

Needs Analysis Development of Mathematics Learning Device Based On 21st Century Skills In Senior High School

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Abstract— The aim of study to analyze the needs the development of mathematics learning device on 21st century skills-based Senior High School in Padang City. The population of the study is high school student's grade XI and Mathematics teacher in Padang city in 2018/2019. The sampling technique used purposive sampling method. The instrument was collected by observation and questioner and Analyzed descriptively. Conclusions of this research are: (1) learning material of high school mathematics class can be developed with 21st century skills-based mathematics learning; (2) Students have sufficient ability to follow 21st century mathematics-based learning; (3) teachers have the ability to use 21st century skills-based mathematics learning tools

Keywords—needs analysis, device of learning, 21st century Skills

I. INTRODUCTION

The world development increase rapidly and globally in changing some various aspects of life as the challenge of a nation in preparing the future generations, including students. Therefore, in this modern age education plays an important role in creating the nation's generations to keep up with the development of science and technology. [1] Ministry of National Education Number 20 of 2003 on National Education System explained that education is a conscious and deliberate effort to create the condition of the learning process so that learners are developing the potential for him to have the spiritual of religion, control self-esteem, intelligence, character, and skills, society, nation and state.

Change for the better must be done because of the education quality of in Indonesia is decrease. From the issued by UNESCO, said that Indonesia Education Development Index dropped from rank 65 to rank 69 of 127 countries, [2]. Due to the low quality of education in Indonesia, then Indonesia has low competency according to PISA [3]. Indonesia is only predicated as a follower instead of a leader of technology from 53 countries around the world. According to [4], nowadays in the 21st century, all alternatives addressing the needs of life in various contexts is based on knowledge. Addressing the needs of the

education sector-based knowledge (knowledge based education), development of knowledge-based economy, community development and empowerment-based knowledge (knowledge based social empowerment), and development in the business sector-based knowledge (knowledge based industry). The government's efforts is evident that changes in the curriculum, additional facilities of educational activities in various fields and levels of education. One area of the study that did not escaped the government's efforts to improve math education.

Development of the 21st century based learning device has been developed by researchers. Development of the 21st century based learning tools effectively to help learners in the learning of mathematics more meaningful so that students are able to understand the material well shown by the completeness of learners [5]. The problem in this research can be formulated as follows. First, learning materials of math class XI SMA can be developed based math learning 21st century skills; second, learners have sufficient ability to follow based math learning 21st century; The third, teacher has the ability to use skills-based math learning tool of the 21st century

Education is currently in the days of knowledge age with the acceleration of knowledge is incredible. Acceleration of knowledge is supported by the application of media and digital technology called the information super highway Gates [6]. This caused all the fields should be ready to change with the times, not least in education. This change must be done in order to not be left behind by the times. Changes that occur in the field of education focused on teaching and learning.

Current learning activity should be adjusted. Learning materials should provide a more authentic design. Learner requires the skills in the 21st century, knowledge and ability in the fields of technology, media, learning and innovation skills as well as life skills and career, [7] developed a framework. This framework also describes the skills, knowledge and skills that must be mastered so that students can be successful in life and work.

Framework The proposed aspects required in the 21st century learning. Learning for the 21st century that about related technology literacy on these skills. These aspects are

increasingly important to ensure learners have the skills to learn and innovate, skills in using technology and media information, and be able to work, and survive by using skills for life (life skills). Skills must be owned at this time cannot be separated on the skills of the 21st century. According to [8], 21st century skills focus on critical and innovation, creativity and innovation communication and collaboration.

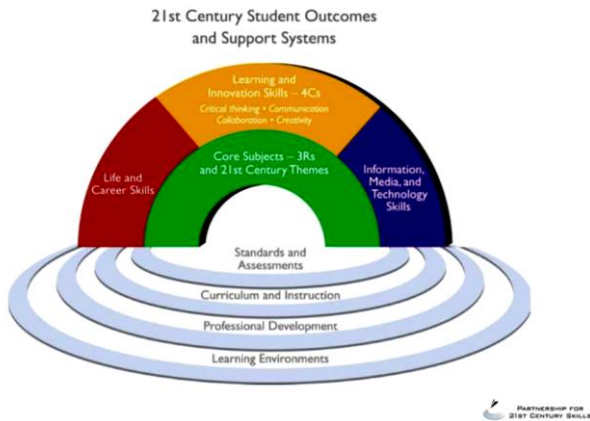


Figure 1. The 21st Century Learning Framework

Mathematics learning by NCTM [9] requires the skills of problem solving, reasoning and proving, communication, connection, and representation so that in mathematics learning was closely related to the skills of the 21st century. Management of learning with the nineteenth century relates to teachers' readiness in learning [10]. Teachers should be able to plan, predict and evaluate the learning that has been done. It can be seen from the administrative requirements of teachers and the implementation of learning in the classroom. Teachers have planning administration contained in Learning Implementation Plan (RPP), which contains goals, lesson, and evaluation / assessment will be prepared in learning process.

