ICESST 2018 International Conferences on Educational, Social Sciences and Technology
PROCEEDING | ICSST 2018
DOI: https://doi.org/10.29210/2018198
Website: http://icesst.fipunp.ac.id
Padang, February 14th - 15th 2018

Validity of RPP and LKPD based on M-APOS model in clas X senior high school

Shelvia Mandasari[1], I Made Arnawa[2], Atmazaki[3]
[123]Universitas Negeri Padang, Padang - Indonesia, (mandasari_shelvia@yahoo.co.id)

Abstract
RPP and LKPD were an important component an the process of learning, nevertheles in the learning of mathematics. The availablity of RPP and LKPD will help teacher to create interactive, inspiring and fun ways to learn. The M-APOS model was one of the learning model which can trigger students to construct their own knowledge, review on their own and also able to connect all of the knowledge with the subject before. From the case to be underlying to do development RPP and LKPD on M-APOS model. This research is a development research by using Ploomp model that consist of preliminary research, development phase and assesment phase. The purpose of this research is to know the characteristic of RPP dan LKPD with the base of M-APOS model is valid's criteria. The result of research is RPP and LKPD base of M-APOS model with the average of validity are 0,790 and 0,757.

Keywords: M-APOS, RPP, LKPD, validity.

Introduction

Mathematics plays an important role in various disciplines. Mathematics is also the key to opportunities. Therefore, it is not surprisingly that mathematics is one part of science that must be mastered by learners ranging from basic education to college. In this era of reform, everyone must be able to compete because of the ever changing challenges of the future as well as the increasingly high competition so that one is required to have Four Cs (4C) skills of creativity, critical thinking, communication, and collaboration. No exception in the process of learning mathematics for one of the goals of learning mathematics in the Regulation of Department of Education and Culture (Permendikbud) Number 64 of 2013 at the school level is that students have the ability to think critically, logically and creatively. This implies that the ability to think creatively is one of the important abilities possessed by a learner.

However, in fact the ability of creative thinking of learners in Indonesia has not been optimal. This fact is based on the results of a study conducted by the International Trends International Mathematics and Science Study (TIMSS) organized by the International Association for the Evaluation of Educational Achievement (IEA) in 2011 in mathematical

ability that sees three aspects of the cognitive domain of knowledge, application and reasoning. The average of the correct answer of Indonesian learners compared to the international average on reasoning ability is only 17% or 2.30% lower than the ability of the application and 6.59% lower than the ability of knowledge. This indicates the weakness of creative thinking ability of Indonesian students. This is because the reasoning according to Krulik and Rudnick (in Happy and Widjajanti, 2014) includes basic thinking, critical thinking and creative thinking.

The low ability and achievement that the learners still have in mathematics learning is an indication that the learning objectives have not been achieved optimally. Based on the observations of several high schools in the city of Payakumbuh namely SMA N 2 Payakumbuh and SMA N 3 Payakumbuh, found that students have not smoothly poured their ideas on the problems given, students have not been able to construct their own knowledge, memories and understanding of the previous material is still lacking, participants students are still fixated on what is exemplified by teachers and learners have not been able to finish everything in a way that is diverse and unique. This indicates the lack of creative thinking ability of learners.

Based on the results of interviews with teachers, information was obtained that learners have a little difficulty in solving mathematical problems given because the lack of mastery of learners of the previous material. In addition, learners have not smoothly poured their ideas in the learning process. This is seen through learners who still often ask the teacher about completion done by learners. Learners have not been able to do everything in a way that is different from the one that has been exemplified before. Learners are still fixated on what previous teachers have taught.

Learning APOS model is one of the learning models that enable learners to construct their own knowledge, encourage early knowledge, solve structured mathematical problems, repeat it and evaluate work independently. APOS is an acronym for action, process, object and schema. The APOS theory is basically a model to illustrate how mathematical concepts can be studied. The theory is a framework used to explain how individuals mentally build mathematical concepts. Characteristics of learning model of APOS is learning using (1) knowledge constructed by learners through mental construction of APOS, (2) using computer, (3) learners study in small group, and (4) using ACE cycle.

