Tutorial model with Student's pictorial riddle based worksheet for practicing representation capabilities of prospective teacher candidate

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Abstract. This study aims to produce a valid and effective Pictorial Riddle-based Student Activity Sheets (SAS) that can improve student's representation skills. The development of Student Activity Sheets uses four D models (Define, Design, Develop and Desseminate) from Thiagarajan. The trial was limited to Open University students in Bojonegoro study group using one shot case study. The research data was collected using validation, observation, tests and questionnaires with validation sheet instruments, observation sheets, learning outcomes tests and questionnaires. Data were analyzed using quantitative and qualitative descriptive analysis, N-gain and t-test. The results of the study show: 1) SAS that was developed are fulfilling in terms of content and construct validity; 2) SAS that was developed are validity criteria fulfilling effectiveness criteria in terms of improving student representation skills and having positive responses. Based on the above, it can be concluded that SAS are valid and effective to improve the representation ability of prospective teacher students.

1. Introduction

Lectures at Open University (UT) have different characteristics from regular universities in the learning process. Learning is remote, the learning model is largely independent. To assist students in understanding teaching materials in their development, tutorials are provided for certain subjects. For Pendas or Nonpendas students, there are face-to-face tutorials and online tutorials via internet facilities [1]. The tutorial principle requires independence for students, so competent tutors must choose a model that can bridge this in carrying out the tutorial activities. After the tutorial model is prepared by the tutor, the next step is to prepare the Tutorial Activity Draft and Tutorial Activity Unit as the operational forms of the tutorial model used. UT students must be able and skilled in overcoming and solving problems presented in learning. Teaching materials in the form of modules that have been prepared by experts make it easier for students in the learning process with the system applied at UT. In the module there are various practice exercises and material deepening exercises through questions that are structured in stages and accompanied by completion or answer keys. With such modules it is expected that the concept of independent learning can be carried out well.

The Basics of Mathematics and Science (PAUD 4305) is a group of subjects that require sufficient learning strategies and methods as well as appropriate supporting media to deliver them in class. The questions presented and asked require analytic thinking on a level above understanding in Bloom's taxonomy, and connecting between concepts before being used to answer or draw conclusions. Students in this course are expected to be skilled in using the concept of set, logic in solving problems in the field of mathematics and fields other and can explain natural phenomena that occur in life using the concept of science, as a provision for kindergarten teachers or early childhood teachers [2].

Judging from the acquisition of the initial test average scores for the Mathematics and Science Basics courses in the PGPAUD S1 study program UT Surabaya Pokjar Bojonegoro averaged 65.4, Lamongan averaged 66.4 and Tuban averaged 64.5 still not satisfying [3]. One of the basic weaknesses is the low ability to analyze a problem presented. One indication is the low score for questions that are different from the example or practice questions, even though the basic concepts of

mathematics and science are the same as practice questions. The ability to represent questions in the subjects of Mathematics and Science Basics to be completed by students is still not optimal.

To facilitate the process of analysis and explain of natural phenomena it usually uses various forms of representation. Functional relationships that occur between physical quantities in a phenomenon are usually expressed in mathematical formulations that are simple and then visualized in graphical form. Interactions between physical quantities that occur in a phenomenon are usually described in the form of interaction diagrams. Along with the advancement of computational technology, the interaction representations of various physical quantities in a phenomenon can be presented using dynamic formats in the form of animations and simulations [4].

By paying attention to the representation ability of PGPAUD S1 students, the process of analyzing a problem solving skill will be easier. Problem solving skills will have very good result if trained to students in groups rather than on their own. In groups, students can give mutual contributions to understand through discussion. It is expected that by learning groups of students will learn faster than studying alone. However, tutors continue to monitor and direct the learning process in groups, so that each individual in the group can be active and not rely on each other's particular abilities. Tutors function as facilitators and dynamic learners, while teaching materials can be given in advance and enriched by tutors and students in certain forms.

One of the teaching materials to enrich students is the Student Activity Sheets (SAS). SAS are in the form of a collection of activity sheets that allow students to carry out real activities with objects and problems learned [14]. SAS is one of the learning resources that can be developed by tutors as facilitators in learning activities [5]. SAS are designed and developed in accordance with the conditions and situations of the tutorial activities that will be faced and serve as study guides that make it easier for students and tutors to make tutorials so that effective interactions are formed in the tutorial [6].

In solving the problems of the subjects of the Basics of Mathematics and Science requires the ability of representation from students. Representative ability is a very important ability in learning Science and Mathematics to apply and interpret various concepts and problems with symbols of objects or processes in the form of words, images, diagrams, graphs, computer simulations and mathematical equations [7, 8]. This ability can help students to solve problems and make decisions that are appropriate, careful, systematic, logical, and consider various points of view. Understanding problems, solving mathematical and scientific problems needs clear illustrations, simplifying in mathematical sentences is an important step to find a way out or find answers to the questions in the course.

