validation Result

Aspect	1st Validator	2ndValidator	Average
Module Format	2.67	3.33	3
Content	3.6	3.4	3.5
Language	3.67	3.33	3.5
Illustration and layout	3.67	3.33	3.5
The use of the module	3.5	3.5	3.5
			3.4

The activities that have been carried out in this stage are validation. Aspects of module validated by an expert as shown in Table 2 were: module format, content, language, illustration

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and picture, and the use of the module. Expert validation of the instrument obtained results of average validation score is 3.4 which means that the instrument can be used with some revised notes about writing format in the module. Practical questionnaire filled with practitioners (lecturers) and 3 students. It consists of 17 items based on 5 characteristics of the module and two additional aspects are time allocation and learning condition (see Table 3). The average items' score is converted to a percentage. The highest score is 3.75 for time allocation aspect as the module clearly distributes the material for every meeting. We obtained the practical value of 82% which means that the practical score of modules is relatively high.

Table 3. Practical Result

Aspects	Score	Aspects	Score
Self-Instruction	3.04	User-Friendly	3.50
Self-Contained	3.25	Time allocation	3.75
Standalone	3.00	Learning condition	3.13
Adaptive	3.63	Percentage	82%

Stage 5: Main product revision

Revision considerate review from expert validators, practitioners, and students. The revision is related to the writing format and revision of exercises.

Stage 6: Main testing field

The draft was carried out with students' who take mathematics learning strategy course as much as 15 students as samples. Students study the module independently and work on the exercise in the module, mid-term questions, and final test. Those scores are analyzed using the T-test to compare it with the limit score 75. Hypothesis statement H_0: the average score of assignment, mid-term and final test is equal to 75. While H_1: the average score of assignment, mid-term and final test is not equal to 75. The result is in Table 4.

Table 4 . Students' Score T-Test Results

	Test Value = 75				
	t	F_f Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
				Lower	Upper
Test_score	16,56814	.000	11.86667	10.3305	13.4029

Based on Table 4, it is obtained sig = 0.000 <0.05 means that H_0 is rejected. So then the average score of assignment, mid-term and final test is not equal to 75. Furthermore, the average score of assignment, mid-term and final test is 86 which means the result of t-test passed the effectiveness criteria. The effectiveness of the module was also obtained from questionnaire data. Students completed a questionnaire response after using the module of mathematics learning strategies. There are 20 statements with 5-Likert scale response. The average questionnaire result is 4.2, which means positive student responses to the use of the mathematics learning strategy module. In accordance with the present results, previous studies have demonstrated that learning module enhanced motivation and self-efficacy of students (Esparragoza & Ivashyn, 2016).

Stage 7: Revision ofProducts

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Stage 6 produced a valid, practical, and effective module. Yet, there are still need some improvement to revise the product. The students think that it's a full-of-text module. Although the explanation is written clearly, it still needs more illustration, graph, and pictures to support the explanation.

The finding shows from the final chapter of the module which material is various current mathematics learning strategies. Students simulated some of the learning strategies in the module. Based on the questionnaire result, the syntax helps them to practice teaching. This learning strategy simulation is important for the pre-service teacher to gain initial experience before teaching in the real class. This is also examined by (Sutherland, Howard, & Markauskaite, 2010) which shows that in the transition period as pre-service teachers. They create their professional identity. One of the indicators is shown by constructing "teacher's voice". It develops when the pre-service teacher conducts learning simulations. The importance of simulation for the pre-service teacher was studied by Lehtinen, Nieminen, & Viiri (2016) that It is vital to design pre-service teacher for simulations with the support to enable them to be able to start teaching well.

There has been a lot of the previous study about developing module. The most related one is a study conducted by (Peniati, 2012) which develop module of science learning strategy based on research result. This developed module brought with the same idea but focuses on mathematics learning strategy. Furthermore, the methodology was refined by using the preliminary study with content analysis of hundreds of articles to know which strategy is actually often used by teachers.

CONCLUSION AND SUGGESTION

Based on the results of the research, the following conclusions are obtained. First, a prototype of the development of a mathematics learning strategy module based on journal studies was developed which met the valid, practical, and effective criteria; (a) Research and information collecting (need analysis) which includes a Preliminary Study, Reviewing Module Development Theory, Analysis of Subject Materials, Reviewing Journal of Mathematics Education; (b) Planning which includes analysis of the content of mathematics education articles; (c) Develop preliminary form of product which includes designing instruments and preparing material; (d) Preliminary field testing which includes expert validation and testing the practicality of small samples; (e) Main product revision; (f) Main testing field; and (h) Revision of product. Second, a mathematics learning strategy module that meets validity (score 3,4), Practical (82%), and effective criteria (4,2) is produced.

Lecturers are suggested to use this module as one of the teaching materials in lecturing on mathematics learning strategies course. It can be used as an example of a reference to the mathematics learning model. This module can be distributed and used in a wider scope. It is only limited to the study of mathematics journals in Indonesia, so it is suggested to other researchers to develop it in the larger scope of international journal studies.

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