Development of Geogebra Learning Media Based on Statistical Reasoning on Statistics Materials of Junior High School Students and its Influence for the Inteligent of Student

Intan Sari Rufiana[1], Cholis Sa'dijah[2], Subanji[3], Hery Susanto[4]

[1]Doctoral Student, Mathematics Education, Universitas Negeri Malang, East Java, Indonesia, [2]Professor, Corresponding Author, Mathematics Education, Universitas Negeri Malang, East Java, Indonesia, [3]Associate Professor, Mathematics Education, Universitas Negeri Malang, East Java, Indonesia, [4]Assistant Professor, Mathematics, Universitas Negeri Malang, East Java, Indonesia

Abstract

This research aimed to develop geogebra learning media based on statistical reasoning. For the purpose of this research and development, ADDIE model by Dick & Carry was used. This research and development produced geogebra learning media based on statistical reasoning for junior high school students. Class environment that applies technology based on statistical reasoning is another variable besides genetic which is adaptive. The integration of new technologies for education is no longer an alternative; it has become an obligation and even guidance to develop these knowledge-sided. Through geogebra, students are directed to build their knowledge not just to memorize rules. The class that applies technology based on this statistical reasoning will develop students' intelligence.

Keywords—*geogebra, statistics, statistical reasoning, intelligence*

Introduction

The rapid development of data in the era of big data like now makes the need for statistics not only needed in the field of mathematics [(1), (2), (3), (4), (5)]. Given the importance of statistical reasoning, several researches related to statistics refer to statistical reasoning [(6)]. Statistical reasoning must be output in statistical learning [(7)]. In addition, statistical reasoning is also an input in statistical learning as a consideration of the process in statistical learning [(8)].

However, current statistical reasoning research is more focused on the level of statistical reasoning. Research related to learning has not had a significant impact. There are no specific learning techniques or methods to improve statistical reasoning abilities [(9)]. It is explained further that there is no significant difference between the ability of students who are taught by using traditional learning and student-centered statistical learning [(10)]. There are important components considered in statistical reasoning besides statistical learning methods, including the use of technology, curriculum, and assessment [(11)].

The integration of new technologies for education is no longer an alternative; it has become an obligation and even guidance to develop these knowledge-sided [(12)]. One of the six principles of learning design is a technological device [(13), (14)]. It was important for many institutions to make vast investments in such innovations with the intention of incorporating digital computer tools into their educational curricula [(15),(16)].

Learning media are various kinds of tools and equipment that can be used to improve or also complement the efforts of teachers in ensuring interesting learning for students [(17)]. In learning statistical reasoning, technology-based learning media are needed. Integrating the use of appropriate technology can facilitate students to test their expectations, explore, and analyze data interactively [(18)].

But in reality, the use of technology for learning is still rarely done. Innovative strategy were not appear in teaching [(15)]. Integration of information technology in reasoning is still rare [(7),(8)]. The use of media in statistics is usually only to produce statistical measurements or to draw graphs. This is done in order to encourage educational efforts aimed at assimilating competencies

from the use of digital technology [19]. One of the technology learning media that is currently being developed is geogebra.

Geogebra is software that can be one of the best choices for learning media that has many benefits for geometry, algebra, and statistics to be more easily understood [20]. GeoGebra empowers pupils to discover, detect patterns, make a assume, illustrate, organize data [21]. The majority of current research is on the implementation of geogebra in learning geometry and algebra, statistical learning using geogebra is still very minimal to be studied. GeoGebra offers geometry, algebra and calculus features in a fully connected, compacted and easy-to-use software environment [22].In statistical learning, technology-based learning media are used not only to produce statistical measures, draw graphics, or analyze data but also to help students visualize concepts and develop the understanding of abstract ideas through simulations. It is expected that by using geogebra learning media, students' statistical reasoning can be improved. The indicator of reasoning ability is to use or interpret statistical models such as formulas, graphs, tables to draw conclusions; solve problems according to the method; communicate information effectively visually, numerically and verbally; assess the accuracy of conclusions based on the quantity of information[23].

Based on the urgent need for technology-based learning media, the researchers are interested in developing geogebra learning media based on statistical reasoning.

Research Methodology

This research used development research with ADDIE development models by Dick & Carry. Some phases of the implementation of research and development of ADDIE (Analysis (A), Design (D), Development (D), Implementation and Evaluation (I&E)) model are as follows [24]:

Analysis Phase

This phase includes analysis activities: 1) needs based on the unavailability of statistical learning media that support the implementation of learning in the classroom, where only teachers and students books are available; 2) literature, obtained from the results of studying student books and teachers books that the objective of statistical learning existing; 3) analysis of learning in the classroom obtained results that in learning, the teacher only uses technology learning media namely LCD to display ppt and students books to students.

Design Phase

At this phase, research planning was carried out which includes:

1) Exploring Potential and Problems

The problem that arises in the schools studied was the use of new mathematics learning media limited to the use of power points to present material and the lack of students' abilities in statistical reasoning;

2) Literature Study and Information Collection

The competencies expected to arise in junior high school students learning statistics are related to statistical reasoning. Statistical reasoning is the way people make excuses with statistical ideas and make "sense" of statistical information which includes skills in making interpretations based on a collection of data, making statistical summaries related to data, where students need to combine ideas about data, make conclusions, and interpret results statistically [24].

