

The Use Of Portfolio Assessment To Overcome The Weakness Of Scientific Approach

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Abstract

This classroom action research was aimed to improve mathematics conceptual understanding of X A UPW SMK Negeri 1 Singaraja after applied scientific approach with portfolio assessment. The subject of this research was 35 students from X A UPW SMK Negeri 1 Singaraja in academic year 2016/2017. The results showed that the application of the scientific approach to portfolio assessment improves the mathematics conceptual understanding of X A UPW student of SMK Negeri 1 Singaraja. The mastery learning increase by 22,86% from 37,14% in cycle I to 60% in cycle II and at last increase to 77,14% in cycle III. The students also give a positive response to the implementation of scientific approach with portfolio assessment with an average score 46,4. The increasing of student mathematics conceptual understanding happen because scientific approach gives big chance to the student to explore and guide them finding the concept, and the portfolio assessment facilitates them to know better their ability so that the student can improve their conceptual understanding.

Keywords: *scientific, portfolio, mathematics conceptual understanding*

1. Introduction

The education in Indonesia is divided into several levels, namely primary education, secondary education, and higher education. Secondary education consists of senior secondary education and vocational education. Vocational Secondary Education aims to improve intelligence, knowledge, personality, noble character, and skills to live independently and follow further education in accordance with the vocational. The subjects in vocational high school are divided into three groups, namely normative subjects, adaptive subjects, and productive subjects. One of the adaptive subjects is mathematics.

The important role of mathematics in life can be seen as it is taught from primary level to college level. This is also affirmed in Law No. 20 of 2003 on the National Education System article 37 which states that the mathematics lesson is one of the compulsory subjects for students at elementary and secondary education level. In accordance with one of the objectives of mathematics learning which is to understand the concepts of mathematics, it explains the interconnection between concepts and applies the concept or algorithm in a flexible, accurate, efficient, and appropriate way in solving the problem then understanding the concept needs to be mastered by students (The Regulation of Ministry of Education No. 22, 2006). "Conceptual understanding is one of the mathematical abilities that help students to organize their knowledge" (Laswadi, Kusumah, Darwis, & Afgani, 2016). According to (Kilpatrick, Swafford, & Findell, 2002) "Conceptual understanding refers to an integrated and functional grasp of mathematical ideas".

High expectations toward students' mathematics concept understanding are different from the fact. There are many results of studies, such as PISA and TIMSS, indicating that students' mathematics achievement is low. It surely indicates that the students' mathematics concept understanding is low. The students' low understanding of mathematics concept can be indicated by the students' inability in re-explaining a concept and applying mathematics concept in solving problems in their daily life.

This phenomenon also occurs in class 10 A, tourism business program at Vocational High School 1 Singaraja. It can be indicated by the results of students' final exam, observation, interviews, and implementation of preliminary tests to find out the students' ability in understanding mathematics concepts. Based on the obtained data, it was known that the students' mastery was classically only 45.7% and the average score is 60.25. It indicated that there was a problem occurring in class. The researchers then made

observations and did interviews to find out more problems. Based on the observation and interviews, it obtained some points.

The students could not give reasons toward their answer of the questions given by the teacher. The students' inability to give the right reasons for their problem solving indicated that the students did not have a good understanding of the concept. When students had problems that require the application of concepts, students tended to ask questions first to verify the correctness of the solution. It indicated that the students are hesitant in solving problems because of the lack of understanding. The students also got confused in solving the problems. Based on the description above, the students had problems in understanding the mathematics concepts.

The students' low understanding of the concept is also regarded as the truth by the teachers. Based on the interviews with the teachers, it indicated that the students had difficulty in understanding the material related to previous material or materials that have prerequisites that must be mastered by the students. Most of the students had forgotten the materials they had learned. It made students difficult in understanding the new material they learned. Although the teachers handled it by doing apperception, in fact, the students were still difficult in understanding the concept of new material. It made the learning process took such a long time because the teacher must re-explain the prerequisite material.

Based on the result of the interviews with students, it showed that the students considered "mathematics is difficult". The students said that mathematics has too many formulas which are hard to remember and memorize. The students were difficult to operate large numbers and counted positive and negative integers. The students also had a difficulty recalling the material which they had learned when the material was used to understand the new material.

