Development of STEM-Based Learning Devices on Pythagorean Theorem Materials

Yety Maryanata1*, Iskandar Wiryokusumo1, Ibut Priono Leksono1
1PGRI Adi Buana University Surabaya, Surabaya, Indonesia
Email: yety.maryanata@gmail.com

ABSTRACT
This study aimed to develop STEM-based Mathematics learning devices equipped with STEM-based worksheets. Devices developed based on STEM can make it easier for students to follow the learning process of Mathematics subject that are equipped with clear instructions in working on all the materials and assignments that will be accepted by students. From the results of data analysis and testing on 30 students of class VIII at SMP Negeri 1 Torjun, Sampang Regency, it was found that this research resulted that the product developed was feasible to be used in the learning process of Mathematics subject. In detail, this conclusion explains that the design expert test, material expert test, peer test, and trials to respond to the products were carried out by 5 students, and continued in limited group trials and large group trials, the results always showed an increase after a small revision was made which resulted in a total percentage of 85.3% being obtained from all aspects, so that the product developed on STEM-based learning devices can be socialized and disseminated to teachers and students to be used as a basis for product development in Mathematics subject in the material of Pythagorean Theorem in Class VIII SMP Negeri 1 Torjun, Sampang Regency.

INTRODUCTION
Many factors lead to low students’ learning outcomes, including negative student behaviors in learning Mathematics that allow students not to be passionate about learning Mathematics. Learning activities in schools usually only emphasize the transformation of factual information, teachers tend to write down definitions or theorems along with their evidence on the blackboard followed by examples of applying the theorems in solving problems, students taking notes on what the teacher explains and examples of solving written questions. In addition, the teacher writes questions on the blackboard and students are asked to work on it, and the teacher asks students to write down the results of their work on the blackboard. Improvements in Mathematics learning outcomes need to be carried out through improving conditions that support
the increase in the intelligence/ability of students, changes in students' attitudes towards Mathematics and the ability and willingness of teachers to change the educational paradigm. The purpose of learning Mathematics must be well understood by the teacher so that the learning process is in accordance with what is expected. The objectives to be achieved in learning Mathematics are (1) problem solving ability; (2) reasoning ability; (3) communication ability; (4) making connection ability and (5) representation ability.

Global developments bring progress in various fields. Including in the education sector. One that has developed in recent years is an education system based on Science, Technology, Engineering and Mathematics (STEM). The method, which has developed in a number of developed and developing countries in recent years, is a learning model that applies integrative thematic learning because it combines four main areas in education, namely knowledge, technology, Mathematics and engineering. Through the STEM method, the learning process involves seven main skills for 21st century students, namely collaboration, creativity, critical thinking, computerization, cultural understanding and independence in learning and careers. With STEM-based Mathematics learning, it is quite effective in preparing students to face the "Industrial Era 4.0", learning Mathematics has been felt by children to be difficult and boring. To overcome these problems, it is worth trying the STEM learning system which is expected to face the Industrial Era 4.0 can provide fun learning and make children happy, besides that students can also have the ability to communicate, in this case is to communicate Mathematically.

According to Prayitno et al. (2013) Mathematical communication is a way for students to express and interpret Mathematical ideas orally or in writing, either in the form of pictures, tables, diagrams, formulas, or demonstrations. A broader understanding of Mathematical communication is put forward by Romberg and Chair (in Qohar, 2011), namely: connecting real objects, pictures, and diagrams into Mathematical ideas; explain ideas, situations and Mathematical relations orally or in writing with real objects, pictures, graphs and algebra; express everyday events in Mathematical language or symbols; listening, discussing, and writing about Mathematics; reading with understanding a written Mathematical presentation, making conjectures, constructing reasons, formulating definitions and generalizations; explain and make questions about the Mathematics that has been learned.

