THE IMPACT OF THE USE OF GEOGEBRA ON STUDENT'S MATHEMATICAL REPRESENTATION SKILLS AND ATTITUDE

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Abstract:

Mathematics is important and applies to science, technology, society or the natural sciences. It is applied directly or indirectly. Most students find this to be a very stimulating, complex, and well-understood subject. Maths in high school is extremely important. The study was designed to investigate the impact of students' mathematical representation skills and their attitudes towards GeoGebra. This study was quasi-experimental and carried out on high school students. We have two groups belonging to the same standard class. The control group consisted of 22 students, while the experimental group consisted of 28 participants. The conventional approach was used to teach certain concepts of plane geometry to the students in the control group. On the other hand, the experimental group taught similar teachings using GeoGebra. The results show that students have more skills in mathematical representation using GeoGebra. The semi-empirical test also showed a significant change in students' attitudes between the pre-test and the post-test. Students are more active in mathematical representation skills in GeoGebra.

Keywords: GeoGebra, mathematical representation skills, attitude, control group, experimental group

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1. Introduction and Background

In recent years, the area of education has advanced at a rapid speed. Teachers and school building make studying more convenient (Maskur, R., 2020; Takači, D. et al., 2013 & Widodo, S. A., 2020). To impact the levels of instruction and learning capability of a student is being checked and balanced time by time. As a result, the present learning process is ideal and changes in methodology and learning processes (Kartowagiran et al., 2017, Kozák et al., 2018). The conventional learning-specific model has become old and is considered the opposite of the technique of teaching. It makes students uncomfortable and not interested during class. Students are more engaged when they feel the learning medium is suited and according to their personality. As a consequence, the ability of a teacher to teach dynamic, innovative, and comprehensive teaching methods (Hendriawan et al., 2019).

Students and teachers engage in various communication actions during the teaching and learning process (Dina et al., 2019, Olowe et al., 2014). If the students' cognitive structures grasp the teacher's subject matter well, the student's cognitive networks (Krisdiana et al., 2019). Students can have a better under better understandent and abilities by learning it in school (Sari et. all 2017). The student's capacity to articulate their mathematical concepts in describing a problem was the prior study paradigm. Students are more inclined to solve problems according to the teacher's instructions. As a consequence, students' mathematics abilities do not fully develop. Alternatively, optimal mathematical skill can increase the quality of mathematics learning, which in turn can enhance the standard of Pakistani education system (Kolodin et al., 2019; Utami, C.T.P., 2019; Purnami et al., 2017; Widodo et al., 2017).

As stated by the "National Council of Mathematics (NCTM)" students must possess five fundamental talents in order to succeed in mathematics. The first one is very important and is related to the expression of mathematical skills (Joyner et al., 2019, Widodo et al., 2019). The mathematical leaning comprised of students' capacity to connect through symbols, graphs, tables, or diagrams. As a consequence, students must possess mathematical representation abilities.

Representation is a strategy that is used to assist students find answers by expressing their views about a problem (Ifanda et al., 2019; Delima et al., 2017; Nugroho et al., 2018). Each student's representation is likely to be unique. Words, phrases, images, tables, graphs, mathematical symbols, and other forms of representation can be used (Septian et al., 2020; Kusuma, D. A., 2020). Mathematical representation is critical because it can assist pupils in organising their thoughts when addressing problems (Lestari et al., 2020). As explained by NCTM, mathematical description is a foundation for understanding of mathematics. Students can differentiate and used different symbols to enhance and extend their knowledge regarding mathematical concepts. NCTM is committed that students should be capable of; How to make, organize, record, communicate and utilize, translate, solve and interpret mathematical symbols, SAVI model and ideas.

According to observations performed at the school, the mean value under the completion requirement for teaching is seventy-five points. As claimed by the data, the mathematical expression of the students is poor. The main challenge for students is translating narrative difficulties into graphical representations and quantitative expression in mathematical models. As a result, the skill of mathematical representation must be improved. Communication abilities include the capacity to represent something. When children study mathematics, they are constantly using their capacity to represent. Approximately 70% of the characteristics that demonstrate representation are associated with mathematical communication (Kolodin et al., 2019; Utami, C. T. P., 2019). Mathematical description is a cognitive ability that influences student maths learning results. According to Saputra's findings, pupils' mathematical representations influence problem-solving strategies' accuracy. When the representation used to obtain the answer is correct, the approach used to find it is correct as well. In the other case, if the representation is incorrect, the approach and the final solution will be incorrect as well (Orozco et al., 2017).

