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Application of Geogebra 4.4 Assisted SSCS Model for Improving the Ability of Mathematics Representations of Students

Ratna Sariningsih[1)] Ratni Purwasih[2, a)]

[1, 2]*Department of Mathematics Education, STKIP Siliwangi Bandung*
Jln. Terusan Jenderal Sudirman Cimahi, 40526

[a)]ratnasari_ning@ymail.com

Abstract. This research is motivated by the students' difficulties in dealing with mathematical verification items. The purpose of this study is to examine the differences of mathematical representation ability of students whose learning use *Geogebra 4.4*-assisted SSCS learning models and that of students whose learning use conventional models and this study is also to investigate the associations between representation ability of students whose learning use SSCS models aided by Geogebra 4.4 and that of students whose learning use conventional models. The method used in this study is quasi-experiment. The population is all students in Mathematics Education of STKIP Siliwangi Bandung in the even semester of 2015/ 2016 Academic Year. The sample is the students of 2014 Academic Year from three classes in the subject of statistical mathematics. The results show that there are differences in the ability of the mathematical representation of the students who obtained SSCS learning models without GeoGebra, and that of students who obtained SSCS learning models aided by Geogebra and that of students who obtained conventional learning models. The students' mathematical representation abilities are considered good. Another conclusion is that there is an association in the ability of mathematical representation of students on SSCS learning models without GeoGebra. Similarly, there is an association in the ability of mathematical representation ability on SSCS learning models with GeoGebra.

INTRODUCTION

Many students or prospective teachers have difficulties in dealing with mathematical statistics verification items because they do not know the benefits of that verification application. However, in the implementation of lectures, there are still lecturers who always present and explain the subject matter, while the students only take notes and take note. This kind of learning activity will make the students become passive and they are difficult to understand the course material [1]. A prospective teacher must have representation ability to raise new ideas that can be delivered. This ability enables students to organize their own thoughts. Dealing with problems presented intricately requires initial assistance in turning these problems into simpler ones; so, it is more easily understood and resolved.

Achieving those objectives requires long thinking process; which is why, there should be a model to develop students' mathematical thinking ability called as *Search-Solve-Create-Share* (SSCS) model, which consists of 4 steps: identifying problems, planning problems solving, conducting problem-solving and socializing problem-solving [2]. The model can be assisted by intermediary media which helps collect many facts as supporting materials to create pictures of mathematical statistics and this is can be done by using mathematical *software*. The benefits of mathematical software are to solve the problems of statistics related to evidentiary based on the theory of set, probability and logical mathematics or making some experiments to get conclusion or new ideas. One of mathematical software used to analyze mathematical statistics is *GeoGebra 4.4*. In this software, there are a lot of menus suitable with the definitions in mathematical statistics.

GeoGebra 4.4 is a mathematical software used for training students' ability to reason inductively; which is collecting a lot of evidence from definitions and theorems of mathematical statistics to the conclusion of evidentiary, and training students' ability to reason deductively; that is supported by theorems that have been

proved by the definitions and also the ideas from pictures, diagrams and symbols that can be delivered to explain the evidence from the mathematical statistics theorems. Therefore, the title of this research is The Application of *Search-Solve-Create-Share* Model for Developing Mathematical Representation Ability of Students in Mathematics Education Study Program with the Support of *Geogebra 4.4* Software.

LITERATURE REVIEW AND HYPOTHESES

Personal representation can create wider representation system and consists of: (a) the characters or symbols consisting of letters, numbers, words, objects in real life; and (b) the rules and practice to combine and operate in the form of symbols [3]. According to Goldin (2002) representation system consists of two basic properties, namely internal and external. System of internal representations is found in the mind of each individual, while the external representation systems can be more easily seen in others [3]. Internal representation consists of ideas to help illustrate the process of learning and solving mathematical problems, and external representation can be expressed in the form of diagrams, formal language, and symbol of numbers. Lesh, Post and Behr [4] stated that there are five representations used in mathematics education consisting of (a) the representation of real-world objects, (b) the representation of concrete, (c) the representation of the symbols of arithmetic, (d) the representation of language in talking, and (e) the representation of images or graphics. The ability of mathematical representation that will be used in this research is the students' ability to express ideas or mathematical ideas in the form of external representation that is visual (charts, graphs, tables, and images), symbolic (equations or mathematical expressions) and verbal (words or written text).