STEM learning plan is expected to be able to train the students' Mathematical communication. In fact, the stage communicate, often neglected in the classroom. Students who conceptually mastered, but has not been used to communicate what is understood, so that when communicating seems not understand the material presented. Students who do not master the concept, while communicating the understanding and ideas, then the audience will not understand more and it will seem to deviate from the material to be delivered. The observation of SMP Negeri 1 Torjun Sampang students showed that students' difficulties in communicating the results of discussions or ideas. It was characterized when a student was given the opportunity to express his ideas, it took a long time for communication between students in a group as well as between students and other students in the class. Students were shy and did not dare to ask, respond or convey their ideas. One of the reasons because they were not used to it. Moreover, the learning outcomes of the Pythagorean Theorem material were unfavorable.

Communication is an indicator of students' understanding of a teaching material, this is supported by Mumme & Shepherd (in McKenzie, 2001 in Zulva, 2013) who realize that language is a catalyst in student understanding. In addition, communication helps to: (1) improve
understanding, (2) strengthen some of the understandings discussed, (3) strengthen student’s learning, (4) develop a comfortable learning environment, (5) assist teachers to know the students’ thoughts so that they can be used as a guide to determine the direction of teaching. According to Naila Milaturrahmah (2017) by applying STEM-based learning, students are motivated to like Mathematics and can further improve Mathematics learning outcomes.

Learning devices are things that must be prepared by the teacher before implementing learning. In KBBI (2016: 17), the device is a tool or equipment, while learning is a process or way of making people learn. According to Zuhdan, et al (2011: 16) learning devices are tools or equipment to carry out processes that allow educators and students to conduct learning activities. Learning devices become a guide for teachers in carrying out learning both in the classroom, laboratory or outside the classroom. Learning devices are a set of media or facilities used by teachers and students in the learning process in the classroom, a series of learning devices that must be prepared by a teacher in dealing with classroom learning. Learning devices includes syllabus, lesson plan (RPP), students’ book, Students’ Worksheet (LKS) and Assessment of Learning Outcomes.

In developing teaching materials, of course, it is necessary to pay attention to the principles of learning. Hasniayati (2013) explains that several principles that need to be considered in the preparation of teaching materials or learning materials include the principles of relevance, consistency, and adequacy. Program integration of STEM (Science, Technology, Engineering, and Mathematics) learning is a learning program that combines two or more disciplines contained in STEM-Sains, Technology, Engineering, and Math (Laboy-Rush, 2010). Central to the various activities in this program is to involve students in defining and formulating a solution to an authentic problem in the real world. Ritz and Fan (2014) revealed that the application of STEM education has taken place in several countries, and each has various forms in terms of its application. In Indonesia, the integration of STEM as a learning approach has not been very popular. Nevertheless, the concept of integration between the fields of science has begun to emerge and be voiced in our educational curriculum, including in the curriculum of 2013. Although it does not explicitly showed the term STEM, but the concept of "thematic integrative" which appears in the curriculum in 2013 indicates the need for the integration of several disciplines within a learning particular field of study, and this is in line with the concept of STEM integration. The following definitions outlined STEM literacy according to the National Governor's Association Center for Best Practices (Asmuniv, 2015).

STEM literacy can be described as follows: (1) Scientific Literacy: The ability to use scientific knowledge and processes to understand the world and nature and the ability to participate in making decisions to influence it. (2) Technology Literacy: Knowledge of how to use new technologies, understand how new technologies are developed, and have the ability to analyze how new technologies affect individuals, society, nations, and the world. (3) Engineering Literacy: Understanding of how technology can be developed through the engineering/design process using project-based learning themes by integrating several different subjects (interdisciplinary). (4) Mathematical Literacy: A collection of analyzing, reasoning, and communicating ideas effectively and from how to behave, formulate, solve, and interpret solutions to Mathematical problems in applying various different situations.

At the end of every learning program, students will definitely get learning outcomes. According to Dimyati and Mujiono (2009), learning outcomes are student achievements in the form of scores or numbers obtained from tests that have been passed. The learning outcomes obtained are in accordance with the assessment carried out. Process assessment is carried out through daily tests with written test techniques, oral tests and
assignments given during the learning process. The written test can be multiple-choice, True-False, matching, essay, short answer. In the curriculum 2013, core competence describes the competencies that learners should study for a particular school level, class and subject matter. Basic competence is the competencies studied by learners for a particular subject matter in a particular class.