The development of knowledge in schools is a source of hope for people of all political backgrounds. In theory, students should participate completely in classroom activities, whereas the teacher's responsibility is to arouse students' interest in learning and actively involve them by selecting appropriate learning approaches and methods for each individual student (Septian et al., 2020). They trouble with subjects that they don't care about, like mathematics. Teachers must gradually change students' attitudes towards mathematics, conveying the idea that mathematics is not as fearsome as students think. The best learning methods and approaches, as well as more innovative and diverse learning opportunities, are a few of the techniques (Tarigan et al., 2017, Warner et al., 2017).

According to Meir, there are four learning dimensions in teachings that may be used as alternatives like somatic, auditory, visual and intellectual. The Somatic Auditory-Visual and Intellectual is represented as SAVI. It is made on the basis of human features. These four features of the learning methods are connected and it is more efficient and well understanding. This method urges student's engagement in the classroom learning process. The SAVI paradigm includes somatic (moving and acting), auditory (hearing and speaking), visual (seeing and drawing), and intellectual (thinking and reflecting/solving problems). Students should be able to learn optimally with these four aspects. Based on these considerations, the SAVI learning paradigm appears to be student-centered, with students encouraged to use most of their senses in the classroom activities (Wijayanti et al., 2017).

The current curriculum is based on students being more engrossed in the classroom setting by the teacher. The teachers wanted to become a standard level curriculum to enhance the classroom setting. The curriculum for mathematics is vital for students to design in a well-organized way. The teacher played a role in the mathematics curriculum (Sutama et al., 2015). There are two learning parts; learning approach and learning medium. Teachers need to suggest a comprehensive curriculum that takes active

part of the students. A teaching tool for mathematics students in the classroom, visual media is being used to help them learn the subject of mathematics better. Students learn mathematics more easily, interactively, conceptually, and efficiently, which is helpful and likely to improve the results of classroom performance.

The new technologies' are playing an important role in the educational learning processes. Nowadays, teachers are using technologies as teaching and learning tools in the classroom. Teachers must learn and understand how to use learning tools. They must achieve their learning goals in a classroom setting. GeoGebra is a very good software, and it is utilized as a teaching medium. It is a dynamic software which is used for making points, lines and curves. It is an excellent selection for making different mathematical objects presentations. Abstract mathematical objects can be drawn correctly, effectively, precisely through GeoGebra (Tasman et al., 2018). It is possible to create diverse geometrical forms such as points, vectors, line segments, lines and polygons in a dynamic manner using GeoGebra's dynamic drawing capabilities. Students take more interest when they are using technology in a classroom setting (Septian, A., 2017). Students can use and visualize GeoGebra to make different geometrical shapes in a simple way. Students can understand various concepts of geometry in a more artistic, inventive, innovative, energetic, and active way through mathematical expressions (Hallal et al., 2016).

Previously, SAVI was utilized as a learning model (Wijayanti et al., 2017; Agustina et al., 2019). Some studies are a mixture of SAVI models with GeoGebra software (Wijayanti et al., 2017). Some software like Macromedia Flash and PowerPoint were utilized in previous studies. MATLAB is dynamic software which is used to draw different mathematical shapes and graphs (Maskur, R., 2020). The mixing of students focus models with mathematical applications is rare. Consequently, study given to the formation of GeoGebra as a teaching tool. This learning environment combines mathematical learning frameworks and classroom GeoGebra. The present models are computer-based environments that only enhance the mathematical expression skills (Little, C., 2011, Korenova, L., 2017). There are several reasons why learning media is still disregarded, including lack of time, inappropriate media, and financial constraints (Widodo et al., 2018, Widodo et al., 2019). Teachers should have appropriate knowledge and skills to run various teaching media (Widodo, S. A., 2018). Various pedagogical tools are still underutilized in the pedagogical learning process and they have not been used (Hakim et al., 2019). Students can not understand exact topics because they do not have enough skills to use them. Professional guidance on blended learning is essential.

We need to find out what makes students unfulfilling. The advancement of computers and technology changes over time. Newly emerging technologies are appreciated not only by the elderly, but also by young children. This technology is very useful and effective in math when used in a classroom. We had to study the impact of GeoGebra on students' math skills and attitudes.

2. Research Methodology

A semi-experimental study was conducted.It had two separate research groups for students. First group was dealt with SAVI teaching supported by Software GeoGebra while other group was dealt with normal teaching. The control group is non-randomized pretest and posttest approach is the experimental approach in this research study.

