Mathematics authentic assessment on statistics learning: the case for student mini projects

D Fauziah1*, Mardiyana1 and D R S Saputro1

1 Department of Magister Mathematics Education, Faculty of Teacher Training and Education Sebelas Maret University

*Corresponding author: fauziahdesrina@gmail.com

Abstract. Mathematics authentic assessment is a form of meaningful measurement of student learning outcomes for the sphere of attitude, skill and knowledge in mathematics. The construction of attitude, skill and knowledge achieved through the completion of tasks which involve active and creative role of the students. One type of authentic assessment is student mini projects, started from planning, data collecting, organizing, processing, analysing and presenting the data. The purpose of this research is to learn the process of using authentic assessments on statistics learning which is conducted by teachers and to discuss specifically the use of mini projects to improving students’ learning in the school of Surakarta. This research is an action research, where the data collected through the results of the assessments rubric of student mini projects. The result of data analysis shows that the average score of rubric of student mini projects result is 82 with 96% classical completeness. This study shows that the application of authentic assessment can improve students' mathematics learning outcomes. Findings showed that teachers and students participate actively during teaching and learning process, both inside and outside of the school. Student mini projects also provide opportunities to interact with other people in the real context while collecting information and giving presentation to the community. Additionally, students are able to exceed more on the process of statistics learning using authentic assessment.

1. Introduction

Authentic assessment is a new idea that provides as alternative idea in the practice of traditional assessment. This assessment is not only used to evaluate the teaching and learning process, but also more than that. It is done as a process to facilitate student learning. Assessment assumed as authentic when we directly examine the student's performance on a righteous intellectual task.

Mathematics is the basic science in the development of science and technology that is inseparable from human life. Authentic assessment can provide an opportunity for students to gain real and meaningful experiences for themselves, as well as demonstrating high-level thinking skills. Mathematics authentic assessment is a form of meaningful measurement of student learning outcomes for the sphere of attitude, skill and knowledge in mathematics. The construction of attitude, skill and knowledge achieved through the completion of tasks which involve active and creative role of the students. Student involvement in performing the task is meaningful for their personal development. In authentic learning, students asked to collect information, understand the various phenomena and their relationships with each other, and linked what learnt in school with the real world outside the school.

Statistics Learning is one of the parts in mathematics school that precise to use authentic assessment. There are several types of authentic assessment, i.e. performance assessment, project assessment, portfolio assessment, and written assessment. In this study, authors interested to explore more deep about project assessment in statistics learning. The project assessment is mini project started from planning, data collecting, organizing, processing, analyzing and presenting the data. This
study will describe the process of using authentic assessments on statistics learning by the teachers and will discuss specifically the use of mini projects to improve student learning in a school of Surakarta.

Some researchers have conducted research on authentic assessment instruments one of them Sher Azim and Mohammad Khan entitled Authentic Assessment: An Instructional tool to Enhance Students Learning. The study concludes that the implementation of the authentic assessment with eight targeted classes of community-based schools in Pakistan is strongly appreciated by students. Authentic assessment strongly emphasizes the meta-cognition and processing of information which is the key to learning. The use of authentic assessment methods may become more widespread if accepted and adopted at the national level.

Based on Permendiknas No. 20 [1] on Standards of Assessment, the assessment system becomes one of the fundamental development components in Curriculum in Indonesia (Curriculum 2013) and authentic assessment is referred to as a form of assessment that measures the competence of attitudes, knowledge, and skills in a balanced way. However, the facts are based on the results of the authors' research on authentic assessment analysis shows that planning and implementation of authentic assessment in the bad category [2]. Teachers have engaged the authentic assessment is difficult in the selection of assessment techniques and the preparation of the instruments in some of the material in mathematics learning. Based on these research results, need to develop authentic assessment instrument that can help teachers and students in achieving learning objectives.

Mini project is one result of the development of project assessment that is expected to help students and teachers in the learning process. Mini project started from planning, data collecting, organizing, processing, analyzing and presenting the data. This type of research is action research. The purpose of the research was to study the process of using authentic assessments on statistical learning by teachers and specifically discusses the use of mini projects to improve student learning in a school of Surakarta.

2. Methods

2.1. Mathematics Authentic Assessment on Statistics Learning

According Wibowo and Wutsqa [3], learning in schools is an application of curriculum implementation in achieving educational goals, so that the goal is achieved or not, an assessment is required. Assessment is a process for collecting information about the quality of a change in student, group, teacher or administrator. In line with that, Johnson & Johnson views the assessment as an attempt to gather information about the quantity or quality of a change occurring to learners, groups, educators or educational implementers [4]. Correspondingly, Kunandar [5] defines evaluation or assessment as an action or a process to determine the value of student success after experiencing a learning process during a certain period. According to Nitko & Brookhart [6] assessment is a term that is defined as a process for obtaining information used to make decisions on students, curriculum, programs and schools, and education policy. Thus the results of the assessment can be evidence as supporting the achievement of students from time to time.