In the 21st century learning students should have the ability to think critically and problem-solving, creativity and innovation, as well as communication and collaboration. Teachers need a worksheet in learning to be able to organize the students' understanding and can help students to understand the material. The device consists of a minimal learning lesson plans and teaching materials that can be a worksheet for students. This learning tool will help teachers to prepare a better grade and evaluate students' understanding and ability thoroughly. Thus it takes a learning tool to help students and teachers in optimizing learning in the class. To be able to develop mathematical learning of the 21st century there are some important things to note are, among others:

1. Main Duties As a Planner Teacher Education

A facilitator and classroom manager the task of the teacher is important in the manufacture of RPP. RPP should be good and the detail and be able to explain all the processes that will occur in the classroom, including the assessment process and targets to be achieved. In

compiling lesson plans, teachers must be able to combine the required targets in the national curriculum, the development of 21st century skills or national character as well as the use of technology in the classroom.

2. Enter Higher-Order Thinking element (Higher Order Thinking)

The technology in this case, especially the Internet will greatly facilitate students to obtain information and answers to the problems presented by the teacher. For problems are knowledge and understanding can find the solution very easily one tendency that students simply be an information gatherer. Teachers should be able to provide application-level tasks, analysis, evaluation and creation, this will encourage students to think critically and read the information they gather before solved duties of teachers.

3. Integration Technology

Schools where students and teachers have access to good technology should be able to utilize technology in learning process, students should be accustomed to working with technologies like working people. Often teachers complain about the technological amenities they have not had, one thing that the learning development of the 21st century can be done without the element of technology, the most important is a good teacher who can develop the learning process is active and collaborative, but of course the teacher should strive to master the technology first. The most basic thing to remember that technology will not be a good and powerful tool if the pattern of learning is still traditional.

4. The application of the approach pattern and a variety of learning models

Some learning approaches such as Problem Based Learning, Inquiry Based Learning as well as learning model cross (jigsaw) or class model upside down (Flipped Classroom) can be applied by teachers to enrich the learning experience of students (Learning Experience). One thing that needs to be understood that students must know and understand the relationship between knowledge learned in school to real life, students should be able to apply their knowledge to find solutions to problems in real life.

II. METHODS

This study is part of research development. The focus of this experiment is to determine the needs and the carrying capacity of the math-based learning tools of the 21st century to improve the high-level thinking skills of learners. The study population involved students and high school teachers in Padang. The sample was taken as many as three schools, namely SMAN 10 Padang, SMAN 12 Padang, SMAN 5 Padang. Data were collected through observation and interviews. The data collected is qualitative data, which will then be analyzed descriptively.

III. RESULT AND DISCUSSION

A needs analysis conducted by field observations, interviews with teachers and math and high school students studying math curriculum that is being used today. To design a learning device that generated the 21st century

mathematics, need to do an analysis of the needs generated for a device designed to empowering and beneficial to school education in particular and the world in general. Analysis of the needs of the research focused on curriculum analysis, analysis of teachers and students.

a. Analysis of Curriculum

According to some experts curriculum change from time to time, due to the needs of people who every year is always evolving and the demands of times tend to change. Curriculum development is considered as a determinant of the future of the nation. The study shows that there needs to be change in the orientation of the curriculum without burdening students with the content but in the aspect of essential capabilities. Kemendikbud develop a new curriculum that Curriculum 2013. National quality standards expressed as competency standards. Competency standards are a minimum quality of graduate level or educational unit. They include attitudes, knowledge, and skills [10]. The 2013 curriculum content standards used in Permendikbud No. 21, 2016 [11].

Process Standards Curriculum

Basically, the implementation of standards in the learning process at the unit level of education has a close relationship with other standards, such as the Graduate Competency Standards and Content Standards. In PP No. 22 of 2016 [12], Standard process described national standards relating to the implementation of learning in the educational unit to achieve competence of graduates. Components the process is minimal ability to assess and process the content into competence. Content component is the ability dimension into human figure resulting from education. Teachers' understanding of the curriculum will determine the design of teachers to lesson plan and translated into forms of learning activities.

