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The Model of Mathematics E-Portfolio Assessment for Senior High School

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ABSTRACT

The purpose of this study is to develop a digital model of mathematics portfolio assessment (e-portfolio) for high school. This research is a development research which consists of the following stages: a preliminary study, designing and developing model (product) and testing the model (product). The result of preliminary study is the identification of teachers' and students' needs showing that: high school teachers generally do not use mathematics portfolio assessment digitally yet (still conventional), but the majority of teachers agreed/ were happy if the model of mathematics portfolio assessment is developed in digital format (electronic) to ease the assessment implementation, and most of the students also agreed/were happy if the portfolio assessment is in digital format. The product of this research is an electronic portfolio assessment for high school mathematics subject, completed with the teachers' and students' guide. The stage of testing the product/model was done through product tryout. The results showed that the quality of the product is excellent that meets the criteria of a valid, practical and effective.

Keywords: *Development, Digital Model, Mathematics Portfolio Assessment*

1. INTRODUCTION

Mathematics portfolio is a collection of students' work that demonstrates effort, progress, and their proficiency in mathematics subject. Portfolio is suitable to know the development of students' work, by assessing a collection of tasks done by students. These tasks are selected and assessed, in order to see the development of students' abilities. Therefore, the portfolio is useful for both teachers and students in the assessment of process and results.

Portfolio is a part of authentic assessment in contextual learning. Authentic assessment is an assessment that involves students in authentic tasks that are useful, important, and meaningful [6].

According to Collins [2] and Glencoe [5], portfolio is a collection of evidence collected for a specific purpose within a specific time.

Crowley [3] stated that mathematics portfolio is a collection of students' work that has been selected. Portfolios can pay attention to the efforts of the best students or more significantly to the mathematical activities of students. Portfolios can show some students' previous and current works to illustrate their progress in mathematics.

The evidence that is saved in portfolio is in the form of documents that can be used personally or in a group as an alternative assessment to make a conclusion about students' knowledge, skills, and/ or attitudes.

The development of technology has enabled anyone to apply it in all areas including in education. The use of technology in the field of education will be needed not only for effective and meaningful education but also for the preparation of digital mathematics portfolio assessment. This portfolio assessment is very possible as it will be much cheaper, compared to the other forms of investments (physical/non-digital portfolio assessment) and their maintenance aspects.

For efficiency, safety, neatness, and attractiveness, the portfolio is usually packed as neat as possible. This is important because the packaging shows a portfolio of a child's developmental level and abilities. If the past, it was usually a file folder portfolio, bundled in the form of a book or a special bag with a bag plastic, which is a place to store the recording sheet of work, then at the present time the portfolio will be more attractive if packaged digitally, for example in computer disk, CD-ROM, flash drive, or it could be published via intranet or internet (website).

Digital mathematics portfolio assessment is an assessment form of learning which is highly effective and efficient in these days. It is partly because the price of paper and other physical objects are very expensive and they broke easily. Through digital mathematics portfolio assessment, teachers do not need to carry physical files with difficulty because the electronic media is in digital format so that it can be stored in the data storage (flash, hard drive, CD-ROM, DVD, etc.) so it does not take a lot of places (large room). In addition, the electronic media is not easy to be weathered like a book or plain paper. The digital electronic media can survive longer with a quality that does not change.

The alternative of developing digital model of portfolio assessment (e-portfolio) for high school is needed as now is in the era of digital (electronic) in which everything can be stored in a practical and in a safe way. In addition, the presence of electronic portfolios can help teachers to finish their work easily because the questions are already available and the scoring process is done

digitally (automatically). As a result, it will increase teachers' work efficiency.

In curriculum 2006 and 2013 in Indonesia, high schools use classroom-based assessment, which uses a variety of assessment tools that are not only test but also non-test including mathematics portfolio assessment [4]. However, it has been dominated by a written test and the implementation of non-digital portfolio assessment. They do not just need a clear concept but also requires a concrete and easy application in doing the assessment. Through this study, it is expected that teachers will be easier, effective and efficient in applying digital mathematics portfolio assessment tool. It is also expected that the product of this study can assess the skills of high school students in learning mathematics correctly, easily, and quickly.