The assessment of knowledge competence by learners is an intellectual potency assessment consisting of knowing, understanding, applying, analyzing, evaluating, and creating. A learner’s knowledge can be assessed through written tests, oral tests, and tasks. The assessment of skill competence is done toward the learners to assess the extent of achievement in the skill dimension. The achievement of core and basic competence covers thinking skills and acting in the abstract and concrete realm. The coverage of skill assessment includes the learners’ skill in thinking and acting of what have studied in the school and other resources. This skill covers: trying, processing, presenting, and reasoning skills. In the concrete realm, this skill covers using, parsing, assembling, modifying, and creating activities. In the abstract realm, this skill covers writing, reading, calculating, drawing (for example, graph and table), analyzing, and composing.

METHODOLOGY

The development of this device referred to the 4-D Model proposed by Thiagarajan, Semmel and Semmel (1974) in (Fajri, K & Taufiqurrahman, 2017). The procedures began by developing the device as the instrument to conduct research. The device developing stage included define, design, develop, and disseminate. However, in this research, the disseminate stage did not do by the researcher. The stage was done until the third Model because this research aimed to develop a STEM-based learning device to be used in the try out school. Thus, the disseminate stage was not done. The diagram of the research method can be illustrated as follow.
The define stage aimed to determine and define the learning requirements by analyzing the learning objectives from the material limitation in which the device was developed. The activities of this stage cover: a) needs analysis, b) students analysis, c) task analysis, d) concepts analysis and e) learning objectives formulation.

In the design stage, the stage aimed to prepare the prototype of the learning devices. It consisted of two steps, namely: a) test organization, b) media selection. Whereas in the development stage, research and development were carried out by adopting the triangulation method (Ike Nurmala Widyastuti, Iskandar Wiryokusumo and Sugito, 2019), which highlights on quantitative method, therefore quantitative method can be used as a facilitator to help the research activities. The facilitator in this research was a material expert, product design validation, fellow, and readability test from the students. This stage aimed to produce a learning device that had been revised based on the feedback from the expert. This stage covered: a) expert validation, b) revision, c) particular lesson plan simulation, d) second revision, and e) limited try out.

The subject of this research was the Mathematics learning device referred to STEM-based learning to improve students’ understanding of Pythagorean Theorem material. It was tried out to 30 students of the VIII grade at SMP Negeri 1 Torjun Sampang Regency. Appropriate
instruments were used to get valid data that matched the objectives of the research. The instruments used to collect data in this research were validation instruments for design experts, material experts and fellows. Meanwhile, for the students' response toward the product developed used questionnaire. For a small group as the initial response before conducting try out was distributed to five students, the limited try out was done to fifteen students, and the group try out was done to 30 students. The data analysis was carried out through descriptive statistics analysis with percentage technique.

RESULT AND DISCUSSION

The instruments made was tested for their validity and reliability. Validity is a way to know the accuracy of a measuring tool (Questionnaire), whether or not it measured what should be measured. If the validity was high, the measuring tool had measured what should be measured in this case is students’ initial knowledge. The result of validity test by using product moment correlation was compared to the r table N=55 with α = 0.05 obtained the value of 0.266. All of the items were valid. The reliability of the instrument showed that the value of reliability coefficient was higher than the r table of 0.6. Therefore, the respondents’ responses were claimed as reliable. In other words, if the same research were conducted at a different time, the respondents would give the same responses, and thus the instrument was reliable.

The result of validation by the design expert was categorized into three aspects: student book, student worksheet, and lesson plan. It was obtained that the student book aspect was valid as the value was 89%, the student worksheet was 88.5%, and the lesson plan was 90%. This indicated that all of the aspects of the product design were proper to be tried out. Overall, the aspect obtained 89.1% valid, which can be concluded that the product developed was proper to be tried out to the limited group.

The result of validation from the material expert was categorized into three aspects: the content, worksheet content, and the learning program plan content. The validity of the content aspect was 89%, the discussion contained in the student worksheet was 91.4%, and the presentation content and accuracy concerning the curriculum presented in the learning process was 83.3%. This indicated that all aspects of the product design were said to be feasible for further testing. Overall aspects obtained a total percentage of 81.9%. It can be concluded that the product developed was feasible to be tested in a limited group.