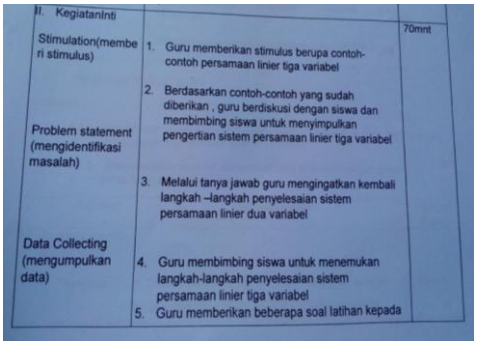
However, in its practice, the APOS model has a particular obstacle to computer usage. In the learning process, it is quite difficult to apply because of several factors. One of them is the lack of teachers' and learners' skills of the programs in the computer, especially mathematics programs. In addition, the preparation of programming language is quite difficult for programs that have been made to run properly. This is reinforced by the results of research conducted by Nurlaelah (2009) which reveals the application of APOS learning model using a computer by utilizing ISETL to find constraints such as in the preparation of instructions. For example that there is a little mistype causes the expected program is not running so that students can not understand and draw conclusions from the program.The same is expressed by Lestarainingsih et al (2015), learners have difficulty finding the concept of gradient and limit by using the computer so it must be assisted intensely. If this is applied to high school class X students, then the same constraints will be found. This is due to the limited ability of teachers and learners

in using mathematical programming language. Teachers and learners only master basic programs like Microsoft Office.

Based on this case, it can be concluded that APOS model is difficult to be implemented so that in this study, a modification has been made. Activities on computer activity are replaced by Working LKPD but the mental construction still follows the mental construction of the APOS model.This model of learning is hereinafter called the M-APOS learning model.

In order for the learning process to run properly should be supported by the availability of learning tools. The availability of adequate learning tools will help teachers in implementing the learning process so that objectives and learning goals which is expected can be achieved optimally. Syllabus is one of the curriculum development products that contains the outline of learning materials, learning activities and assessment design. Complete, detailed and systematic presentation steps are outlined in the form of a Lesson Plans (RPP). Learning activities in RPP are prepared by prioritizing the learning process in an interactive, inspirational, fun, motivating learners to be active and creative during learning so that learners are able to develop their mindset. The RPP also serves as a facilitator for learning enhancement that facilitates the interaction of learners such as asking, expressing opinions and understanding knowledge and procedures learned.

However, RPP used by teachers has not been designed optimally in developing the mindset of learners. Based on the analysis of RPP used by teachers in SMA Negeri in Payakumbuh, it is seen that RPP has not optimally involve students actively in engineering and initiating learning activities and construct their own knowledge so that learners give less attention to learning. One of the RPP used in SMA N 3 Payakumbuh as picture 1:

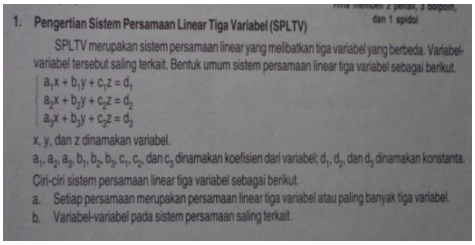


II. KegiatanInti		70mnt
Stimulation(membe ri stimulus)	1. Guru memberikan stimulus berupa contoh-contoh persamaan linier tiga variabel	
Problem statement (mengidentifikasi masalah)	2. Berdasarkan contoh-contoh yang sudah diberikan , guru berdiskusi dengan siswa dan membimbing siswa untuk menyimpulkan pengertian sistem persamaan linier tiga variabel	
	3. Melalui tanya jawab guru mengingatkan kembali langkah –langkah penyelesaian sistem persamaan linier dua variabel	
Data Collecting (mengumpulkan data)	4. Guru membimbing siswa untuk menemukan langkah-langkah penyelesaian sistem persamaan linier tiga variabel	
	5. Guru memberikan beberapa soal latihan kepada	

Figure 1. Example of Presentation of Main Activities in RPP

Based on the picture 1, it can be seen that learning model used is Problem Based Learning. However, the lesson steps in the main activities of the lesson plan have not described detailed. Descriptions of learning activities described only in the form of outlines and no explanation. For example, in the stage of stimulation is not explained what kind of stimulus given to the learner and the absence of the example intended in the description of the activity, so that learners are able to deduce the meaning of the system of linear equations of three variables.