Based on the result of the interviews and observations it can be concluded that the mathematics concept understanding of the students at class XIA, tourism business program at vocational high school 1 Singaraja needs to be improved. The researcher also gave a preliminary test of mathematical conceptual understanding to reinforce these assumptions as well as to find out how far the students' understanding of mathematics concept is. The test was conducted at class 10 A, tourism business program. It was followed by 35 students. The test consisted of three questions. Based on the preliminary test, it indicates that the average of students' score is 59.5 and the percentage of mastery is 29%. The highest score and the lowest score obtained by the students are 75 and 41.7.

Based on the result of the preliminary test toward mathematics concept understanding, it can be concluded that the students' understanding of the mathematics concepts is still low and needs to be improved. To overcome that problem, it needs to identify the causes of low students' understanding of the mathematics concepts. Based on the result of the problem identification, it indicates that the problem is caused by: (1) the students' tendency to memorize the formulas and materials, (2) the students feel reluctant to ask the teacher when having difficulties, (3) the students forget the concepts they have learned, (4) lack of students' initiative to do exercises independently, (5) the learning process in the classroom is less student-centered.

Understanding how students learn and being able to apply the concept or material in learning is important to create effective learning. According to ?, to study mathematics, it must be gradual, sequential, and based on past learning experiences. According to Hudoyo (2003), Mathematics is a tool for developing ways of thinking. By learning mathematics, students can logically, analytically, systematically, critically, and creatively practice using their minds and have the ability to cooperate in dealing with various problems and able to utilize the information they receive. In NCTM (2000), it is explained that mathematics should be directed to the development of the following abilities: (1) problem solving, (2) reasoning and proof, (3) communication, (4) connections, (5) representations.

Learning using scientific approach is a learning process designed in order to make students actively construct their concepts, principles through observing stages (for identifying or finding problems), formulating problems, proposing or formulating hypotheses, collecting

data with various techniques, analyzing data, drawing conclusion, and communicating the concept (Kemendikbud, 2013).

A scientific approach is an approach to learning activities which prioritizes the students' creativity and invention (Kosasih, 2014). The scientific approach expects students to reason or process information through rational reasoning, obtained information from observations or experiments must be processed to discover the interconnectedness of information with other information, communicate the obtained information with others to build students' knowledge, skills and experiences. If the students are accustomed to learning by observing, questioning, gathering information, reasoning, and communicating, they will learn more actively, and think critically, and the acquired knowledge will be remembered in a long time. The learning process will be more meaningful and will improve the students' learning outcomes.

In this study, the scientific approach is combined with portfolio assessment. Portfolio assessment is expected to maximize the application of the scientific approach. Portfolio assessment is a procedure of gathering information about the students' development and ability by its portfolio, where the information is collected formally using certain criteria, for the purpose of decision-making on students' status (Marhaeni, 2006). According to Dantes (2008) portfolio assessment is a comprehensive assessment approach because (1) it can include both cognitive aspects, affective aspect, and psychomotor aspect, (2) it orients both in learning process and outcomes, (3) it can facilitate students' importance and progress individually.

The students' portfolio provides a comprehensive description of the students' process and achievement in a period of time. The portfolio serves to assess students' progress in a period, to know the effectiveness of learning, to evaluate the educational programs, to help students to self-assess, and to identify the students' weaknesses in the learning process. "Portfolio assessment is an assessment conducted by assessing students' sample set of works in a specific area which is reflective integrative to know the interest, development, achievement, and the students' creativity in a period of time " (Alimuddin, 2014).

The advantages of using a portfolio are: (1) the portfolio provides various ways to assess student learning in a period of time, (2) the portfolio allows teachers to provide more authentic judgments than pencil-and-paper tests, (3) the portfolio lets the students showing their strength and weakness in the learning process, (4) the portfolio gives a chance to students to develop their competencies.

The scientific approach to portfolio assessment is expected to improve students' understanding of the mathematics concept. "Conceptual understanding is the comprehension of mathematics concepts, operations, and relations"(Kilpatrick et al., 2002). According to Bloom (Suherman, 2003), understanding is a level in the cognitive aspects associated with mastery or understanding. According to Gagne (Suherman, 2003) an abstract idea which is possible to classify whether objects and events belong or not to the abstract idea.

The understanding concept becomes fundamental in learning mathematics and improving procedural abilities. "In order to be mathematically proficient, a student must have a conceptual understanding of the topic" (Cummings & Cummings, 2015). The students should have a deep understanding of the mathematics concept and interrelationships to improve their mathematics skills. The students will also be able to represent and communicate their ideas. Learning by understanding is important in order to make students are able to resolve new issues that cannot be avoided in the future.