The result of peer validation was categorized into three aspects: the content aspect, worksheet content, and the learning program plan. The validity of the content aspect was 89%, Students’ work was 82.8%, and presentation content and accuracy concerning the curriculum presented in the learning process was 100%. This indicated that all aspects of the product design were said to be feasible for further testing. Overall aspects obtained a total percentage of 90.6%. It can be concluded that the product developed was feasible to be tested in a limited group.

The result of validation from student responses to find out synchronization between the validation test of a design expert, material expert, and peer was categorized into three aspects of design: book content, presentation content in student worksheet, and attractiveness. The validity of the book content presented was 73%, the content presentation of the student worksheet was 78%, and the attractiveness aspect was 76.6%. This indicated that all aspects of the product design were said to be feasible for further testing. Overall aspects obtained a total percentage of 75.8%. In other words, the product developed was feasible to be tested in a limited group. There were some notes attached to the questionnaire item no. 1, which got a response from five
students as many as 64%, therefore although it did not affect the product design, which as a whole got a percentage of 75.8%, the researchers continued to make minor revision so that the results obtained got a better design. After a slight revision, the limited try out resulted in an increasing percentage of 76%. This indicated that for instrument no. 1, the tryout result increased from 64% to 76%; therefore, the product could be continued to the next tryout in a larger group.

After validating the students' responses from the product tested in small groups covering 5 students (the validation of students' initial responses before being tested). The results of the limited group trial applied to 15 students showed that the data description were categorized into 3 aspects in which digging about the design on the aspect of book content, the aspect of content presentation on the students’ worksheets, and the aspects of attractiveness; as much as 78.8% of the trial result on the aspect of content book was obtained, 79.5% of the level of presentation in the aspect of content presentation on the students’ worksheet was acquired, and 84.6% of the aspect of presentation in the aspect of attractiveness was reached. It showed that all aspects of product design were feasible to the large group trial. The total percentage of overall aspects was 80.6%, so that the product developed was feasible to be tested in large groups.

According to the limited group trial of the product, a large group trial was conducted. The results showed that the data description was classified into 3 aspects in which digging about the design on the aspect of book content, the aspect of content presentation on the students’ worksheets, and the aspects of attractiveness; the aspect of book content in the result of trial test got 85.9%, the aspect of content presentation obtained 86.5%, and the aspect of presentation in the aspect of attractiveness got 83.5%. It claimed that all aspects of the product design were feasible for field trials. The total percentage of overall aspects was 85.3%, it meant that product developed was feasible for field trials. However, due to time constraints, the researcher only got a chance to take it to the trial in large groups. Field trials regarding different schools (small group trials, limited trials and large group trials) from any district, city, or provincial school groups were done by the researcher independently.

Based on the data listed above, it can be seen the Assessment Diagram by Design Experts, Material Experts, Peers and Student Responses in the form of a bar chart as shown below:

Figure 2. The Assessment Diagram of Design Experts, Material Experts, Colleagues and Students’ Responses
The following was the overall percentage of total validation on each trial:

![Graph showing validation percentage on each trial]

**Figure 3. The Validation Percentage of Trial Results on STEM-Based Learning Instruments**

More results coming up in this research revealed that STEM-based Learning Instruments were found to be effective in enhancing the Mathematical understanding on Pythagorean Theorem material for the students of class VIII at SMPN 1 Torjun, Sampang Regency by listing the data acquisition as follows: a) Knowledge Competence in Pretest and Post-test, there was found an increase of students’ mean scores in the learning outcomes which was from 63.1 in the pretest to 88 in the posttest. Meanwhile, according to the calculation of N-GAIN analysis, it was found that the increase in students’ knowledge increased, as the N-gain average was 0.71, it meant that there was an extremely high increase in learning outcomes for main knowledge competencies. b) Competence of social and spiritual attitudes was categorized into “good” as its mode value was 3.00. c) The students’ competency skills got 3.41 of category B+. This results were presented on the following diagram:

![Diagram showing achievement of students' knowledge competency]

**Figure 4. The Diagram of the Students’ Knowledge Competency Achievement**

According to Permendikbud No. 65 of 2013 about the Standards of Primary and Secondary Education, it is stated that the preparation of learning instruments was part of planning the learning. It was designed in syllabus and lesson plans regarding the content
standards. In addition, the learning planning also went hand in hand with the preparation of learning devices and resources, assessment instruments, and learning scenarios. Based on that description, it stated that learning instruments were set of devices or facilities used by teachers and students in the learning process in the classroom, a series of learning instruments must be prepared by a teacher in dealing with classroom learning. Learning instruments covered syllabus, lesson plans (RPP), student books, student worksheets (LKS), and the assessment of learning outcomes.