Frey and Schmitt [7] states that authentic judgments are used to measure abilities in tasks that represent real-world problems. Authentic is often used as a task of reflection of the fact knowledge’s student [8]. In line with that opinion Nitko and Brookhart [9] that the authentic word meaning in authentic judgment is to present tasks directly to students who are meaningful to their education.

Authentic assessment according to McMillan [10], “… involves the direct examination of a student’s ability to use knowledge to perform a task that is like what is encountered in real life or in the real world”. Authenticity is judged in terms of the nature of the task completed as well as the context of the task. Like any performance assessment, the students “plan, construct, and deliver an original response, and explain or justify their answers”.

Furthermore Kunandar [5] reveals the purpose of authentic assessment that is: track the progress of students, check the achievement of student competence and detect competencies that have not mastered by students, a feedback for improvement for students. Assessment will be authentic if it meets the criteria, i.e. (1) Context which means the interconnection and transfer of learning from class to real world outside of class. Requires pure recording of tasks performed in ordinary conditions in everyday life; (2) Student factors that include problem-solving skills and high-level thinking. Requires
effective students using the knowledge gained to shape performance or product performance, as well as increase the depth of knowledge.

Similarly, Mueller [11] explains that authentic assessment is a form of judgment that requires students to perform real-world tasks that are capable of demonstrating meaningful applications in both knowledge and skills. Authentic assessment provides students with opportunities to link their learning and apply essential knowledge and skills to real-world tasks and problems. Authenticity is the element of every successful assessment that resembles a real-world skill or activity and aligns itself with a learning outcome.

Based on several definitions of authentic assessment, it can be concluded that authentic assessment is the process of collecting information by educators who intact about the development and achievement of competence which includes the range of attitudes, knowledge, and skills undertaken by learners through various assessment techniques that are able to reveal, prove or demonstrate. It is appropriate that meaningful learning at the same learning objectives has been achieved.

Mathematics authentic assessment is the use of authentic assessment on learning mathematics, especially on secondary school statistics materials. Statistics is one of the most important branches in mathematics. The purpose of teaching this material is to develop students’ mathematical communication level in explaining condition or problem in real life. Statistics Learning is one of the branches in mathematics that precise to use authentic assessment. Mathematics authentic assessment on statistics learning referred to in this research devoted to the use of project assessment.

2.2. Mini Projects
There are several types of authentic assessment, i.e. performance assessment, project assessment, portfolio assessment and written assessment. The type of assessment used in this study is project assessment. Hamzah [12] states that project assessment is an absolute assessment to students within a certain time. Project assessment is used to determine understanding, ability to apply, investigation, and ability to inform thing clearly. The project assessment is an in-depth investigation of real topics, where students have the opportunity to apply their skills.

Based on some opinions, it can be concluded that the assessment of the project is an assessment of the tasks that must be completed by students within a certain time. The completion of the task is as investigation by students, starting from planning, data collecting, organizing, processing, analyzing and presenting the data.

Mini project in this study is a simple project assignment given to junior high school students’ class VIII SMP statistics material. This mini project is aimed at students as a form of assessment that is able to measure their statistics ability.

2.3. Model of Action Research
Model of this action research is a modified version of Lewin’s model. This model consists of 4 steps in a cycle, i.e.: develop a plan, act to implement it, observe the action in the setting and reflect on the effects in order to re-plan.

2.4. Developing Plan
The action research plan conducted through the following steps. In the first step implementation of authentic assessment in a mathematics classroom. The second step, the reconnaissance, during this step the school visited for several times. In these visit meetings held principal, interview with mathematics teachers and analysis of assessment documents used by teachers. In the third step a general plan developed for implementation of authentic assessment. The plan consists of the following step:
  a. Looking for data that can be obtained from the home or school environment
  b. Students’ planning to collect data
  c. Presenting data as line, circle and trunk diagrams
  d. Data processing by determining the mean, median and mode values of the data
  e. Creating a report on the results of the activity
  f. Presenting the report in front of the class
  g. Summing up activities together
2.5. Implementation and Observation Steps
In this step, the plan implemented. Authentic tasks given to students to improve student learning, as well as to assess student learning through authentic assessment. During this step, observation of the implementation process also remained continuous to get necessary information on students’ learning in order to provide feedback on the teaching and learning process. Data collected during teaching in the classroom to understand the process of applying authentic assessment.

2.6. The Reflection Steps
While reflecting, the focus was on questions such as:
   a. Did I do what I planned to do?
   b. What changes need to be made in my plan to implement in future?
   c. What was my role during the implementation?
   d. What was the role if students?
   e. What supported or hindered in implementation?
   f. What students’ learning was I assessing?
   g. How did my implementation enhance students’ learning?
   h. What strategies were used to enhance students’ learning?

This research is an action research. According to Fueyo & Koorland in Mills [9], there are two reasons to used action research; first to get in depth understanding of the particular phenomenon which the study aimed to explore. Second, action research provides an opportunity to the teachers to understand their own and learners’ behavior which empowers them to make informed decisions, link prior knowledge to new, learn from mistakes, and ask questions and find the answers systematically.