The purpose of this research is to produce a digital model of high school mathematics portfolio assessment (e-portfolio) so that it can ease the assessment process of students' experience in learning mathematics in high school. Specifically, this study aims to 1) Identify the initial conditions (preliminary study), 2) Design and develop mathematics e-portfolio, completed with the teachers' and students' guide, and 3) Test the products that have been produced to assess the validity (content assessment by experts in mathematics and mathematics learning experts), practicality (by practitioners, and media and instructional design experts) and the effectiveness of the product (by groups of students).

2. METHOD

This study used Research and Development (R & D) method. It is a kind of research that is followed up by the development and dissemination of a product [1]. The reason of using this method are (1) the results of educational research generally have not been packaged, ready to be used, so that it cannot be directly applied in the teaching and learning process, it needs to be facilated by developing a product that can be used effectively, (2) R & D aims to develop the use of the product through validation phases of the process, so that it can be applied effectively in school.

The model of the development consist of 1) analyzing the products that will be developed (preliminary study), 2) designing and developing the initial product, and 3) testing the product (model) and revising the product, and 4) disseminating and implementing the product [10, 11].

The steps in developing the digital model of mathematics portfolio assessment for high school are done as follows: 1) Preliminary study which includes: (a) identifying the needs and character of students, (b) identifying the needs of high school teachers, (c) identifying the applicable curriculum; 2) Designing and developing which include: (a) the selection of media and formats, (b) goal setting, (c) the selection of the portfolio, (d) the selection of portfolio tasks, (e) the preparation of the draft (product development) in the form of e-portfolio, which includes the teachers' and students' guide; 3) Conducting product tryout and product revisions.

Product tryout is conducted to assess the product so that it fulfills the criteria of validity, practicality and affectivity [7]. To obtain a valid product, it needs validation testing performed by the content and learning experts of mathematics, and then it should be revised in accordance with the input from the experts. To fulfill the criteria of practicality, the product was tested by practitioners (teachers) and media experts, and then it was revised in accordance with feedback from practitioners and the media experts. To get an effective product, the product was tried out to groups of high school students, and it was revised in accordance with the input and response of the students as users.

This study used three data collection techniques. They were (1) documentation, (2) questionnaires, and (3) observation. Documentation technique was used to collect data in the form of curriculum used by teachers and high school students, and to collect other information for the purpose of identifying the needs of students and high school teachers. Questionnaire was used to identify the needs of high school students, teachers (in preparing the e-portfolios), validating the instrument, judging the products by subjects (experts, practitioners, and users). Observation technique was used to see the use of high school mathematics portfolio assessment and its implementation in the classroom.

The data in this study were analyzed by two kinds of techniques. First, the data were analyzed qualitatively, which was analyzing the information obtained from the questionnaire; the identification of curriculum and students' and teachers' needs; and suggestions and feedback from the experts, practitioners, and student responses. Second, the data were quantitatively analyzed using descriptive statistics to see the percentage of answers from the questionnaires that were filled out by the experts, practitioners, and students.

3. RESULTS AND DISCUSSION

Preliminary study was conducted to collect the data analysis about the students' and teachers' needs. Necessity is the gap between what is expected and the actual conditions [9]. Needs analysis is used as a tool to identify the problem in order to determine the appropriate action. In this study, a need analysis was conducted to obtain information from teachers and students about the implementation of high school mathematics assessment, especially mathematics portfolio assessment. If there is a problem, then, it is important to know about the causes of it, whether the teachers' assessment process is adequate, and whether mathematics e-portfolio is something they need or they want, and so on. Thus, needs analysis is conducted to identify the needs of teachers and students in using mathematics e-portfolio.

Based on observations and interviews of teachers (during the preliminary study) it was evident that: a) Teachers generally do not understand the e-portfolio assessment well. Most of them understand about the non-digital (conventional) model of portfolio assessment, b) In general, the implementation of mathematics e-portfolio assessment is varied among teachers. Some teachers asked students to find mathematics questions in the Internet after school hours. Most of the others do not use e-portfolio assessment at all with the reason they cannot or do not have the materials for it, c) In assessing digital portfolios, teachers often encounter various difficulties. Among of them are they are not accustomed to learn mathematics using digital portfolio assessment, limited fund and tools (such as laptops) to implement e-portfolio assessment, and it is difficult for them to design the e-portfolio, d) To implement e-portfolio assessment, teachers need help in: getting funding provided by school to buy the tools needed, getting the access to attend the workshops, and in getting the guide books for preparing the e-portfolio assessment.