One of the problems can be overcome by using a pictorial riddle SAS to develop student representation skills in small and large group discussions. Pictorial riddle can be a picture, poster or simulation presented by a tutor equipped with questions through the learning process to find solutions [9]. The tutorial the tutorial requires representation skills such as mathematical abilities used to form abstract analysis data to concepts that require mathematical comparability, solving problems that require precise mathematical calculations. As well as in verbal abilities that are useful for understanding definitions, arranging sentences and communicating conclusions [10].

The research problem formulation is how high students' representation ability after the tutorial is applied with Pictorial Riddle SAS is feasible in the subjects of the Basics of Mathematics and Science. The purpose of this study is to describe the ability of the representing students to solve various problems in the subjects of the basics of mathematics and science through the application of Pictorial Riddle based SAS that are feasible in terms of valid and effective criteria.

The development and application of Pictorial Riddle-based SAS in the Mathematics Basics and Science courses of the PGPAUD S1 program are important because: (1) there is a demand to achieve ideal conditions, namely to provide the Activity Tutorial Design, Tutorial Activity Unit with SAS that are able to serve Basic learning students- the basis of Mathematics and Science is in accordance with the conditions of students and it is expected that there will be an increase in the process and learning outcomes of students after their representation abilities are trained, (2) provide a problem solving basis

in the fields of Mathematics and Science in terms of representation ability experienced by students.

2. Research Methods

This research develops products namely SAS which later can be used in tutorial activities. This is in accordance with the opinion [11,12] which states that the main purpose of development research is to develop effective products that can be used in schools. The procedure for developing the devices used in this study is four D models (Define, Design, Develop and Desseminate) which were adapted from Thiagarajan, Semmel and Semmel [13]. Definition: Analysis of PGPAUD S-1 curriculum. Student Analysis. Concept Analysis in the subjects of the Basics of Mathematics and Science. Task Analysis are in the Basics of Mathematics and Science. (2) Design: compilation of pictorial riddle-based SAS. (2) Development: Validation of pictorial riddle-based SAS and revisions based on validation results. (3) Dissemination in class: Research design to determine the effectiveness, whether or not there is influence of the application of a tutorial model with pictorial riddle-based SAS to the representation ability of prospective PAUD teacher students using a one shot case study. The research class received treatment with a pictorial riddle-based SAS then viewed the results.

The Research Objectives are S1 PGPAUD students during 2018.2 period in Bojonegoro study group. Class of Mathematics and Science Fundamentals are taken as research subjects based on the consideration of the class taught by the tutor according to the official schedule of UT Surabaya for the Bojonegoro District study group.

Research data includes: (1) validation of pictorial riddle-based SAS in tutorial activities. (2) Description of the implementation of the classroom model tutorial with the pictorial riddle-based SAS in the tutorial process. (3) Effectiveness of using SAS pictorial riddle models in improving student representation skills.

The instruments used in the development and observation activities during the implementation of the pictorial riddle-based SAS in tutorial activities included the following: Peer Validation Sheet about pictorial riddle-based SAS developed, Questionnaire Student response about the application of pictorial riddle-based SAS in the tutorial activities of the Basics of Mathematics and Science, The observation sheet for the activities of tutors and students in the tutorial process is equipped with a field note format that will record other events, both relevant and irrelevant, Documentation photos during the tutorial process, Learning outcomes test with pictorial riddle-based SAS, Data was processed in qualitative and quantitative descriptive using N-gain and t-test.

3. Results

a. Validity of Pictorial Riddle SAS

Assessment of student worksheets SAS is carried out with instruments that cover 4 aspects of feasibility, namely didactic, content, presentation, and time. SAS are made on 6 topics: Association, mathematical logic1, Mathematical logic 2, Knowing Living things, Knowing Nature, and Knowing Chemistry. Each of these aspects has several components of feasibility as in Table 1.

Table 1. Results of Pictorial Riddle SAS Validation

No.	Feasibility Component	Value			Mean	Information
		V1	V2	V3		
Didaktic						
	Suitable Learning Outcomes	10	8	9	9.00	Very good
	The grooves of material flow	10	8	9	9.00	Very good
	Facilitating students' learning	9	9	8	8.67	Very good
	Facilitating students' evaluation activities	9	9	9	9.00	Very good
Content						