The students who remember facts and procedures without understanding often do not know when and how to apply what they know. The students who have an understanding of the concept know the origin of the information and how to get it so that they are able to derive the information. According to NCTM (2000), there are three things used to assess the students' understanding on the mathematics concepts, namely: (1) describing concepts by their own way, (2) identifying or giving examples or non-examples of concepts, (3) using concepts correctly in a variety of situations.

Based on the research conducted by Wahyudi (2015) it indicates that the implementation of the portfolio assessment has a positive effect on the learning achievement of fifth-grade students. In addition, the research conducted by Widayani (2016) indicates that

the application of the Scientific Approach to Portfolio Assessment positively affects the Mathematical Communication Ability of senior high school students. The result of this study is used as the basis to make an action, so it is expected that the application of the scientific approach to portfolio assessment can improve the students' understanding of the mathematics concepts.

Based on the explanation above, it needs a solution to overcome the existing problems in order to improve mathematics concept understanding at class 10 A, tourism business at vocational high school 1 Singaraja. Therefore, the teachers are expected to be able to solve the problem. One of the right alternatives that can be conducted to improve students' understanding of the mathematics concepts is applying the scientific approach to portfolio assessment.

The students will discover knowledge by the process of observing, questioning, gathering information, reasoning, and communicating. The scientific approach can be used as a bridge to develop the attitudes, skills, and knowledge of learners. According to Hosnan (Aprianita, 2015), the weakness of the scientific approach is spending much time to implement the stages and not all students are willing to participate actively in the learning process. Sometimes the students only observe what their peers do. It makes the students having no opportunities to apply the concepts obtained during the learning process. The weakness can be overcome by applying a portfolio assessment.

The portfolio assessment is one of the procedures which provides opportunities for a comprehensive assessment of both process and learning outcomes (Dantes, 2008). The portfolio assessment on learning mathematics requires students to be responsible for the tasks given so that the teachers can find out how far is the students' ability in applying concepts and train them to apply the concept of mathematics correctly.

Based on the description above, it is the right action to overcome the problems that occur in class 10 A, tourism business program by applying scientific approach with portfolio assessment. By the stages of scientific approach activities, the students will find the concept of mathematics and are able to remember it in a long time so that the students' conceptual understanding will be better. The application of scientific approach combined with portfolio assessment is expected to strengthen the understanding of students' mathematical concepts especially in applying the concept. Therefore, the researcher is interested to apply scientific approach with portfolio assessment in mathematics learning by conducting a research, namely "The Application of Scientific Approach with Portfolio Assessment to Increase Mathematics Concept Understanding at Class 10 A, Tourism Business program at vocational high school 1 Singaraja."

Based on the background of the problems which have been described, this study aims to describe the improvement of mathematics concepts understanding of class 10 A, tourism business program at vocational high school 1 Singaraja by applying the scientific approach with portfolio assessment and to indicate the response of students at class 10 A, tourism business program at vocational high school 1 Singaraja toward the application scientific approach with portfolio assessment in mathematics learning.

2. Method

This is a classroom action research. The study is conducted in three cycles. Each cycle consists of four stages, namely action plan, action implementation, observation or evaluation, and reflection (Arikunto, 2016). This study is collaborative. The researchers cooperate with mathematics teacher teaching in that class, so it is expected to obtain the optimal result.

The subjects in this study are students of class 10 A, tourism business program vocational high school 1 Singaraja. There are 35 students. The objects of this study are (1) mathematics concept understanding at class X A class 10 A, tourism business program vocational high school 1 Singaraja, (2) students' response to mathematics after applying scientific approach with portfolio assessment.

The instruments in this research are test and questionnaire. The test used to collect data on students' understanding of mathematics concept is an essay. The questionnaire is

used to collect data on students' responses to the application of scientific approach with portfolio assessment.

The collected data then are analyzed descriptively by calculating the comprehension score of students' mathematics concept based on standard-setting cut score of Mathematics and the students' learning completeness in classical and the average score of students' responses. The criteria used in classifying students' mathematics concepts are presented in Table 1.

Table 1. Completeness Criteria for Mathematics Concept Understanding

Mathematics Concept Understanding	Category
$72 \leq \bar{X} \leq 100$	Complete
$0 \leq \bar{X} < 72$	Incomplete

The students' learning completeness (LC) in classical is counted by using the following formula.

$$LC = \frac{N}{n} \times 100\% \tag{1}$$

where LC = learning completeness, N = the number of students who are complete, n = the number of students. Then the data of students' response analyzed descriptively based on the average of the score (\bar{R}), ideal mean (MI), and ideal standard deviation (SDI) is determined by using the following criteria.