The STEM (Science, Technology, Engineering, and Mathematics) integration program in learning was a learning program combining two or more fields of knowledge contained in STEM – Science, Technology, Engineering, and Mathematics (Laboy-Rush, 2010). The core to the various activities in this program was to involve students in defining and formulating a solution to an authentic problem in the real world.

Ritz and Fan (2014) revealed that the implementation of STEM education worked in several countries, and each had various forms of its application. In Indonesia itself, the integration of STEM as a learning approach was out of sight. Nevertheless, the concept of integration between scientific fields had begun to blend in the educational curriculum, including in the 2013 curriculum. Even though the term STEM was not explicitly revealed, the concept of "integrative thematics" referring in the 2013 curriculum indicated that integrating various fields of science in a particular field of study was required as in accordance with the concept of STEM integration. The following described the literacy definition of STEM according to the National Governor's Association Center for Best Practices (Asmuniv, 2015).

This research developed learning instruments on Pythagorean material. The learning instruments developed were lesson plans, students’ worksheets, student textbooks, teacher manuals, attitude assessment instruments, knowledge assessment instruments and at communication skills assessment instruments on the Pythagorean Theorem Material in class VIII SMP.

As mentioned above, STEM learning was expected to enhance social interaction in the learning process and improve students’ learning outcomes. Several previous researches successfully obtained the results they had in mind; besides facilitating the learning process for teachers and students, it also improved the students’ learning outcomes.

Regarding the product development planned by the researcher, the validation test was done by the design expert, which was Dr. Drs. Achmad Noor Fatirul, ST., M.Pd. and obtained 89.1%, it had quite significant assessment and feasibility; the suggestion given was to make the font and its size different. It was then revised by the researcher. Moreover, the material expert validation also concluded that the product developed was possible to be applied to the next trial. Concerning the material expert validation done by Abdul Manaf, S.Pd., M.Pd., the obtained percentage was 81.9%. The colleagues, Ulfah, S.Pd., who administered the test obtained 90.6%, it showed that the product developed was feasible to be applied in the next trial. However, the initial validation of students’ responses on the developed product which was carried out to 5 students obtained 64%; it referred to number 1 of the instrument item, although it had no effect on the implementation of the trial in a limited group since the total percentage of assessment was 75.8%, but the researcher still revised all products he developed.

As many as 15 students who were tested the limited trial received the responses with the percentage total of 80.6%, it revealed that the researcher’s revision increased from 75.8% to 80.6%. It also indicated that the product was able to be tested in large groups. In the large group trial, the total percentage obtained was 85.3%. This trial was done in a large class involving 30 students.
Therefore, the conclusion drawn by the researcher showed that the product developed was tested for validity and it was worthy in the learning instruments design of STEM model at schools. So that this product was able to be produced or disseminated, distributed to groups of teachers who taught Mathematics subjects at school environment and outside the school. Although this product was applicable in field trials of junior high school in the other districts and cities, this product was able to be distributed. The researcher kept doing the field trials for other occasions independently, so that the product could be generalized not only to the research area, but also the other schools.

Based on the Permendikbud No. 65 of 2013 concerning the Standards for Primary and Secondary Education, it is stated that the preparation of learning instruments should be done in planning the learning. It was designed as a syllabus and lesson plans referring the content standards. In addition, planning the learning also included the preparation of learning devices and resources, assessment instruments, and learning scenarios. Learning instruments were considered as a set of devices or facilities used by teachers and students during the learning process in the classroom, a series of learning instruments prepared by a teacher in dealing with classroom learning. Learning instruments used were syllabus, lesson plans (RPP), students’ books, student worksheets (LKS), and the assessment of learning outcomes.