This research study was carried out at Government Higher Secondary School Bagra Buner over the students of class 8th.There were two sections of class 8th (A & B). The section A of class 8th was taken as an experimental class while section B of class 8th was taken as a control class to conduct the research. seven research study sessions were held. Among them five were distribution of learning stuffs and two were to conduct for before test and after test. The research scale and instrument for the study was conducted a test, non-test and learning instrument. The conducted test over the same topic was identical for both the groups. The reliability of the instrument was checked by Anates 4.0.5 software. Questionnaires and diaries were used as non-test tools. The questionnaire had 20 sentences which is about learning that were separated into negative and positive sentences. The data analysis used the normalcy test and percentage performance. The number of responders from each response choice is presented in the questionnaire data processing.

3. Results and Discussion

A mean pretest result of 4.32 with a standard deviation of 1. 678 is shown in Table 1. The control class average mean value is 4.81. It has standard deviation is 1.296. The difference of mean value was 0.50. The experimental group's SD is higher than the control groups. Which means that the experimental group outperformed the control group in terms of mathematical representation skills.

Table 1: Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Exp_PreTest_Scores	28	2.00	7.00	4.3214	1.67892
Control_Pretest_Scores	22	3.00	7.00	4.8182	1.29601
Valid N (listwise)	22				

The Table 1 showed that the Exp_PreTest_Scores and Control_Pretest_Scores having minimum values of 2 and 3 while maximum value 7, 7 respectively. In order to determine if the change in the mean is statistically significant or not, the assumption test must first be carried out.

Table 2: Tests of Normality (Experimental)

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Exp_PreTest_Scores	.177	28	.024	.909	28	.019
a. Lilliefors Significance Correction						

Table 3: Tests of Normality (Control)

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Control_Pretest_Scores	.171	22	.092	.911	22	.050
a. Lilliefors Significance Correction						

When finding the difference in mean value of pretest is significant or not, a normality test was performed to know whether population's distribution is normal or not (Hopkins et al., 1990; Lilliefors, H. W., 1967; Septian et al., 2020; Glass et al., 1972). The normality tests are shown in Table 2 and 3.

Table 4: Pretest data with normality test

Group	Group Significant or not	Value Information
Experimental	.024	Normally Distributed
Control	.092	Normally Distributed

Table 4 above describes the best data values of 0.024 and 0.092 for the experiment and the control, respectively. In significant values of p> 0.05, it was found that the entire population was normally distributed. In other words, if the resulting output is greater than 0.05 then Ho is considered acceptable. This proves that the two classes have the same mathematical expression, as stated previously.

The number of students who improved their mathematical representation skills in each group is also presented in Table 4, along with an assessment of the degree of improvement.

Table 5: Age of gain index data

Gain Index	Total	Experimental Class Explanation	% Age	Total	Control Class Explanation	% Age
gi >=7	19	High	67.85	13	High	46.42
3<gi <7	8	Average	28.85	10	Average	35.71
gi <3	1	Low	3.57	5	Low	17.85

Table 5 reveals that the experimental class had 19 pupils, 8 students of average, and 1 student of low mathematical expression. 13 pupils in the control class had a high increase in mathematical expression, 10 had an average increase, and 5 had a poor.

SAVI learning using GeoGebra improves students' mathematical expression and representation skills of geometry. The investigation has been carried out by two different

classes in order to evaluate the statistical test analysis. A normality test has been conducted on them.

The experimental class has a significant value of 0.000, which is less than 0.05. It seems that the amplification index of the specimen from the experimental category came from commonly distributed populations, as shown within the table below. From the statistics, it's clear that the comparison category results come from a commonly distributed population.

Table 6: Gain index data normality test

Group	Significant Value	Details
Experiment	0.000	The value indicated that population normally distributed
Control	0.001	The value indicated that population normally distributed

Table 6 shows that the experimental and monitoring classes are evenly distributed. Hence, no homogeneity test is needed. Table 6 shows that the populations of the experimental and control classes are normally distributed and therefore do not need to be tested for homogeneity. The experimental class value is 0.000 is greater than 0. 001. It tells us clearly that bending using SAVI by GeoGebra is an efficient role and impact of students' mathematical skills.

This kind of learning is innovative for students because they study through group worksheets using the SAVI and GeoGebra teaching shown in the class. At the beginning, the learning activity was not a success because the pupils were used to learning in groups, in particular because the group had more pupils than the control class (Wijayanti et al., 2017). Students seemed to like SAVI studying with Geogebra from start to finish, especially after receiving guidance and inspiration (Nopiyanti et al., 2016).