Table 2. Criteria for the students' average score

Score Range	Category
$\bar{R} \geq 51$	Very Positive
$42 \leq \bar{R} < 51$	Positive
$33 \leq \bar{R} < 42$	Fair
$24 \leq \bar{R} < 33$	Negative
$\bar{R} < 24$	Very Negative

3. Result and Discussion

Based on the research conducted, the students' learning completeness improvement in classical is on Figure 1

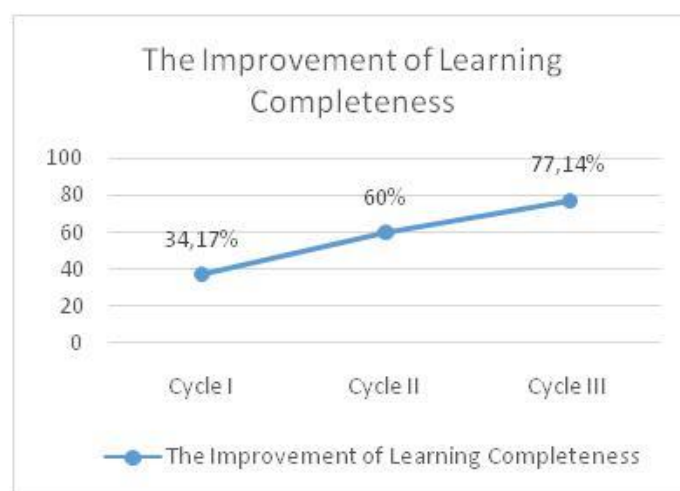


Figure 1. Graph of the Improvement of Students' Learning Completeness in Classical

The students understanding the mathematics concepts have improved. From cycle I to cycle II, the students' learning mastery increase to be 22.86%. It is from 37.14% to 60%. From cycle II to cycle II, students' learning mastery increase to be 17.14%. It is from 60% to 77.14%. In cycle III, the students' learning completeness has achieved the success indicator. It achieves 75%. At the end of the cycle III, the students fill out a questionnaire to find out the response to the application of scientific approach with portfolio assessment which has been implemented. The questionnaire response consists of 15 statements.

Based on the data analysis, it indicates that the average score of students' response is 46.4. It means that the students give a positive response to the application of scientific approach with portfolio assessment. In the first cycle, the score of the students' mathematics concepts test is increasing. The students' learning mastery in the first cycle is 37.14% so it has not required the success indicators. The incompleteness indicator is caused by several obstacles which occur during the implementation of cycle I. The reflection on the implementation of the cycle I am conducted to overcome the obstacles and is as an effort to improve the learning process.

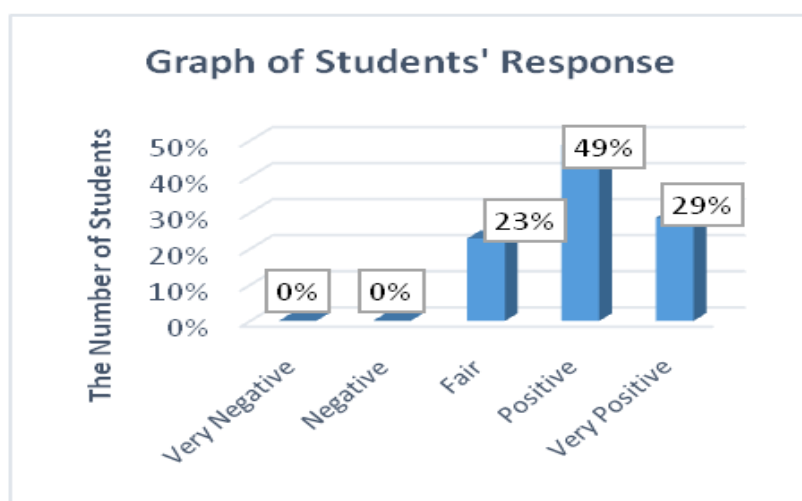


Figure 2. Graph of the Students' Response toward Application of Scientific Approach with Portfolio Assessment

The implementation of action in cycle II is conducted based on the reflection of cycle I. In general, the implementation of action in cycle II is better than cycle I. Based on the advantages that have been explained before, although there are still some obstacles. The result of the conceptual understanding test in cycle II shows good results because the students' learning mastery has increased becomes 22.86%. The reflection of cycle II is implemented to maintain the advantages and overcome the deficiencies that still occur so that cycle III can be well-planned.