Model of this action research is a modified version of Lewin’s model. This model consists of 4 steps in a cycle. The four steps consist of: to develop a plan, act to implement it, observe the action in the setting and then to reflect on the effects in order to re-plan. The study was conducted in SMP Negeri 12 Surakarta with the subject of the study of VIII students with a total of 28 students, consisting of 12 male students and 16 female students. While the object of research is the result of mathematics learning. Data was collected through the results of the assessments rubric of student mini projects. The data were analyzed using descriptive statistics analysis method.

3. Result and Discussion
The analysis of the data indicates that participation of students in authentic assessment task developed their understanding of the Statistics Learning “Presentation and Processing of Data”. In the learning process students consisting of 28 students are divided into seven groups at random. Each group has a chairperson who coordinates their activities in completing the mini project and completes all activities in the mini project together. Some activities done by students in accordance with the developing plan i.e., (1) Looking for data that can be obtained from home and school environment; (2) Students’ planning to collect data; (3) Presenting data as line, circle and trunk diagrams; (4) Data processing by determining the mean, median and mode values of the data; (5) Creating a report on the results of the activity (6) Presenting the report in front of the class; and (7) Summing up activities together.

There are seven reports with different themes from their activities, shown in the following Table 1.

| No | Group Name       | Theme Report                  | Group Scores |
|----|------------------|-------------------------------|--------------|
| 1  | Al Khawarizmi    | Favourite Food and Drinks     | 89           |
| 2  | Ibnu Sina        | Number of Siblings            | 78           |
| 3  | Galileo          | Book Collection               | 82           |
| 4  | Einsten          | Types of Vegetables           | 86           |
| 5  | Newton           | The Price of Food in The Cafeteria | 79    |
| 6  | Thomas A Edison  | Age of Family Members         | 82           |
| 7  | Habibie          | All of Our Dreams             | 75           |

Average: 82
Based on Table 1 it is seen that each group gets a good score with an average of 82. The plan implemented and each group is very enthusiastic in completing the mini project given. Group 1 looked for data on 5 foods and 5 drinks most favored by family members from each group member. Group 2 looks for data on the number of siblings of each group member. Groups 3, 4, and 5 collect data by registering the data sought. Groups 6 and 7 collect data by interviewing the age data of family members and dream data from classmates.

The result of data analysis shows that the average score of rubric of student mini projects result is 82 with 96% classical completeness. Findings showed that teachers and students participate actively during the teaching and learning process, both at school and outside school. Student mini projects also provide opportunities to interact with other people in the real context while collecting information and giving presentation to the community. Additionally, more students are able to excel on the process of statistics learning using authentic assessment.

The last step is reflection. Almost all the activities planned by the teachers are done well. Before the implementation step, students and teachers agreed with their respective roles. Students must cooperate with their peers to do their mini-projects that given by teacher. If there is something that is not understood, students can ask the teacher or their friend. However, teachers are still difficult to be able to assess all student activities when the data collection process outside the classroom. The next mini project needs to have a self-assessment sheet and peer assessment sheet so that teacher can be helped in the assessment process outside the classroom. Overall implementation of this mini project has been able to enhance students' learning.

4. Conclusion
This study shows that the application of authentic assessment can improve students' mathematics learning outcomes. Based on the results of the research described, there are suggestions as follows: 1) The application of authentic assessment is expected student learning outcomes can be improved optimally, especially on the subjects of mathematics. 2) Implementation of authentic assessment is expected to improve the professionalism of teachers. 3) In order for other researchers interested in doing more in-depth research on authentic assessment.

References
[1] Nitko A J and Brookhart S M 2011 Educational Assessment of Students (Upper Saddle River, NJ: Pearson Education, Inc)
[2] OECD 2014 PISA 2012 Result: What Students Know and Can Do Student Performance in Mathematics, Reading, and Science vol 1 (Paris: OECD Publishing)
[3] Fauziah D, Mardiyyana and Sari D R 2017 ICRIEMS Proceeding (The Faculty of Mathematics and Natural Sciences: Yogyakarta State University)
[4] McMillan J H 2004 Classroom Assessment: Principles and Practice for Effective Instruction (3rd Edition) (Boston: Pearson Education)
[5] Depdiknas 2007 Peraturan Menteri Pendidikan Nasional No 20 Tahun 2007 tentang Standar Penilaian (Jakarta: Depdiknas)
[6] Johnson D W and Johnson R T 2002 Meaningful Assessment Boston (MA: Allyn & Bacon)
[7] Kemmis S and Mc Taggart R 2004 The Action Research Planner (Victoria: Deakin University Press)
[8] Wibowo R and Wutsqa D U 2014 Jurnal Riset Pendidikan Matematika 1 158
[9] Uno Hamzah B and Koni 2012 Assessment Pembelajaran (Jakarta: Bumi Aksara)
[10] Mill G E 2003 Action Research: A Guide for The Teachers Researcher (New Jersy: Prentice Hall) p 10
[11] Kunandar 2009 Guru Profesional, Implementasi Kurikulum Tingkat Satuan Pendidikan (KTSP) dan Sukses dalam Sertifikasi Guru (Jakarta: Rajawali Pers)
[12] Mueller J 2005 Journal of Online Learning and Teaching 1 1