Based on students' needs analysis, it was clear that the majority of students (40.79%) felt happy if the mathematics assessment utilizes a computer or other electronic devices and 12, 43% of students were not happy with it. In addition, most students (58, 58%) agreed when the mathematics assessment is conducted using e-portfolio assessment model (by using computer) so that it is easy and quick to see the results of the assessment, and very few of students (6.51%) disagreed with it. It shows that the students generally need mathematics e-portfolio assessment model. The results of students' character analysis indicated that most students enjoy learning mathematics and are willing to study mathematics seriously. They wish that they had an easy and fast assessment model.

From the result of teachers' needs analysis, it was found that about 66.67% of teachers agreed or were happy if the e-portfolio assessment model was implemented because it can help them see the result of students' assessment easily and quickly.

In relation to e-portfolio, the teachers argued that they need: a) Digital assessment software that is interactive, b) The results of students' scores are immediately observable and analyzed, c) Mathematical problems or exercises can be accessed via an intranet or the Internet (website), d) Set of exercises in multimedia, and e) Knowledge of the information and technology (IT) to create mathematics e-portfolio assessment.

Related to the curriculum, the teachers use curriculum 2006 for students in grade XI and XII and curriculum 2013 for grade X. Mathematics at high school covers the following aspects 1) Logic, 2) Algebra, 3) Geometry, 4) Trigonometry, 5) Calculus, 6) Statistics and Probability. These aspects are then described further in the Standards of Competence and Basic Competence.

The data collected through needs analysis and curriculum identification is then used as basis for planning and designing the product.

The design of the product includes several procedures, such as: media selection, the selection of the format, and the initial design of e-portfolio (goal setting/ student competencies are developed, determining the type of portfolio, determining the content of the portfolio assignments), and setting up the early draft of the product.

The selection of appropriate media and formats are necessary to produce a product that meets the purpose. The media used for this product is Adobe Flash, computer software which is the flagship product of Adobe systems. The result is an interactive CD that can be easily used by teachers or students via the Internet or intranet on Personal Computer (PC) or on a laptop. Because today is digital era, almost anyone can use this product using PC or laptop and it is very easy to use it. Students can immediately see the results of their work at that time without waiting for a long time.

The learning objectives were used as basis to make the portfolio tasks. The portfolio is a collection of students' work which are selected. According to Pheeney [8], there are three types of portfolios; those are portfolio of work/process, portfolio of exhibitions, and portfolio of evaluation/product. This study focuses on portfolio of work/process. It consists of students' tasks in grade X, XI, and XII.

The tasks for each class contain chapters about the tasks in the form of multiple choices and short answer. Class X has 7 chapters (form of roots, exponents and logarithms; equations and quadratic functions; inequality; mathematical logic; trigonometry; three dimensions) with 320 questions. In class IX, there are 8 chapters (statistics; probabilities; trigonometry; circles; many parts; composition of functions and inverse functions; limits function; derivative) with 240 questions. In class XII, there are 7 chapters (integral, linear programming, matrices, vectors, transformation geometry; ranks, progression, and sigma notation; exponential and logarithmic functions) with 255 questions, so that overall there are 815 questions.

The collection of tasks above was then processed using Adobe Flash program, so that it becomes an e-portfolio assessment, completed with teachers' and students' guide.

The system of the e-portfolio assessment product consists of: (1) the initial menu contains some icons option, namely splass screen option, option of Class X, Class XI, Class XII, (2) At each option of class sub-menu contains subs of menu of "Tugas per Bab (Task per Chapter)". In the sub-chapter menu contains the display of questions that need to be answered by students, ranging from number one until the last number, (3) Answering the questions on an interactive box by selecting the icon or menu of "Lembar Jawab (Answer Sheet)" which contains

options of sub-menu "Pilihan Ganda (Multiple Choice)" and "Isian Singkat (Short Question)", (4) Icon of Correction, to match the answers with the answer keys that have been digitally set or programmed, and the right or wrong answers will appear, (4) Icon Recapitulation of value, to see the score, (5) The Reset icon, to start from the beginning (from question number one), and (6) Icon exit to end (exit) the program.