Pizzini and Shepardson (1990) suggested that *Search*, *Solve*, *Create* and *Share* (SSCS) model refers to the four-step problem-solving sequence starts at investigating the problem (*search*), planning settlement of the problem (*solve*), constructing the problem-solving (*create*), and the last is discussing the settlement obtained (*share*) [5]. Pizzini (1991) stated that: (1) *search* phase activities include initial inquiry about a problem that is given to the students [6]. During this phase, the students can put their ideas into a list of what is known and what is being asked as a result of their investigation in depth on the issues; (2) in *solve* phase (Planning Settlement), the students produce and implement the plans to find solutions to the problems that exist or create the problems themselves, develop critical thinking and creative skills, formulating hypotheses in the form of conjectural answer, choose the method to solve the problem, collect and analyze data and solve the problems (3) *Create* (Constructing Settlement/Completion). In this phase, the students create a product which is a solution based on the assumptions that have been chosen in the previous phase. At this stage, the students examine the assumptions whether they are right or wrong. In addition, the students show the results as creative as possible and, if necessary, the students can use charts, posters or models. (4) *Share* (Discussion) phase is the final phase of this learning model. In this phase, the students discuss with the teacher and friends in the group on the findings, solutions or conclusions they earn. The students can use the recording media, video, posters, reports, and media.

As we know that during the learning for explaining algebra into two-dimension geometry, the students have difficulties to draw characteristics of algebra variable 2 from geometry form transformed into descriptive form in solving evidentiary of mathematical statistics items, although the teacher or lecturer has made assumption or hypothesis in form of picture; so, what is needed is the evidence of image from computer software that is more highly accurate in accordance with the purpose desired by the teacher or lecturer.

GeoGebra is computer software designed for the purpose in the field of mathematics, especially geometry and algebra. GeoGebra is widely known in high school and college as a tool for the students to solve the problems and also find the ideas while doing various experiments, especially the experiment to estimate two-dimension curve shape. As we know that during the learning for explaining algebra into two-dimension geometry, the students have difficulties to draw characteristics of algebra variable 2 from geometry form transformed into descriptive form in solving evidentiary of mathematical statistics items, although the teacher or lecturer has made assumption or hypothesis in form of picture; so, what is needed is the evidence of image from computer software that is more highly accurate in accordance with the purpose desired by the teacher or lecturer.

Based on the problems and literature review, then, the hypotheses of this study are:

1. There are differences in mathematical representation ability between the students whose learning use SSCS models, and the students whose learning use SSCS model aided by *GeoGebra 4.4* and the students whose learning use conventional models.
2. There is an association among mathematical representation abilities of students whose learning use SSCS model.

RESEARCH METHODS

The method used in this study is quasi-experiment "(Tunjukan model desain penelitianya) ". The population of this study is all students in Mathematics Education of STKIP Siliwangi Bandung in the even semester of 2015/ 2016 Academic Year. The sample of this study is the students of 2014 Academic Year from three classes in the subject of statistical mathematics. Of the three classes, one class is an Experimental class 1 and the other class is the Control class and the next class is the second Experimental class. Design research as follows:

O X O
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O O

Information:
A = Grouping the subject is not random class
O = pretest posttest
X = S*earch*, *Solve*, *Create* and *Share* (SSCS) model

RESULTS AND DISCUSSIONS

To determine the equality of the research sample, then, the researchers analyzed the statistical data to test the mean difference of the students' prior mathematical knowledge score derived from the data of students' mathematical representation and reasoning ability pretest. The test consists of normality test, homogeneity test and mean difference test. In each learning, the calculation results of the students' prior mathematical ability have normal distribution and are derived from homogenous group. To determine the difference of mean in the three groups of sample based on the students' prior mathematical representation and reasoning skills, then, one-way Anova test was done.