In addition to the availability of RPP, in the lesson also needed a guide for learners to understand the acquisition of information for the material taught that is LKPD. LKPD are sheets that contain clues, clear instructions so that learners understand the concepts being taught. However, the availability of LKPD is still very minimal and not yet effective. The existing LKPD is not the LKPD which is designed solely by the teacher according to the subject and the learning objectives but the LKPD which is issued by several publishers to the school. Based on the analysis on LKPD offered, the authors see the material presented in LKPD very succinct so that learners do not find the process to find the concept. Learners are given facts and information without being given the opportunity to construct their own math ideas. Through the presentation of the material in the form of a summary, the unavailability of opportunities for learners to think about the material in more depth. One of the LKPD used in schools as in figure 2.



1. **Pengertian Sistem Persamaan Linear Tiga Variabel (SPLTV)**

SPLTV merupakan sistem persamaan linear yang melibatkan tiga variabel yang berbeda. Variabel-variabel tersebut saling terkait. Bentuk umum sistem persamaan linear tiga variabel sebagai berikut.

$$\begin{cases} a_1x + b_1y + c_1z = d_1 \\ a_2x + b_2y + c_2z = d_2 \\ a_3x + b_3y + c_3z = d_3 \end{cases}$$

x, y, dan z dinamakan variabel.

$a_1, a_2, a_3, b_1, b_2, b_3, c_1, c_2$, dan c_3 dinamakan koefisien dari variabel; d_1, d_2, dan d_3 dinamakan konstanta.

Ciri-ciri sistem persamaan linear tiga variabel sebagai berikut.

a. Setiap persamaan merupakan persamaan linear tiga variabel atau paling banyak tiga variabel.
b. Variabel-variabel pada sistem persamaan saling terkait.

Figure 2. Example of LKPD Presentation Used by Learners

Besides the presentation of the material, other problems that are found are the questions given in LKPD. The solution given in the sample problem caused the students confusion because of the lack of clear instructions in the completion and the lack of explanation of why the problem was solved in this way. The problems in LKPD mostly contain multiple choice questions rather than questions and descriptions. This makes the learner often guess the answer of multiple choice given. LKPD should be able to maximize the understanding in the effort to form basic skills in accordance with indicators of achievement of learning outcomes that must be pursued.

Based on the description of the problems that have been raised, then a research was conducted to produce mathematics learning devices based on M-APOS model that meets the valid criteria. The indicator of creative thinking used is (1) flexibility, (2) authenticity, (3) Decomposition and (4) Smoothness.

The formulation of the problem in this study is "how are the characteristics of learning tools in the form of RPP and LKPD based on the M-APOS model that can meet the valid criteria to improve the creative thinking ability of X class high school students?". The purpose of this study is to know the characteristics of learning tools in the form of RPP and LKPD based on M-APOS model that meets the valid criteria to increase the creative thinking ability of X class high school students.

Method

This type of research is a developmental study using the models of Plomp, starting from the preliminary research phase, the prototyping stage, and the assessment phase [5]. To obtain a valid M-APOS model based learning device, a preliminary research was conducted. Based on the results of the analysis in the preliminary research phase, learning devices based on M-APOS model has been designed. The preliminary research

phase consists of needs analysis, curriculum analysis, learner analysis and concept analysis. In the development or prototype phase (development or prototyping phase), learning device based on M-APOS model was designed. In the prototyping stage, the prototype is formative evaluation. The prototyping stage consists of prototype 1, self evaluation and expert review; prototype 2, ie one-by-one evaluation; prototype 3, ie small group evaluation, and prototype 4 which is the result of formative evaluation. The M-APOS model-based learning tool that has been designed was self-evaluated and validated by expert review. Validation of the device was done by three lecturers of Mathematics, one lecturer of Education Technology and one lecturer of Bahasa Indonesia.

Results and Discussion

Preliminary Research Results

At this stage, identification or analysis is required for the development of M-APOS-based learning devices. Activities in the preliminary analysis begin with needs analysis, curriculum analysis, learner analysis and concept analysis. The description of the results of the initial investigative phase are.