The implementation of action in cycle III is implemented based on cycle II reflection. Cycle III is a refinement of action in cycle I and II so that the learning process in cycle III has been done well and conducive. It makes the students' understanding of the mathematics concept increase. This is demonstrated by the results of the comprehension test of students' mathematics concepts. Based on the test, the students' learning completeness is 77.14% so that it has required the success indicators.

During the implementation of the study by applying scientific approach, there are some points found. At the observing activity stage, the students are asked to observe problems related to daily life. Observing activities makes the students knowing the relationship between the observed object and the material being studied. For example, the students observe their friends who move the rope vertically. Based on the observations made by students, the fact obtained is the wave caused by the rope resembles a graph of the sine or cosine functions. The presentation of the problems in everyday life that can be solved with

mathematics leads students to know that mathematics is important to learn. Observing activities increases students' curiosity so that the learning process becomes more meaningful. According to (Narayani, Gading, & Suartama, 2015) and Widayani (2016), the observing stage prioritizes the meaningfulness of the learning process.

At the stage of the questioning activity, the students develop several questions related to the material being studied. This question can be related to information that is not understood or to obtain additional information. Obstacles experienced in the first cycle are the students difficult to compile questions. In overcoming these obstacles, the teacher provides comments, examples, and explains how to construct questions. In this way, the students can begin to compose their own questions. The things which need to be considered in the preparation of this question are the quality of the questions compiled by the students and the suitability of the questions with the learning materials. The quality questions show the students' cognitive and curiosity. In this study, the students' questions have a good enough quality, although sometimes the relevance of questions with observations still needs to be improved. By the questioning activities, the students have learned to develop themselves and improve their skills in asking questions logically, systematically, and using the good and correct language.

In collecting information activities, the students collect information about the material that has been learned or material related to the material being studied. At the beginning of the study, the students do not carry out this activity. After they are confirmed, they do not know what information they should collect so their students' workbook is emptied by them. The teacher is thereupon providing matching questions. This action is taken in addition to addressing the above issues, as well as to prevent the inaccuracy and non-conformity of information that students gather with the material being studied. Thus, the students learn more effectively and do not spend much time. By information-gathering activities, the students apply and practice to gather information.

The next stage is the reasoning. In this stage, the students use the information collected. Then the process and link the information to find the concept of the material being studied. The students practice thinking logically, systematically and improve reasoning power. The students' competencies achieved are the ability to apply procedures, the ability to think logically and systematically. In this stage, the teachers have an important role in helping students reasoning or to link the information they get. This stage will be quite difficult to implement when the students do not collect information and understand the prerequisite material well. The students' activity in this stage is not much different from the demand of the curriculum of 2013 which states that the activities of reasoning involve processing information that has been collected students (Rochintaniawati, 2014).

The last stage of the scientific approach is communicating. In this stage, the students communicate the results of their discussion. In this activity, the students are often not confident and difficult in communicating the results of the discussion. This is handled by providing assistance and directing students to communicate logically and effectively. The help provided by the teacher is able to encourage students' interest. In this study, it indicates that communicating activities have several benefits that increase students' confidence, improve students' ability to speak, and express opinions clearly.

Based on the points above, it indicates that the scientific approach has slowly changed the students' learning habits better in the learning process. According to Narayani (2015) the students' group who are taught by applying the scientific approach systematically leads the students to be active in the learning process. Thus, the application of the scientific approach is well proportional to the learning outcomes obtained by students' group who are taught by using a scientific approach. According to Marjan (Narayani, 2014) learning with a scientific approach is better than a direct learning approach to improving learning outcomes and science process skills.

During the implementation of this study, the weakness of the scientific approach is found, namely, the implementation of the stage of scientific approach takes a longer time. According to Hosnan (Aprianita, 2015), scientific approach takes a longer time to be applied. It creates teachers' limitations in knowing the development of students' capabilities. Based on

this weakness, the researcher applies portfolio assessments. The portfolio assessment provides an opportunity for teachers to conduct a comprehensive assessment. The portfolio is expected to allow students to fully express their abilities.

During this study, there are several things found. They are related to the application of portfolio assessment. At the first meeting of the implementation of research, the teachers, researchers, and students make an agreement on the portfolio that will be made students. The agreement includes portfolio components, students' portfolio arrangement, portfolio collection, portfolio assessment and portfolio assessment components. This agreement is made to explain and facilitate the students in arranging the portfolio. Then, the learning process is directed at providing tasks in accordance with the required portfolio components.

