3. Development Instructional Design with TPACK

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Proceedings of the 2nd Progress in Social Science, Humanities and Education Research Symposium (PSSHERS 2020) Development Instructional Design with TPACK Integrated Inquiry Learning Model to Improve Student Problem Solving Skills Edy Waluyo1* and Nuraini2 1,2Faculty of Mathematics and Natural Sciences, Hamzanwadi University, East Lombok, Indonesia *Corresponding Author: edywaluyo@hamzanwadi.ac.id ABSTRACT Instructional Design with TPACK integrated Inquiry Learning is an instructional design developed by integrating technology, pedagogical knowledge and subject matter knowledge about what and how the subject matter is taught. This study aims to develop a instructional design using the discovery learning model Based TPACK to improve the problem solving skills of students. The research method used is development research Borg and Gall with stage analysis, product design, product development, product implementation and evaluation. The research was conducted on 60 students of Madrasah Tsanawiyah Muallimat NW Pancor consisting of 2 classes with 30 students each. Data collection instruments consist of guidelines or validation sheets, practicality questionnaires and study results tests. Data collection using validation sheet instruments, practicality questionnaires and problem solving skill instruments. The data obtained is analyzed with descriptive analysis techniques. The results of the analysis show that the instructional design developed with TPACK integrated Inquiry Learning is valid, practical and effective and feasible to use. Keywords: Inquiry Learning, TPACK, Problem Solving Skill 1. INTRODUCTION The development of science and technology in the 21st century has changed the characteristics of learners so that it requires an innovative orientation and way of learning. In the 21st century learning needs to be done such learning so that every learner who has high order thingking skills , problem solving ability,communication ability, and mathematical thinking ability to be able to face global challenges (NCTM, 2000). The importance of problem solving ability does not seem to be in line with the results of a survey conducted by TIMSS (Trends in Mathematics and Science Study) and PISA which stated that the results of mathematics learning of Indonesian students are still low. Timss results in 2015, stated that the results of mathematics study indonesian students ranked 44th out of 49 countries with an average score of 397. While the results of pisa's three-year survey data in 2015, Indonesia only ranked 62 out of 70 participating countries, at an average score of 386 which is still relatively low compared to the average international score of 490 (Wahyudi & Indri, 2017:). The results of the TIMSS study also showed that the mathematical learning achievements of Indonesian learners are still low on the incapableness of Indonesian learners with problems that require high thought in solving them (Sumaryanta, 2018). Students' thinking ability can be developed through problem solving. In the learning process in class, teachers are required to be able to design learning that is able to train and develop thinking skills and problem solving skills of learners (Waluyo, 2002). With problem solving one will be required to think systematically, critically, logically, as well as have an unyielding attitude to find solutions to the problems faced. Problem solving as an individual skill in analyzing, interpreting, reasoning, predicting, evaluating, and reflecting (Anderson, 2009). Problem solving is an intellectual activity to find solutions to problems involving knowledge and experience (Maimunah, Purwanto, Sa'dijah, & Sisworo, 2016). Problem solving as an ability to use previously known knowledge in new situations to solve problems (Ulya, 2016). By solving the problem, students will try to find the right solution in their own way to solve the problem Facing the development of technology in 21st century learning today, teachers arerequired to have knowledge TPACK (Technological, Pedagogical, Content Knowledge) that is able to integrate technology, pedagogy and content knowledge in learning, especially Inquiry learning. Technological pedagogical content knowledge (TPACK) is one of a new type of knowledge that teachers must learn to be able to integrate technology 157 well in learning (Mishra & Koehler, 2006). TPACK has become a framework or framework that can be used to analyze teacher knowledge related to the integration of technology in learning (Koehler, Mishra, & Cain, 2013). From this understanding, Technological Pedagogical Content Knowledge (TPACK) or knowledge of pedagogical technology and content is the knowledge of the proper use of technology in pedagogics that are appropriate to teach a content properly. TPACK is a teacher's knowledge of when, where, and how to use technology, while guiding students in improving their knowledge and skills in a particular field of study. Inquiry learning provides opportunities for students to be active and involved in the learning process. It deals with how to analyze problems fairly, objectively, critically, openly and comprehensively and positively influence students' scientific attitudes. Inquiry learning is learning that prepares a situation for children to conduct their own experiments. In the broadest sense, if focuses on investigating what is happening, do something, use symbols and look for answers to their own questions, connect one discovery with another discovery, compare what is found alone with what was found by others (Sidharta, 2005). The inquiry begins when students experience confusion about situations or phenomena when planning and carrying out experiments to test their hypotheses. The process involves all scientific activities to obtain information such as hypothesizing, predicting, reading, planning and carrying out experiments and collaborating with other scientists. Learning becomes meaningful to students when they have the opportunity to ask questions, carry out investigations, collect data, make conclusions and discuss. In other words students are directly involved in active learning and higher-order thinking, which in turn will guide and direct them to scientific inquiry-based learning. The more important purpose of inquiry learning is to prepare students to (1) be able to solve problems encountered in daily life by using the scientific concepts they have learned, (2) be able to make the right decisions using scientific concepts, and (3) have a scientific attitude in solving problems encountered so as to enable them to think and act scientifically. Inquiry is a core part of contextual-based learning activities (Trianto, 2012). The steps of inquiry activities are observation, questioning, propose hypothesis, data gathering, conclusion. Inquiry learning stage includes confrontation with problem, data gathering, data experimentation), organizing, formulating and explanation and analysis of the inquiry process (Joyce, 2009). Based on this, a learning model that provides technology that can improve students' problem solving skills is learning with discovery learning model based on TPACK. 2. METHOD The research method used is development research Borg and Gall (2007) which is a systematic process carried out in developing an educational product and refers to the development of learning design