Needs Analysis

In the requirement analysis phase, information gathering about the problems in mathematics learning was conducted. Information gathering was done by interviewing teachers and students and giving questionnaires to learners. Activities undertaken also observed the learning process and learning tools that exist in the field.

The result obtained from the requirement analysis is that the mathematics learning device has not yet been optimally used. The results of interviews with teachers of mathematics, it was found that teachers have already implemented various methods in the process of learning mathematics but has not run optimally. Lessons Plan (RPP) used by teachers has not facilitated learners in improving their ability, especially the ability to think creatively. LKPD) used by learners is a LKPD sold by publishers whose contents are more likely to directly present the concept and principle without any process to obtain, so that learners are not accustomed to using the thinking skills in solving the problems given. Therefore schools need a valid mathematical learning tool.

Curriculum Analysis

At this stage, the study of Curriculum 2013 for compulsory mathematics subjects of grade X SMA / MA semester I was conducted. This analysis is needed to study the material coverage and learning objectives for each LKPD meeting. Aspects that are considered in analyzing the curriculum are aspects of KI and KD. The results of KI and KD analysis are elaborated into indicators of achievement of competencies in order to be easily understood by learners.

Concept Analysis

Conceptual analysis aims to determine the content and subject matter needed in the development of LKPD, by identifying the key concepts taught, detailing and arranging them systematically according to the order of presentation. The results of concept analysis based on the curriculum of 2013 on compulsory mathematics of class X SMA semester I, there are 6 chapters which are studied: (1) equations and inequality of

absolute value of one variable, (2) rational and irrational inequality of one variable, (3) system of linear equations three variables, (4) the inequality system of two variables (linear-squares and squares), (5) functions.

Analysis of Learners

Analysis of these learners aims to determine the quality of individuals who can be used as guidance in the design of LKPD. Student analysis includes academic ability, age, penchant and maturity level, motivation to subject, experience, psychomotor skill, ability of cooperation and activities usually done by learners in their daily life. The analysis was done on the students of class X SMAN 2 Payakumbuh and SMA 3 Payakumbuh by spreading the questionnaire to learners and observing the learning activities.

The questionnaire results indicate that many learners are having difficulties or difficulty in learning mathematics such as difficulties in understanding the material, developing ideas as well as remembering the previous material relating to the material being studied. Learners prefer learning activities in groups. This character indicates that learners prefer to do an activity together. Learners also need a learning resource in the form of LKPD dominant red color maroon with A4 paper size and accompanied by an interesting drawing in accordance with the material, the implementation of the learning steps are directed and clear, so that learners can understand the material and solve problems in groups.

Prototyping Phase Results (Design Prototype)

Designing LKPD

1) The Didactic Aspect

The presentation of the material begins by giving problems in everyday life related to the material being studied. To further attract the attention of learners, on the subject given the appropriate picture that is expected to help learners understand the problem given. Furthermore, learners are required to write down the information obtained from the problem. It aims to learners able to understand the problem well. Then, learners are given instructions and clear steps in solving the problems given. This stage is called action stage. One of the examples of action stages in LKPD such as Figure 3.

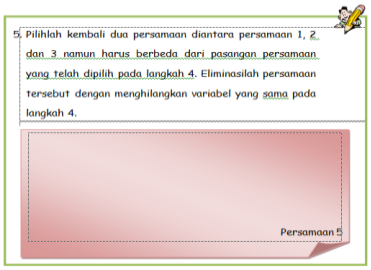


Figure 3. Example of Action Stage Presentation In LKPD

After doing the action stage, then the students are given second problem. From these problems the learners are asked to repeat the completion steps that have been given at the action stage. This stage is called the process stage. It aims to enable learners to understand and apply the completion measures that have been given at the action stage. Examples of problems given in the process stage can be seen in Figure 4.

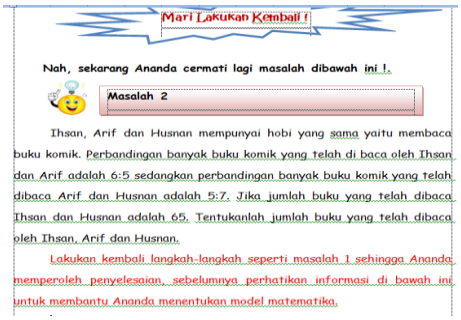


Figure 4. Sample of Process Stage Presentation In LKPD

Then learners are asked to provide reasons or explanations about the characteristics of the material that has been studied. This stage is called the stage of the object. At the stage of the object learners have been able to treat a concept as a cognitive object that includes the ability to act on an object. Figure 5 is an example of the presentation of an object stage in LKPD.