By the portfolio assessment, the students become more responsible and disciplined about the tasks assigned. This is observed by the students' punctuality in collecting the tasks. The students' punctuality affects the scores obtained in the portfolio assessment. In addition, portfolio assessment also requires students to properly archive their tasks. The more complete the student portfolio component, the better it gets. Surely this greatly affects the students' responsibility and discipline. According (Dewi, 2013), the portfolio assessments train the student to be disciplined.

During the application of portfolio assessment, the researchers note some of the difficulties faced in using students' portfolio. In the cycle I, the researcher finds the responsibility and discipline of students in doing the tasks which have not run effectively. This is observed from the completeness, remedial efforts, and punctuality of some students still in the fair category. The researcher indicates that the students have a difficulty in writing well-received information. In addition, the researchers also indicate that some students feel difficult to write the information they obtain. This can be observed from the writing style and location of errors made. Then the researcher uses the portfolio assessment sheets given to each student to provide feedback on each student-made portfolio. In this portfolio assessment sheets provide feedback in the form of value and advice in accordance with the advantages and disadvantages of students' portfolio. By this assessment sheet, the students can do self-evaluation to improve their ability.

Providing feedback makes students knowing their weaknesses and advantages, in which part of their abilities should be improved. This helps students understand and apply the concept better. In the assessment of the next cycle portfolio, the students have shown a better change. The researcher can see the differences in the portfolio assessment results obtained between students who are serious in working on portfolios with students who are not serious. This can be observed from the fulfillment of the four indicators of portfolio assessment, namely completeness, quality, improvement efforts, and punctuality of portfolio collection. The students who work on the portfolio seriously have a better understanding of the concept which is reflected by the results of concept comprehension tests. According to Widayani (2016) conducting a learning process with portfolio, assessment has a positive impact on students' mathematical communication skills.

In this study, there are advantages of portfolio assessment found, namely correcting students' mistakes in the learning process, improving the responsibility and discipline of students, doing self-evaluation to know the advantages and disadvantages, allowing teachers to identify specific concepts that become students' weaknesses and become materials reflection of the learning process for the teachers. The portfolio assessment has a positive impact on students' understanding of the mathematical concept, but it does not mean that portfolio valuations replace existing conventional assessments. According to (Birgin & Baki, 2007) "It is not completely true to leave the traditional assessment methods aside and accepts the new assessment ones. Besides using portfolio assessment method, using the other assessment methods will enable more reliable information about students ". One of the weaknesses in portfolio assessment is its reliability so that the teachers still apply conventional assessment although applying portfolio assessment to obtain more reliable information. In addition, the main problem of students' portfolio assessment is spending much time. Besides assessing, the teachers also provide feedback in accordance with the students' portfolio. The teachers must consider the collection time of the portfolio with

available time for the assessment. According to Widayani, (2016) the main problem in her study is spending much time. According to Birgin & Baki (2007), another disadvantage of using portfolio is very time to consume for teachers to score student's works and to assess student's performance over time in the crowded classroom. Birgin & Baki (2007) also says, "Therefore, it is suggested to use checklist, rubrics, and digital portfolio form to reduce the time for the assessment of it". Although the researcher and teacher have overcome this weakness by using assessment and checklist rubrics it still spends much time.

Based on the result obtained, this study has been able to answer the problem formulation and solve the problem of the mathematics concept understanding experienced by the students. The application of the scientific approach to portfolio assessment can improve the mathematics concept understanding at class 10 A, tourism business program at vocational high school 1 Singaraja. In addition, the students also give positive responses to applied learning.

4. Conclusions

Based on the result of research and discussion there are several things can be concluded. The application of the scientific approach to portfolio assessment can increase mathematics concepts understanding of students in class 10 A which major is tourism business at vocational high school 1 Singaraja in academic year 2016/2017. It can be indicated by the students' learning mastery which has increased each cycle and reached the indicator of success set up. The response of students in the class 10 A which major is tourism at vocational high school 1 Singaraja toward the application of scientific approach with portfolio assessment is in a positive category. The average score of the students' response is 46,4.

The teachers who have problems with students' mathematics concept understanding are suggested to apply a scientific approach with portfolio assessment as an alternative to solve the problem. It should be noted that the obstacles in applying a scientific approach are the students not conducting questioning and gathering information stage. Thus, the teacher should guide the students well in order to be able to conduct the stage. There is a difficulty in applying the portfolio assessment. It more time allocation to check and provide feedback on the portfolio which the students collect.

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