The STEM (Science, Technology, Engineering, and Mathematics) integration program in learning was defined as a learning program combining two or more fields of knowledge contained in STEM—Science, Technology, Engineering, and Mathematics—(Laboy-Rush, 2010). The purpose of this program various activities was involving the students to define and formulate a solution to an authentic real-world problem.

Ritz and Fan (2014) revealed that the implementation of STEM education worked out in several countries, and each had various forms of its application. In Indonesia itself, the integration of STEM as a learning approach was under the ground. Nevertheless, the concept of integration between scientific fields had begun to blend in the educational curriculum, including in the 2013 curriculum. Even though the term STEM was not explicitly revealed, the concept of "integrative thematics" referring in the 2013 curriculum indicated that integrating various fields of science in a particular field of study was required as it was in line with STEM integration. The following described the literarcy definition of STEM according to the National Governor's Association Center for Best Practices (Asmuniv, 2015).

A research develops a learning devices on Pythagorean material. Learning devices which are developed included lesson plans, students’ worksheets, students’ textbook, teacher’s handbook, attitude assessment instruments, knowledge assessment instruments and communication skills assessment instruments on Pythagorean Theorem Materials in grade VIII Junior High School.

As mentioned previously, STEM learning is expected to increase social interaction in the learning process which can simultaneously improve students’ learning outcomes. Some previous studies have proven a lot of desired results, in addition to facilitating the learning process for teachers and students, other impacts are also expected to improve students’ learning outcomes.

The improvement in learning outcomes or students’ knowledge competencies through STEM approaches and by the development of STEM-based Learning Devices is in line with the results of research conducted by Ismayani (2016) that the average achievement of students’
creative thinking skills after STEM project-based learning increased compared to the previous one.

Other research conducted by Milaturrahmah (2017) include: 1) teacher prepares media and learning resources, syllabuses and worksheets, as well as practical devices and materials before the learning process takes place, the implementation of learning consists of three stages namely introduction, core, and closing which Mathematics teacher prepares the condition of students psychologically and physically and use STEM approaches in the preliminary stages, then Mathematics teacher does practice at the core stage, involving students in practice, students are actively involved in doing practice in the classroom, guiding students in practicing, utilizing technology (computer, internet), using active learning strategies, communicating actively with students at the time of learning, not using problem solving learning methods, combining STEM in one subject (at least 2 STEM disciplines), students are motivated to like Mathematics, developing teaching materials, teaching according to the area of expertise taken during S1 and there is no gap among learners, then Mathematics teacher along with students do assessment and reflection in the closing stages, and it is found products of projects that have been implemented, then Math teacher gives assessments in the form of description tests at the evaluation stage; 2) factors or constraints experienced by teachers during the practice are students do not understand the worksheet given so that the practice is not completed, the teacher also experiences constraints on the unavailable devices and practical materials, and the completion method of the unfinished work done by teacher is the giving of homework and makes the person in charge in preparing devices and practice materials.

The result of the study reinforced by Brenda R. (2020) propose that there is an emphasis on preparing K-13 students for STEM labor, the initiative aimed at exposing teachers and students to STEM applications is also rising. From some of the results of research and theories submitted by the experts above show that the learning device which is applied to learning implemented with a STEM approach can increase students’ learning activities as well as can improve students' competence both knowledge, Social and Spiritual and Skills.

In this study, the development of the product planned by the researcher, validation tests conducted by the validation of design expert Dr. Drs. Achmad Noor Faturul, ST., M.Pd. get a significant assessment and advisability results of 89.1% and the advice given is to make the shape of the letter and font size differently in the appearance. This revision is made by all the researchers. Furthermore, the validation of material experts also gets the conclusion that the developed product can be applied to the next trial. In the validation of material experts by Abdul Manaf, S.Pd., M.Pd. gets a percentage result of 81.9%. Peer test conducted by Ulfah, S.Pd. is obtained a percentage of 90.6%, this also indicates that the developed product is suitable to be implemented in the next trial. However for initial validation of students’ perception about the product developed by 5 students is found a percentage of 64% on instrument number item 1. This does not affect the implementation of the trial in a limited group because the total percentage in the assessment gets 75.8%, but the researcher still revises all the developed products.