The followings are the findings in regards with the students' mathematical representation and reasoning abilities as presented in Table 1.

TABLE 1. Data Recapitulation of Mathematical Representation Ability

MATHEMATICAL ABILITY	**SSCS Learning**		SSCS Learning aided by **Geogebra**		**Conventional Learning Model**	
	(n = 30)		**(n = 31)**		**(n = 31)**	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
Mathematical Representation	13,33	3,79	16,053	2,93	11,38	2,99

Skor Maksimum Ideal = 20

After testing the normality of data distribution on mathematical representation abilities, then, the data of representation ability was obtained. Based on these findings, the tests used one-way ANOVA. The results can be seen in Table 2 below.

TABLE 2. Data Recapitulation of Students' Representation Ability

Ability Mathematical		**Sum of Square**	**Df**	**Mean Square**	**f**	**Sig.**
Mathematical Representation	Between Groups	437,417	2	218,709	20,527	0,000
	Within Groups	1246,574	117	10,654		
	Total	1683,992	119			

Based on the ANOVA test results on the ability of mathematical representation, it is found that the value of sig. in each learning is 0.005. Thus, there are significant differences between the ability of mathematical representation of students whose learning use SSCS without GeoGebra and that of students whose learning use GeoGebra and that of students whose learning use conventional model.

The advanced test was conducted to see the students' mathematical representation abilities that are better on the three learning models presented in the following Table 3.

TABLE 3. Sceffe Test on Students' Mathematical Representation Ability

Dependent Variable	Learning Model	Learning Models	Sig.	Sig.
Mathematical Representation	SSCS	SSCS Geogebra	0.002	0.002
		Conventional	0.029	0.029
	SSCS Geogeb	SSC	0.002	0.002
		Conventional	0.00	0.00
	Conventional	SSCS Geogebra	0.29	0.29
		SSC	0.00	0.00
	* The mean difference is significant at the 0.05 level			

From the table above, it is revealed that analyzed that the ability of mathematical representation of students whose learning use SSCS model without *GeoGebra* is better than that of students whose learning use conventional model and it can be seen from the value of sig. that reached 0.029 is less than 0.05. In contrast to the ability of representation using *Geogebra*-assisted SSCS learning, at the mean difference is obtained negative value which means that mathematical representation ability of students whose learning use SSCS model without GeoGebra is no better than that of students whose learning use *Geogebra*-assisted SSCS learning model. It can be concluded that mathematical representation ability of students whose learning use Geogebra-assisted SSCS learning model is better than that of students whose learning use SSCS model without GeoGebra and that of students whose learning is conventional. This is because that Geogebra-assisted SSCS learning model can stimulate students to use statistics.

Learning to use SSCS provides the opportunity for students to explore ideas to solve the problems it faces. Ability visible representation when students expressing ideas in the form of pictures and graphs through sofwere GeoGebra. Through this, students can see and prove the conjecture or hypothesis regarding the issues to be resolved. Student Activities also looks active and create an environment conducive classroom so as to provide a meaningful learning experience.

CONCLUSION

This study provides some conclusions as follows. There are differences in the ability of the mathematical representation between the students who obtained SSCS learning model without Geogebra, and the students who obtained GeoGebra-assisted SSCS learning model and the students who obtained conventional learning model. The students' ability of mathematical representation and reasoning is considered good. Other conclusion is that there is an association in the ability of mathematical representation of students on SSCS model without *GeoGebra*. Similarly, there is an association in the ability of mathematical representations and reasoning of students whose learning use *Geogebra*-assisted SSCS learning model.

Among the difficulties faced by the students in completing mathematical reasoning and representation tasks is the ability to interpret and draw conclusions. Almost all the students are unable to complete the tasks. Meanwhile, the items relatively considered easy are the task of synthesizing mean and synthesizing probability. In addition to some of the above difficulties, it can also be concluded that the students tend to get bored with their own learning through teaching materials given far too long. The students wanted variation of learning directly from the lecturer.

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