Drawing a plane in geometry created using GeoGebra software also allows students to use all their senses, including speaking, hearing, seeing and observing (Mahendra et al., 2019). Students learn through SAVI by studying alone and in groups, then revealing the meaning of their learning through movement, listening, observation, problem solving and analytic thinking (Ulvah et al., 2016). This can lead to poor mathematical representation abilities, boredom, and misfortune in secondary school mathematics. Contrary to SAVI learning, which is guided by the teacher and uses the five senses. The teacher is no longer the only source of information for the pupils, but helps them to find it (Tasman et al., 2018, Hallal et al., 2016). The students use GeoGebra.

The gain index will be provided for all mathematical representation competency indicators for both class groups, as well as for the overall class group. The table below displays the experimental and control classes' gain index values for each number.

Table 7: Mathematical representation ability

Index	Experimental Group	Control Group
Mathematical Statement	0.92	0.73
Imagery (visual representation)	0.83	0.62
Statement of Mathematical Facts	0.61	0.61

The value of the amplification index of the experimental class was higher than that of the control class, as shown in Table 7. The experimental class has moderate (0.62) and high (0.82) index values for written text competency. In the control class, medium interpretations receive 0.62 and high interpretations get 0.73, therefore the experimental class's rise in markers of student mathematical representation competence is greater than the control class's increase.

Table 7 shows that numerous indicators showed a rise. Students can describe mathematical expressions in language (everyday issues) and graphically (indicators). As a result of the combined influence of the learning model and GeoGebra tools, students are now able to visualise storey issues into mathematical expressions and pictures (Korenova, L., 2017). Geogebra, as a tool, allows pupils to design images and see mathematical formulas (Tasman et al., 2018). Several research have shown that incorporating GeoGebra-assisted SAVI learning models into curriculum can help students improve their representation skills (Hohenwarter et al., 2008; Machromah et al., 2019; Granberg et al., 2015).

4. Assessment of the Attitude

This table shows students' attitudes towards learning SAVI, applying GeoGebra and difficulty performing mathematics. According to Table 8, students' opinions on the first learning signal obtained by SAVI were almost all positive, with 89.84% of the students expressing a good attitude towards the indicator. For the second metric, a measure of learning powered by GeoGebra, the results were almost entirely positive (88.72% positive response rate) and when it was the third metric, the measure of mathematical representation problems, the results were almost entirely positive (93.09 percent positive response rate). As shown by the results of a study of a questionnaire completed by all students of all ages and up to 20 items, with 11 affirmative and 9 negative, the results were different. Students' mathematical representation skills, as well as their attitudes toward learning mathematics, were assessed in this study, which used SAVI in conjunction with GeoGebra to aid in research. The questionnaire showed that students' responses to the SAVI learning supported by GeoGebra were generally favorable, indicating that they enjoyed the experience. As a result, students respond positively to learning in general, which is a result of the design of learning as well as the way the instructor presents and encapsulates information, due to learning in general.

Table 8: All student % age attitudes

Indicators	Fair Attitude	Unfair Attitude	Details
SAVI learning attitudes	91.15	8.85	Mainly Positive
GeoGebra as a teaching tool	90.65	9.35	Mainly Positive
The challenges of mathematical expression	94.33	5.67	Mainly Positive
Mean (%)	92.02	7.95	Mainly Positive

Each declared indicator is scrutinized to better understand student opinions. Regarding the first indicator of students' attitudes towards learning of SAVI, 91.15% of students expressed a favorable opinion. This implies that the application of SAVI learning in the classroom has been welcomed by almost all students. The typical student has a good opinion about using GeoGebra as a learning material, with a rate of 90.65% in the second opinion. This shows that almost all students enjoy using GeoGebra as a tool for learning math. This is reflected in the third indicator of students' opinions on mathematical representation skills, which is 94.44% positive. This shows that almost all students answered well the mathematical representation problems presented in class (Orozco et al., 2017). The results show that students' attitudes towards all three indicators are almost entirely favorable. The results can be said that the students' attitude when learning SAVI with GeoGebra software is generally good.

Students' attitude towards learning SAVI to use GeoGebra has improved (Korenova, L., 2017). Students collaborate, learn from each other and reach their maximum (Istiqomah et al., 2020). The attitude of the learner has an impact on his or her motivation and learning outcomes (Sepriyanti et al., 2019). Like different studies, attitudes have an effect on students' attitudes, whether they may be studying in class or at school (Mahendra et al., 2019). Students can benefit from the SAVI learning model supported by the app (Orozco et al., 2017).

5. Conclusions

SAVI and GeoGebra students have stronger mathematical representation skills than students learning traditional techniques. According to the research results, the students' attitude towards learning SAVI integrated with GeoGebra is very encouraging.

Data Availability

The information was supplied regarding data availability.

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