Complete component	9	10	9	9.33	Very good
Contextual	9	8	9	8.67	Very good
Relevant Example	8	8	9	8.33	Good
Questions support the achievement of representation capabilities	9	8	8	8.33	Good
Presentation					
EYD language	9	9	9	9.00	Very good
Simple and easy to understand language	9	9	9	9.00	Very good
Proportional font type and size	9	9	9	9.00	Very good
Illustration / picture helps understanding	9	8	9	8.67	Very good
Suitable color combination	10	8	9	9.00	Very good
Time	9	10	9	9.33	Very good
The time to work on an SAS is proportional	9	9	9	9.00	Very good
Average value	9.14	8.57	8.86	8.86	Very good

The values given to SAS have a scale range of 1 to 10. Table 1 presents the results of the SAS assessment conducted by experts with the following values: validator 1 gives the average value of all components 9.14; for validator 2 gives a value of 8.57; and validator 3 gives a value of 8.86. So that the average value of the three experts is 8.86 with the value category being very good. The three expert validators also stated that the Pictorial Riddle SAS in the subject of Mathematics and Science Basics is valid and worthy of being used in the tutorial.

b. Effectiveness of Pictorial Riddle SAS

Increasing the ability of representation in understanding the subject matter of the Basics of Mathematics and Science can be known by determining N-gain. The value of N-gain and the sensitivity of the items used can be seen in Table 2 below.

Table 2. N-Gain and Sensitivity Values Item representation ability

Topic	***N-Gain***		**Sensitivity**	
	coefficient	**Information**	**coefficient**	**Information**
The set	0.77	Height	0.67	Sensitive
Mathematics logic 1	0.75	Height	0.67	Sensitive
Mathematics logic 2	0.74	Height	0.64	Sensitive
Living things	0.72	Height	0.62	Sensitive
Know Nature	0.76	Height	0.60	Sensitive
Introduction to Chemical Science	0.76	Height	0.58	Sensitive

Table 2 shows that the improvement of the ability to represent concepts before and after the learning process for six topics of learning material with a tutorial model with Pictorial Riddle-based SAS in high criteria on each topic and sensitive to the learning process on all topics.

The results of the analysis of data normality test representation ability understanding of the subject matter of Mathematics and Science Basics students with the Kolmogorov-Smirnov Test obtained p-value or statistical significance which overall the topic has a value greater than 0.05, the

data are normally distributed for all topics . Because the requirements for normality of data have been fulfilled, then testing the difference in average between the pretest and posttest for all discussion topics using paired t-test can be done and there are significant differences between the ability of representatives to understand the Basics of Mathematics and Science students between the pretest and posttest for all topic of discussion. The results can be seen in Table 3 below.

Table 3. Test of Differences between Pretest and Postest with t-Test

No.	Topic	t	df	Sig. (2-tailed)	Information
1	The set	-29.819	33	0.000	Ho Denied
2	Mathematics logic 1	-27.069	33	0.000	Ho Denied
3	Mathematics logic 2	-28.889	33	0.000	Ho Denied
4	Living Things	-33.033	33	0.000	Ho Denied
5	Know Nature	-29.702	33	0.000	Ho Denied
6	Introduction to Chemical Science	-34.920	33	0.000	Ho Denied

Table 3. shows that the significance (2-tailed) of the p-value of the paired t-test statistic for all pairs (pretest and posttest) on each topic was apparently less than 0.05. Thus, H_0 is rejected and H_1 is accepted. So that it can be stated that there is a significant difference between the students'ability in understanding the concept between the pretest and posttest for all topics.

Student response data is designed not to determine the level of validity and effectiveness of the tutorial model, although there are several questions in the questionnaire that can be used to strengthen data about the feasibility of the model [14]. In particular, the student response was designed to determine the strengths and weaknesses of the tutorial model with pictorial riddle-based SAS viewed from a student's perspective. Student response data and records during the implementation are used as material to make improvements. The results of the analysis of the response questionnaire given to students also show that most students feel new to the learning process, feel clear about the presentation of lecturers, find it easy to learn and use teaching books and SAS.

4. Conclusion

The tutorial model with pictorial riddle-based SAS developed to improve the ability of conceptual representation of concepts included in the criteria is very good and feasible to use in the tutorials of the Basics of Mathematics and Science. The tutorial model with pictorial riddle-based SAS developed includes being effective because of the increase in the ability of representation to understand the Basics of Mathematics and Science as indicated by the N-gain value, fulfilling the high criteria for all discussion topics. Most students feel new to the process of learning activities, feel clear with the presentation of lecturers, find it easy to learn and use the textbooks and supporting pictorial riddle-based SAS developed.

The practicality in the form of the implementation of the tutorial with the criteria of very good, good, good enough, not good and various obstacles during the implementation of the tutorial and how to overcome it at each tutorial meeting need to be examined and studied in the next study. This model needs to be developed and tested in lectures at regular universities. The tutorial model developed is still based on paper and pencil tests, it is necessary to innovate in the form of ICT-based learning.

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