This e-portfolio is also completed with teachers' and students guide. Teacher guide contains direction on how to use and take benefit from the e-portfolio assessment. Students' guide contains instructions on how students use the e-portfolio effectively.

To obtain a valid, practical, and effective product then the tryout was conducted.

a. To examine or assess its validity, the product was assessed by content of assessment expert and mathematics learning expert. The criteria of the expert are (1) having a broad knowledge and skills about mathematics learning and assessment of mathematics learning, (2) earning Master's or Doctoral degree in Mathematics Education. The experts assessed the product from the aspects of the content, language, and appearance as well as its usage. The content expert validation showed that the product is valid (94,74%), while the mathematics learning expert validation showed that the product is valid (93,27%). These results indicated that the product has been very good or very valid (94,00%), which means that the e-portfolio developed already meets the requirement of validity criterion.
b. To examine or assess its practicality, the product was tried out by practitioner (mathematic teacher), and instructional design and media expert. The criteria of the practitioner are having a broad knowledge and skills on teaching mathematics and having the experience of teaching mathematics at senior high school. The criteria of the instructional design and media expert are having a broad knowledge and skills on instructional design and earning Master's or Doctoral degree in Education. The practitioner and the instructional design and media expert assessed the product from the aspects of the content, language, and appearance as well as aspects of use. The practitioner' assessment showed that the product is very good (94,20%), while the instructional design and media expert' assessment showed that the product is very good (91,35%). These results indicated that the product has been very good (92,78%) or very practical, which means that the e-portfolio developed already meets the requirement of practicality criterion.
c. To examine or assess its effectiveness, the product was tried out by a group of high school students. 15 students took part in this process. The students were asked to tryout the product, then they were asked to give feedbacks and responses through questionnaire. The results of the questionnaire showed that students felt happy with the product (92,78%). This means that the e-portfolio developed already meets the requirement of affectivity criterion.

Development is a process or effort to create a design, device, system or method of physical and tangible form that is useful for achieving certain goals and in accordance with the requirements. Development is done to achieve the goals to be achieved. Development is directed to produce a product that can be used either as individuals or groups.

This development produces mathematics e-portfolio assessment which can be used to facilitate teachers in assessing mathematics subject in high school. The use of electronic assessment is an effort to improve the quality of the assessment which has been done so far, which in turn can improve the quality of teaching mathematics in high school in general. By applying the assessment or valuation models, it can electronically measure the ability and skills of high school students in learning mathematics easily and quickly. Through e-portfolio assessment, teachers do not need to carry physical files with difficulty because the electronic media has a digital format that can be stored in the data storage (flash drive, hard drive, CD-ROM, DVD) so it does not take a lot of places (large room). In addition, the electronic media does not become obsolete like a regular book. The digital format of the electronic media can survive all time with quality that has not changed.

Utilization of this digital assessment will change the existing assessment system which has been dominated by a written test and non-digital format. This product is in line with high school Curriculum 2006 and 2013 in Indonesia, which encourages teachers to use classroom-based assessment, which is using a variety of assessment tools, including test and not test [4]. Thus, this product can help teachers to implement an easy and quick assessment process.

4. CONCLUSION

The product of this study is a set of mathematics e-portfolio assessment which is completed with teachers' and students 'guide.

From the initial assessment, teachers generally do not use mathematics e-portfolio assessment, but most of the teachers and students agreed/ were happy if it is developed, so that it can help them see the results of the assessment easily and quickly.

This product consists of high school mathematics assignments of class X, XI, XII. It was designed and developed using Adobe Flash program and it was packaged in the form of a CD.

The results of the tryout showed that the product is valid (94,00%), practical (92,78%), and effective (92,37%). Thus, it can be used in the teaching and learning process.

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Table 4: Frequency distribution table of classified Cronbach's alpha

Cronbach's alpha	Frequency	Valid Percent	Cumulative Percent
under 20	4	10.0	10.0
0.20 -0.40	1	2.5	12.5
0.41-0.60	3	7.5	20.0
0.61-0.80	6	15.0	35.0
0.81 - 1	26	65.0	100.0
Total	40	100.0	-

Table 5: Frequency distribution of distracters according to selection

Selected distracters	Frequency	Percent	Cumulative
all	271	12	12
1-non-selected	77**8**	34.6	46.6
2- non-selected	854	38.1	74.7
3 non-selected	342	15.3	100
total	2445	100	**-**