Curriculum Assessment Standards

Curriculum assessment standards used in 2013 is based on Government Regulation No. 23 of 2016 [13]. Assessment in the educational process is a component that cannot be separated from the other components, especially learning.. Assessment of learning outcomes by educators monitored the process. Curriculum 2013 required the use of authentic assessment (authentic assessment). In the paradigmatic manifestation authentic assessment of learning requires authentic and learn authentic (authentic learning). It is believed that the more authentic assessment students' ability to provide information holistically and valid.

b. Analysis of Teacher and Student

Teachers and students are the main actors learning process to achieve the learning objectives. Teacher is a motivator, facilitator, mediator and creator of learning. Teachers should provide stimulation to be thinking process of students. However, the reality has found that teachers view students' skills in math, based on the results of the cognitive value of existing ones. In this case the class X senior high school seen from the results that they get. Cognitive ability class XI and XII class is determined from the cognitive abilities of the class below. Teachers are more dominated in learning, teachers give students listening material followed and the continuation of the task. This kind

of learning is less beneficial for students. Students who have high motivation and ability that is able to follow and understand the subject matter. While students who have low motivation and ability will be difficult to follow the material presented by the teacher. As a result of learning is boring, because students are not involved actively to participate in learning.

Students are directed to accept and abide by the directions of teachers, students were getting lazy and do not like to learn. Students are not given the opportunity to think critically and creative, and activities and collaborate to develop the potential in students. To change this paradigm, we need to design learning device that can direct and develop creativity in the learning process in the classroom. In the 21st century learning students should have the ability to think critically, creativity, communication and collaboration. This means that through learning the students should be able to develop these abilities. 21st century skills can be developed in learning through the learning materials.

c. Observations Based Math Learning Tool of 21st Century

The results of the observation of the learning process several high schools in the city of Padang is still using conventional methods. To ensure the observations, followed by informal interviews with several teachers of mathematics. They say that the process of learning in the classroom are still using conventional methods. Teachers teach still use methods that are less varied, the participation of students in the passive student teachers complete example problems seeing and listening. Teachers in the completion of exercises is focused on the use of the most important results are correct formula. There are ongoing training and learning tools that can be used by teachers in the 21st century.

The results of observations made on schools, they found teachers who teach in the class did not carry out the learning of mathematics such as principle and the expected characteristics, which means that the learning process tends to be one-way dominated by the teacher. The observation is confirmed by good interview with the principal, teachers who teach in class XI and class XI students can be concluded:

- 1) Mathematic learning in the classroom tend to be in a conventional manner. Active teacher explains the topic, describing the completion of the sample questions. Then the students are required to complete the exercises as directed by the teacher with emphasis on the application of the existing formula.
- 2) Learning has not emphasized on understanding concepts, mathematical modeling and bring about the completion of the real situation of students. So that the learning of mathematics is still relying on students' memories about the formulas given. Learning this kind of mechanistic, which is not beneficial to improve students' understanding of the concept

d. Interview Results-Based Math Learning Tool of 21st Century

The result of research interviews with students get an idea of how the learning process they experienced. Math is hard and difficult to be understood, the teacher always

emphasized form completion conducted by teachers so that students respond in accordance with the explanation and guidance of teachers that form the algorithms, the mathematical concept of the invention is always ignored in the learning process. While interviews with classroom teachers who teach in class XI. How is the involvement of students in the learning process. Of the teachers interviewed some of them choose to use almost 60% expository method of learning for children viewing capabilities by teachers are not able to follow the lessons using a particular method. The reason is the learning method with certain measures will take more time for learning, while teachers must complete the material according to allocation of time there. Learning was only for the sample material applications in everyday life, but not to learn the material. Furthermore, the students were taken to the abstract realm of mathematics, and teachers provide the finished material without providing the opportunity for students to explore the material and understand it in its own way. Students are given the material facts, concepts and procedural by default and students receive normative. Learning in the classroom was only for the sample material applications in everyday life, but not to learn the material. Furthermore, the students were taken to the abstract realm of mathematics, and teachers provide the finished material without providing the opportunity for students to explore the material and understand it in its own way. Students are given the material facts, concepts and procedural by default and students receive normative. Learning in the classroom was only for the sample material applications in everyday life, but not to learn the material. Furthermore, the students were taken to the abstract realm of mathematics, and teachers provide the finished material without providing the opportunity for students to explore the material and understand it in its own way. Students are given the material facts, concepts and procedural by default and students receive normative.

They recognize learning approach that they do not involve students in solving problems in solving problems of teachers completed the first instance, then the new students do the problems in accordance with the settlement that has been done way teachers. Such an approach does not provide understanding of concepts in students, so that students' skills in problem-solving is very low because in this way the students are not encouraged to reason, but one of the study of mathematics is to improve students' reasoning power.