including needs analysis, product design, product development, product implementation and evaluation 2

(Dick W & Carey L, 2001). The research was conducted on 60 students of Madrasah Tsanawiyah Muallimat NW Pancor consisting of 2 classes with 30 students each. Data collection instruments consist of guidelines or validation sheets, practicality questionnaires and study results tests. The validation guidelines compiled consist of 12 questions with measurement indicators including: (a) Aspects of the formulation of learning objectives, (b) Aspects of content, (c) Aspects of language, and (d) Aspects of time. While the product practicality questionnaire consists of 10 questions with indicators including: (a) Aspects of feeling good about the learning component, (b) Aspects of feeling novelty in learning, (c) Aspects of interest in learning. While the test results learn about problem solving skills in the form of essay test with indicator 1) understand the problem; 2) develop a strategy or settlement plan; 3) solve the problem according to the plan that has been made, and 4) re- examine the answer (Winarti, 2017). Product validation is carried out by 3 validators in the field of education, namely 2 experts in learning materials and technology and 1 expert / practitioner implementing learning and conducted trials to obtain valid instruments. The quality of development products in the form of design in this research is based on the criteria of validity, practicality and effectiveness. Instructional design is said to be valid if there is a correlation between the characteristics of the learning model used with each component of the instructional design developed and the product developed in accordance with the established eligibility criteria. Validation instruments used to measure instructional design validity data that have been developed using criteria such as table 1 below. Table 1. Instructional Design Validity Criteria Score Interval Criteria 85 < X Very

Valid 70 < X ≤ 85 Valid 55 < **X ≤ 70 Valid** Enough 40 < X ≤ 55 Less **Valid** 3

X ≤ 40 Invalid Product practicality testing di is basedonthe assessment of educational experts that the product developed can be applied and operational trials in the field. The criteria for practicality of the product developed are determined by criteria such as table 2 below. Table 2. Instructional Design Practicality Criteria Score Interval Criteria 85 < X Very Practical 70 < X ≤ 85 Practical 55 < X ≤ 70 Practical Enough 40 < X ≤ 55 Less Practical X ≤ 40 Impractical Testing the effectiveness of the developed product is carried out by looking at the student's final test scores to measure the student's math problem solving ability. Indicators of product effectiveness are determined by criteria of at least 85% of the number of students given a math problem solving ability score of 75. 3. RESULTS AND DISCUSSION 1. Preliminary Research The preliminary research was conducted by interviewing mathematics teachers to find out the characteristics of learning conducted by teachers at Madrasah Tsanawiyah NW Pancor. The results of observations and interviews show that the learning is still conventional, where the teacher only explains and explains the subject matter, followed by giving examples of questions and then giving exercises of similar questions with the questions that have been explained.. Meanwhile, based on the questionnaire given to students of Madrasah Tsanawiyah NW Pancor showed that (2) Kemampuan problem solving mathematics students are still low, judging from the practice after learning that shows students are only able to solve problems if the problem has the same form as the example given. Based on this, it is necessary to develop an instructional design that involves students actively in learning that can train and develop math problem solving skills. 2. Product Design The product is developed according to the stages of learning activities that refer to the TPACK-based Inquiry learnin model which is how teachers relate pedagogical knowledge that is what teachers know about teaching, namely the application of the Inquiry learning model to what subject matter knowledge the teacher knows about. The learning stages developed include: (1) Problem Orientation, (2) Data Collection through verification, (3) Data collection through experiments, (4) organizing and formulation, (5) Analysis of Inquiry Process. 3. Development and Evaluation 3.1 Product Validity Product Drafts developed are validated by 3 experts, namely learning materials experts, learning technology experts and learning practitioners. Expert validation is done to obtain responses, suggestions, comments and corrections to the initial product for further improvement to improve product quality. Analysis of validation data by experts by referring to the knighthood in table 2. The validation results of the experts showed that overall the products developed belonged to valid categories and it was decided that no revisions were made and presented in the following table 3. Table 3. Validat ion Results of Instructional Design with TPACK Integrated Inquiry Learning Model Validator Validity Level Category Decision Validator I 80 Valid No Revision Validator II 81 Valid No Revision Validator III 83 Valid No Revision 3.2 Product Practicality The practicality of the product developed is based on the assessment score of the practicality questionnaire by the opinion of learning experts using practical criteria as in table 3.