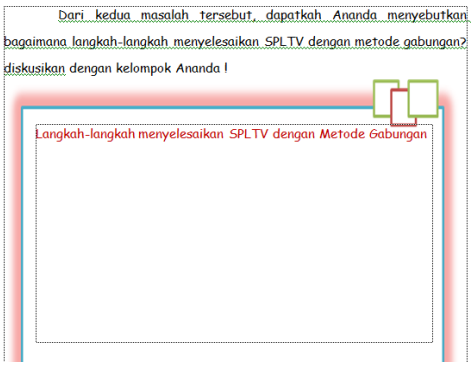


Figure 5. Sample of Object Stage Presentation In LKPD

Furthermore, learners are asked to link or connect all knowledge with certain mathematical concepts so that learners are able to construct their knowledge of the given problem. This stage is called the stage of schema. Figure 6 is an example of a schema stage in LKPD.

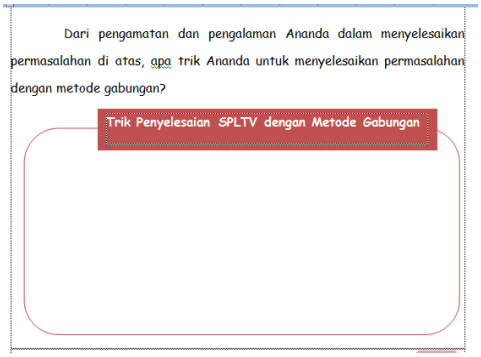


Figure 6. Example of Schema Stage Presentation in LKPD

2) Aspect of Content

The material using M-APOS model is presented in accordance with indicators of achievement of competence. For example, to achieve "indicators identifying SPLTV" learners are confronted with observing a problem that leads learners to create a mathematical model. From the mathematical model obtained, the learners identify the mathematical model. Learning activities are equipped with instructions about the steps

that must be done clearly by the students with pictures so that the learning process goes meaningful, interesting and fun.

3) Display

LKPD display is made as attractive as possible, consisting of LKPD cover with dominant color maroon. This color was chosen because based on the preliminary analysis of the students about the more dominant color they liked, and maroon color is liked by mostly learners. The LKPD component consists of introduction, table of contents, instructions on the use of LKPD, introduction, chapter title, KD, indicators and learning objectives, sample questions and practice questions.

4) Language Aspects

Writing and language used in LKPD in accordance with the enhanced spelling (EYD). LKPD uses simple and communicative language and does not contain multiple meanings. In addition, commands and questions on LKPD are prepared in clear sentences so as to direct learners to perform activities or answer questions as expected.

b. Prototype 1

Prototype 1 is the initial stage of LKPD design result. To obtain a valid LKPD, there are two steps taken to validate LKPD, which is self evaluation and expert review. Below is described the validation of LKPD prototype that has been designed.

1) Result of Self Evaluation

Self evaluation is an evaluation done by looking at the error learning device that has been designed. Such errors are errors that do not require special skills and they can be seen as directly as typing errors, and punctuation errors. In general, errors in LKPD mostly occur in typing words and punctuation. For example an error occurs on the word "perbedaan" (difference) written "perbedan" and "sistem" (system), written the word "sitem". At the end of the sentence also many are not punctuated ".". So for LKPD perfection, a revision / improvement was done so that LKPD which is designed not have many mistakes / not far from the expected product specifications.

2) LKPD Validation Results by Expert (Expert Review)

During the validation process there are several revisions suggested by the validator. In addition to providing some suggestions, the validator also assesses the LKPD that the researcher has made. RPP validation results based on the M-APOS model are in valid criteria with an average index of 0.790. While the validity of LKPD based on model of M-APOS also reside in valid criterion with index average 0,757.Based on the validation of these experts it can be concluded that the RPP and LKPD based on the M-APOS model have met the valid criteria.