In a limited trial conducted on 15 students who had received students’ perception by a total percentage of 80.6%, this indicates a progress from product revisions carried out by researchers from a percentage of 75.8% to 80.6%. This indicates that the product can be done in trials in large groups. In large group trials, it is obtained a total percentage of 85.3%. This trial is conducted in a large class, namely in a class that is an aggregate of 30 students used as a subject test.
Thus the researcher concluded that the developed product has been tested for validity and can be used in the implementation of the design of STEM model learning devices at school. So that this product can also be produced or disseminated to the group of teachers who teach Math subject in the school environment and outside the school. Although this product should be able to be done in field tests involving other districts and cities within the scope of junior high school, this product can be produced for distribution. For field tests, researchers will continue on other occasions independently, so that the product can be generalized to other schools outside the school environment that is used as a trial.

CONCLUSION
From the results of data analysis and discussion in chapter IV that research produces a developed product that is worthy of use to be applied in the learning process in Mathematics subject. In detail, the conclusion is as follows:

1. The form of STEM-based learning devices to improve the Mathematical understanding of Pythagorean Theorem materials in students of grade VIII SMPN 1 Torjun Sampang Regency is in the form of Student Worksheets (LKS), Student Books and STEM-based Lesson Plan (RPP). The product developed is for Mathematics subject class VIII semester 2 academic year 2020/2021.

2. STEM-based learning devices are suitable to improve the Mathematical understanding of Pythagorean Theorem materials of students of class VIII SMPN 1 Torjun Sampang Regency with the following data result authentications:
   a. Small Group Student Perception Test, the overall aspects is obtained a total percentage of 75.8%, this shows that the developed product is worthy trials in limited groups.
   b. Limited Group Trials, the overall aspects is obtained a total percentage of 80.6%, this shows that the product developed is worth testing in large groups.
   c. Large Group Trials, the overall aspects is obtained a total percentage of 85.3%, this concludes that the products developed are suitable for field trials.

3. STEM-based Learning Devices is effective to improve the Mathematical understanding of Pythagorean Theorem material on students of class VIII SMPN 1 Torjun Sampang Regency with the following authentications of data result:
   a. Knowledge Competence Reviewed from Pretest and Post-test, there is an improvement in the average learning outcome value obtained by students, namely 63.1 in pretest activities to 88 in post-test activities. Meanwhile, from the calculation of N-GAIN analysis is obtained a high improvement of students’ knowledge with marked N-gain average value of 0.71 which means there is a very high improvement for learning outcomes of core knowledge competencies.
   b. Social and Spiritual Attitudes Competence, obtained a good category value by a value mode of 3.00.
   c. Skills Competence, students obtained a grade point average of 3.41 by category B+.

From the description above, it gives a the final conclusion that a developed products about STEM-based learning devices can be socialized and disseminated to teachers and students to be used as a basis for product development in Mathematics subjects in Pythagorean Theorem material in Class VIII State Junior High School 1 Torjun District Sampang.
REFERENCES
Akbar, Sa’dun. 2013. Instrumen Perangkat Pembelajaran. Bandung: Remaja Rosdakarya

Ani Ismayani (2016) Pengaruh Penerapan STEM Projec Basic Learning Terhadap kreativitas Matematis Siswa. Indonesian Digital Journal of Mathematics and Education Volume 3 Nomor 4 Tahun 2016 http://idealmathedu.p4tkmatematika.org ISSN 2407-8530

Anita Hidayati, Rufii dan Yaso Wiyarno. (2020). Pengembangan Buku Ajar IPA Kelas VI Semester I untuk Siswa Sekolah Dasar. Jurnal Gammath. Vol.5 hal. 9-15

Arifin, Zaenal. 2010. Evaluasi Pembelajaran. Bandung: PT Remaja Rosda Karya
Arikunto, Suharsimi. 2010. Dasar-dasar Evaluasi Pendidikan. Jakarta: Bumi Aksara