From observations and interviews above were found some important points: **First**, the teacher is less planning so not a lot of varied teaching methods. Teachers use the method of group discussion at the beginning of the semester material with the assumption, the discussion group takes much so that if given in any material that teachers will be short of time to complete the material in one semester. Teachers have confidence that the students better understand the lecture method and materials will be faster finished to be taught. The result is a fast material is finished and assessment conducted only in the material provided. **Second**, teachers are not accustomed to compile teaching materials by a particular method, the teacher only make up matter so that prepared by the students in the form of material and sample questions. Teachers need a worksheet

in learning to be able to organize the students' understanding and can help students to understand the material, but not many teachers who can create a worksheet for reasons of time constraints and the ability of teachers to create a worksheet that is effective. **Third**, learners have had a student guide that includes lesson activities. Books of students and teachers the main reference book in mathematics in the curriculum in 2013, but despite it being the reason teachers do not use varied teaching methods, according to the students' books teachers are less effective when applied in learning. This is effective in terms of the time required to follow every step of learning in a book. **Fourth**, assessment, in fact oriented assessment conducted matter in general, teachers do not see the other abilities that can be developed through the study of mathematics. The view that mathematics as a subject to be mastered the material making teachers perform evaluations with matters relating to the material and procedural concepts without oriented to specific mathematical ability.

IV. CONCLUSION

The results of research showed that high school mathematics learning materials can be developed with 21st century based learning. Each learner has sufficient ability to follow the 21st century based mathematics learning. High-thinking ability of learners has not become a primary goal and one approach that can improve high-level thinking skills is an approach that refers to 21st century mathematics learning. However, teachers experience obstacles in developing learning with 21st century math learning approaches to that required 21st century-based learning tools that can help learners in improving high-order thinking skills.

There are contained of skills that needed to answer and resolve the challenges of the times. To develop 21st century skills, based on learning in math classes, educators should apply lessons that are more likely to refer to those skills, such as, collaborative learning, meaningful learning, and so forth. In addition, teaching materials must also undergo a number of adjustments from content-based to context-oriented.

SUGGESTIONS AND RECOMMENDATIONS

The development of learning device was needed to help teachers and learners to achieve maximum learning outcomes. To the researchers suggest to follow this by designing research-based instructional materials based math learning 21st century in order to improve high-level thinking skills of learners.

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REFERENCES

- [1] Permendikbud, Nomor 20 Tahun 2003, Sistem Pendidikan

- Nasiona, Jakarta: MONE, 2003.
- [2] Majid. S, "Analysis of Education and Poverty in Aceh", *JournalsPencerahan*, vol. 8, pp. 15-37, 2014.
- [3] PISA, *Results in Focus: What 15-Year-Olds Know and What They Can Do With What They Know*. <http://www.oecd.org/pisa/keyfindings/pisa-012-resultsoverview.pdf> (Accessed 30 Maret 2016), 2012.
- [4] Mukhdis. A, "The Indonesian Human Figure and Character Excellence in the Field Technology As the Demands of Life in the Era of Globalization", *Character education Journal*, vol. 3, pp. 115-136, 2013.
- [5] Murniati, LD. Candiasa. IM. and Kirna. IM, Device development Realistic Mathematics Education to Improve Students Problem Solving Ability SMP. *Journal of Education and Teaching*, pp. 114-124, 2013.
- [6] Wijaya. EY. Sudjimat. DA. &Nyoto. A, "21st Century Education Transformation As Human Resources Development Demands in the Global Era", *Proceedings of the National Seminar on Mathematical Education 2016 ~ Kanjuruhan University of Malang Poor*, 2016.
- [7] Partnership for 21st Century Skills (P21), *Framework for the 21st Century Learning*. (<http://www.p21.org/our-work/p21-framework>, (accessed October 13, 2017), 2014.
- [8] Trilling. B, & Fadel. C, *21st Century Skills: Learning for Life in Our Times*. San Francisco: John Wiley & Sons, Inc, 2009.
- [9] National Council of Teachers of Mathematics (NCTM), *Professional Standards for school Mathematics*, USA: NCTM, 2000.
- [10] Kemendikbud, *Permendikbud 20 Year 2016 on SKL Primary and Secondary School*. Jakarta: Ministry of Education and Culture, 2016.
- [11] Kemendikbud, *Permendikbud 21 of 2016 on Standard Contents of Primary and Secondary School*. Jakarta: Ministry of Education and Culture, 2016.
- [12] Kemendikbud, *Permendikbud 22 of 2016 on Standard Process of Primary and Secondary School*. Jakarta: Ministry of Education and Culture, 2016.
- [13] Kemendikbud, *Permendikbud 23 of 2016 on Standard of Elementary and Secondary School Assessment*. Jakarta: Ministry of Education and Culture, 2016