Product Development Phase

1) Validation

At this phase, a geogebra learning media expert was validated by 4 validators, 2 from geogebra media experts and 2 material experts. The validation data were then analyzed using the following formula:

$$P_m = \frac{\sum x_i}{32} \times 100\%$$

Note:

$P_m P_m$ = percentage of eligibility for all items

$\sum x_i \sum x_i$ = total score obtained for all valid items by validators

If the value of Pm ≥ 74%, the media is a valid medium, and therefore it does not need to be validated.

2) Revision

After validation, a design revision was conducted based on validators' input. This input was used as a basis for improving learning media.

1.1 Implementation and Evaluation Phase

The initial product was then tested on a limited basis. After being tested, students were asked to provide responses related to the learning media used. The students' response data were then analyzed using the following formula:

$$P_a = \frac{\sum x_i}{N \sum y_i} \times 100\%$$

Note:

$P_a P_a$ = percentage of eligibility for all items

$\sum x_i \sum x_i$ = total score obtained for all items by the user

$\sum y_i \sum y_i$ = the number of expected scores for all items by the user

N = the number of students who filled out responses

If the value of Pa ≥ 74%, the media is said to be practical, so there is no need to revise it.

The results of students' responses were then used to revise product learning media 1. The results of this revision are referred to as the final product whose results are given back to students. This is done to test whether the learning media has been effective for improving students' reasoning or not. Data analysis of the effectiveness of this media was obtained from the results of the pre-test and post-test of students' statistical reasoning abilities. The mean values of pre-test and post-test scores were compared using paired sample t-tests on the condition that the sample must be normally distributed.

Result and Discussion

Initial Product Development Results

At this phase, geogebra media was developed in junior high school statistics material. The preparation of the media was done based on the competencies that exist in the applicable curriculum.

Experts' Validation Results

The results of the learning media validation are presented in Table 1 below:

Table 1. Results of Learning Media Validation

Validator	Percentage	Caption
Media 1 expert	84.37%	Valid
Media 2 expert	90.62%	very valid
Material 1 expert	90.62%	very valid
Material 2 expert	87.50%	very valid

From the results of the validation above, there was a value that represents that the media were valid and very valid. Input given by the media expert validators is that learning media needs revision, namely the addition of sliders to facilitate changes in the amount of data, refinement of layout, changes in writing, and hiding features that are not needed.

Trial Results

The next step after the media has been validated and then revised is a trial of 1 product. The test was conducted at a junior high school with 30 students. Students were given statistical learning by utilizing the learning media that had been developed. After learning, students were given students' response questionnaire to be filled in. The students' response data were then analyzed using formula (P_a) as stated in section 2.4 above. From this questionnaire, it was ascertained that learning media was very practical to use. It can be seen from the analysis of students' responses that have a value (P_a) of 87.7%. The results of this study are in accordance with the function of the media, one of which is to guarantee interesting learning for students [17], their interest improved greatly and teaching efficiency boosted significantly[19]. From the students' response questionnaire, there were suggestions/inputs from students that it is necessary to get used of using the geogebra application to make it easier. This input is used for further learning.

Effectiveness Test Results

The effectiveness data were obtained from the scores of pre-test and post-test results of trial 2. Data were obtained from questions related to statistical reasoning. Paired t-test data analysis was performed with the help of SPSS with a significance value of 0.01. The SPSS test results showed that the pre-test and post-test score were normally distributed. It was also obtained data as follows:

Table 2. Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	99% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest - Posttest	-1.79000E1	7.18403	1.31162	-21.51533	-14.28467	-13.65	29	.000

From the above data, it was obtained that t_{count} = -13.647. This value was then compared with the table value with α = 0.01 and degrees of freedom = 29 that is equal to -2.462. Because the value of $t_{count} < t_{table}$, H_0 was rejected, which means the average score of post-test is bigger than the pre-test value. It can be concluded that the developed geogebra learning media met the effectiveness criteria which could improve students' statistical reasoning abilities. This also affects the intelligence of students. One of intelligentt components is reasoning. Some experts even explain that reasoning and intelligence refer to the same thing [25), (26)].

The factors that influence intelligence are not only biological aspects, namely genetic. Environmental factors will also greatly affect the development of human intelligence [(27),(28)]. Intelligence is not entirely due to biological variables. Intelligence is also influenced by other variables. Any variables can affect intelligence if this variable is related to adaptive nature [(29)]. Class environment that applies technology based on statistical reasoning is another variable besides genetic which is adaptive. The class that applies technology based on this statistical reasoning will develop students' intelligence.

Geogebra is software for developing mathematical ability, with the use of geogebra, students can manipulate various types of mathematical constructions from the simplest to the most complex.. The impact is students will understand better and will open the way for further learning [(30)]. It is emphasized again that geogebra can facilitate students in exploring, representing, and analyzing one concept with another concept [(23)]. As explained in the theory that technology-based learning media is not only used to calculate statistical measures, draw graphs, and also analyze data but it can be used to help students visualize concepts and develop understanding statistics abstract ideas.

Final Results

The final result of this development research is the learning media of geogebra software on grade VIII SMP/ MTs statistical material. The resulting file is a ggb file format. To operate, it is necessary to install geogebra software on PC / laptop used, or by visiting the geogebratube website so that it can operate without installing geogebra software.

Conclusion

From the process and results of the research stated above, it can be concluded that the geogebra learning media developed is effective which can improve students' statistical reasoning abilities and intelligence.

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