Conclusions

This research is a development research that produces LKPD based on M-APOS approach. Based on the research that has been done, it can be concluded that (a) LKPD development process based on M-APOS model for high school X students is carried out with Plomp development model consisting of three phases: initial investigation phase, development phase and assessment phase. Based on the development process that has been implemented, the results which is obtained is in the form of RPP and LKPD based

M-APOS model for high school students X SMA has valid both in terms of content and constructs.

There are several things that researchers can suggest based on the conclusions of this research those are, (a) to be used by mathematics teachers as an alternative to LKPD class X (b) it is hoped that there will be further tests in other schools to see the wider practicability and effectiveness of the developed LKPD c) For researchers who continue this research, it is advisable to innovate in subsequent research.

Acknowledgments

With the completion of this research, the researcher would like to thank all those who have helped, such as the mentor; Rector of Universitas Negeri Padang (UNP); principal of SMAN 3 Payakumbuh; mathematics teachers and students of SMAN 3 Payakumbuh so that the research could run well.

References

Arnawa, M. (2006). *Meningkatkan Kemampuan Pembuktian Mahasiswa dalam Aljabar Abstrak Melalui Pembelajaran Berdasarkan Teori APOS*. Disertasi pada Universitas Pendidikan Indonesia: tidak diterbitkan.

Asiala, M et al. (1997). "*A Framework for Research and Curriculum Development In Undergraduate Mathematics Education*". Journal of Mathematical Behavior, (online), (http://www.math.wisc.edu/~wilson/Courses/Math903/APOS-Overview.pdf)

Asiala, M et al. (2001). "*The Development of Students' Graphical Understanding of The Derivative*", (online), (http://www.math.kent.edu/~edd/SlopeStudy.pdf)

Dubinsky, E. And M. McDonald. *APOS: A Constructivist Theory of Learning, In Undergraduates Mathematics Education Research, In Holton, D. (Eds),* 2000. *The Teaching and Learning of Mathematics at University Level*, Kluwer Academic Publisher, Dordreeth

Evans, JR. (1994). *Berpikir Kreatif: Dalam Pengambilan Keputusan dan Manajemen*. Jakarta: Bumi Aksara.

Lestarianingsih, Yunika dkk. (2015). "*Pengembangan Lembar Aktivitas Mahasiswa Topik Turunan Berdasarkan Teori APOS*", 3 (1) : 12-13

Nurina, Happy dan Djamilah Bondan Widjajanti. (2014). *Keefektifan PBL Ditinjau dari Kemampuan Berfikir Kritis dan Kreatif Matematis, Serta SELF-ESTEEM Siswa SMP*, 1 (1): 10-12

Nurlaelah, E. (2009). "*Kajian Hasil-Hasil Penelitian Yang Berkaitan dengan Teori APOS dan Kreatifitas Matematika. Universitas Pendidikan Indonesia*": tidak diterbitkan.

Permendikbud Nomor 103 Tahun 2014 Tanggal 8 Oktober 2014 Tentang Pembelajaran Pada Pendidikan Dasar dan Pendidikan Menengah.

Permendikbud Nomor 022 Tahun 2016 Tanggal 28 Juni 2016 tentang Standar Proses Pendidikan Dasar dan Menengah.

Plomp, T. dan N. Nieveen. 2013. *Educational Design Research*. Enschede: Netherland Institute for Curriculum Development (SLO).

Shadiq, Fadjar. (2014). *Pembelajaran Matematika : Cara Meningkatkan Kemampuan Berfikir Siswa*. Yogyakarta: Graha Ilmu

Suryadi, D. (2010). *Membangun Budaya Baru dalam Berfikir Matematika*. Bandung: Jica.

Talajan, Guntur. 2012. *Menumbuhkan Kreatifitas & Prestasi Guru*.Yogyakarta: LaksBang PRESSindo.

Weyer, Sarah R. (2010). *APOS Theory as a Conceptualization for Understanding Mathematical Learning*. Jurnal Pendidikan Matematika (online).

Yerizon. (2011). *Meningkatkan Kemampuan Pembuktian Matematis Melalui Pendekatan Modifikasi APOS Pada Mahasiswa.* Disertasi pada Universitas Pendidikan Indonesia: tidak diterbitkan.