Based on the poll data collected that the products developed in practical categories as shown in table 5 below. Table 4. Results of Assessment of Practicality Instructional Design with TPACK Inquiry Learning Model Validator Category Practicality Category Validator I 83 Practical Validator II 81 Practical Validator III 85 Praktical 3.3 Product Effectiveness The effectiveness of the use of the developed product is seen from the student's final test score to measure the student's math problem solving ability. Tests on students' math problem solving skills were given to students in grades VII B and VII C with a total of 30 students each. Product effectiveness indicators are determined by criteria of at least 85% of the number of students who score 75 math problem solving skills. The results of data analysis of

the results of the math solving ability test can be seen in table 5 below. Table 1

5. Student Problem Solving Ability Test Results Number of student (≥ 75) Percentage Class VII A 30 28 93,33 Class VII D 30 27 90,00 Amount 60 55 91,67

Based on the table above, it can be seen that out of 4

30 students in grade VII A there are 93.33% who get a math problem solving ability score ≥ 75. As for grade VII D, out of 30 students there are 90.0% who get a math problem solving ability score ≥ 75. Similarly, overall out of 60 students there were 91.67% of students who scored math problem solving ability ≥ 75. Thus it can be said that the developed products are effective for use. The development of TPACK integrated instructional design is based on a framework of questions that try to develop and document the teacher's vision of how to teach. The learning process starts from formulating big ideas related to important topics that will be conveyed to students to facilitate understanding based on the experience of the teaching teacher. Based on the idea, teachers generalize it based on the teacher's pedagogy knowledge and the material knowledge that will be taught such as how, why, and what materials will be taught in shaping students learning and teaching teachers. Inquiry learning creates an environment that motivates students to learn by providing opportunities for them to build their own meaning and develop deep understanding, learn student strategies and be able to transfer research skills to other projects and other situations where information is needed. TPACK refers to the ability of teachers to transform the content of the material into a pedagogical form that is very good and adaptive for various abilities and backgrounds of students (Purwaningsih, 2015). Improving students' cognitive learning outcomes with the implementation of TPACK because teachers or researchers are not only required to master the learning materials, but also master pedagogical knowledge. The development of TPACK integrated instructional design using the inquisic learning model has an impact on improving students' math problem solving ability judging by the validity, practicality and effectiveness of the learning design developed that includes valid, paktis and effective categories after field trials have been conducted. 4. CONCLUSIONS The product has been developed based on needs analysis and based on TPACK integrated Inquiry learning model which is how teachers carry out learning with Inquiry learning model with how teachers associate pedagogy knowledge to the knowledge of the subject matter to be taught. The products developed have met the eligibility criteria both in terms of validity, practicality and effectiveness of the product. The product is classified as valid based on the results of 3 validators from learning material experts, learning technology experts and learning practitioners. The products developed are relatively practical based on the assessment score of practicality questionnaires by the opinion of experts using the criteria of practicality set and from the results of the trial I shows students can use well developed products. The product developed is also classified as effective, shown from the percentage of students who got a test score of science literacy ability ≥ 75 of 91.67% of all students totaling 60 students higher than the indicator of effectiveness of the product set at 85%.

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