The Effectiveness of Application Visualization, Auditory, Kinesthetic Learning Models in Mathematical Problem-Solving Abilities

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ABSTRACT

This research aims to describe the effectiveness of mathematical problem solving by applying the *VAK (visualization, Auditory, Kinesthetic)* than the *direct* learning model for Junior High school students' ability. This research uses a quantitative approach with a Quasi-Experimental and a Non-equivalent Control Group Designed. The population is the entire of the eleven grade. There were 76 representatives as samples that by using the purposive sampling technique. It uses a mathematical problem-solving test. The analysis technique both used descriptive and inferential analysis. Without the visual, auditory, kinesthetic (VAK) learning model, the average outcome is 60.13, and problem-solving abilities fall into the very medium category. Then the average outcome that applies visual, auditory, kinesthetic (VAK) learning models is 72.37, and problem-solving abilities fall into the very high category. The Inferential statistical results that due to sig. = 0.06 = 0.05 so can be concluded that H_0 is rejected. So there are differences in the mathematical problem-solving abilities with applying the visualization, auditory, kinesthetic (VAK) learning model. The effectiveness test results show that the VAK learning model is more effective for improving mathematical problem-solving ability.

Keywords: *Learning style, Visual, Auditory, Kinesthetic, Problem-solving.*

1. INTRODUCTION

Student characteristics as the research area, among others: intelligence, aptitude, motivation, social class, level of aspirations, perceptions, and attitudes. Each student also has different capabilities in dealing with abstractions, solving problems, and learning. Each student has a different learning style to receive, process, and remembers information obtained also vary.

Dimayati & Mudjiono [1] states that we have a brain with unique characteristics between man's left and right brains. The right brain has long-term memory characteristics, while the left hemisphere belongs to the Sort term memory. In his book entitled Revolution of Learning for Children, They express ideas related to (a) the functions of the brain-mind is an open system; (B) modalities, intelligence, learning styles, and creativity in learning, as well as ways of its development; (C) the use of music, sound, relaxation, drawing, humor, and a dream to build an atmosphere of play and learn effectively and exciting with kids, without prejudice to the nature of learning; and (d) activities, tips, and advice that is easy to do to develop the ability to learn and access information through the entire learning modality that we have.

DePorter [2] states that every 30 students, 22 on average, can learn effectively to bring activities that combine the visual, auditory, and kinesthetic. But the rest is so fond of one form of teaching than the other two that the student should strive to understand the lesson with no precision in presenting the lesson in the manner they prefer.

There is three main level of cognitive, such as visual, auditory, and kinesthetic. The visual learners are learning with visuals such as colors, pictures, maps, and diagrams. Learn to use the eye senses through observing, drawing, demonstrating, reading, using media and props. This learning style accesses visual images that are created or remembered, such as color spatial relationships, portraits, mental images, and prominent images; The auditory Learners have access to all kinds of sounds and words created or memorized, for example, music, rhythmic notes, dialogue, prominent voices [3], [4]. Kinesthetic learners are learners who absorb information from various physical movements. Level cognitive according to [5] that the students' approach can perceptually shape the learning profiled by using data stored in memory through visual, auditory, and kinesthetic perception.

Problem-solving is one of the main aspects of the mathematics curriculum required to apply and integrate mathematical concepts and skills and make decisions [6]. Developing problem-solving skills involves learning and practice; it is necessary to record and remember lest experience is not a product but some process. It affects cognitive abilities in understanding and presenting problems and using strategies, including identification, arrangement, and selecting appropriate strategies. Cognitive skills are essential to relate to the learning process, learning strategies to make them more confident and understand the subject's content Besides, the application and absorbing the values of a subject containing more easily.

Based on the observation on students' problem-solving skills, there are several obstacles in making mathematics answers. First, they are lack confidence, lack concept knowledge, difficulty in choosing strategies and developing their ideas; they would rather imitate an example than express their view creatively. Next, there are diversities of students' characters such as learning styles, individual variations, etc. In addition, the methods and models of traditional teaching are too general in schools to influence the input of knowledge gained by students. Students have their way of learning something new both in class and outside the classroom. This method is called a learning style. It is characteristic of a student who deals with strengths and infirmities in taking and processing information.

The problem of learning style faced by students is no guidance application of teaching concept [7]. Some teachers in school teach as much as they want, instead of doing what they should do. For example, the teachers apply and treat the same method or concept to many students. In contrast, each student has a difference in learning, uses inadequately validated tests, inappropriate groupings, learning styles suitable for only one dimension of style, one-course learning style training days' for teachers, etc. Traditional teaching methods that continue to use Teachers are also one of the obstacles in learning styles,

The focus of the research is descriptive quantitative problem-solving in VAK learning that has to be known the effectiveness in mathematical learning model by using an experiment and control classroom. One of the learning models that optimizes the three learning types is to make the learner feel comfortable Theoretically states that the VAK learning model is a learning model that considers learning to be effective by paying attention to the three modalities, learning is carried out utilizing the potential students already have by training and developing it. Can solve problem-solving in effective mathematics learning [8].

Learning is a set of measures designed to support the learning process. Successful learning process necessary techniques, models, and specific approach according to the characteristics of objectives, learners, materials, and resources needed so that appropriate and effective strategies, there is a learning model that can be used in learning activities by optimizing the potential of students and maximizing the involvement of students, using the VAK model [9]. In a nutshell, the study of [10] stated that learning styles, which are considered factors that influence students' diversities, had been well studied. Understanding students' learning will help teachers organize their styles in teaching that are appropriate to student learning performance. Based on the explanation, the researcher is interested in applying VAK in learning mathematic models.

2. RESEARCH METHOD

This research uses a quantitative approach, especially experiment research, to find the effect of specific treatments under controlled conditions [11]. Quasi Experiment Design is used because, in reality, it is difficult to obtain a control group for research to determine the effectiveness of the VAK model on mathematics problem-solving abilities.

The research design used is the Non-equivalent Control Group design. In this study, the samples will be grouped into two and given different treatments. In the beginning, students were given a pretest to determine the student's initial abilities. The experimental group was the group that was given treatment by applying the VAK learning model (visualization, auditory, kinesthetic) and the control group was the untreated group. The design research can be shown as follows:

O_1	X	O_2
O_3	-	O_4

Fig.1 Non-equivalent Control Group Design

Note:

X = Experiment
\- = Control
O_1 = pre-test experiment group
O_2 = post-test experiment group
O_3 = pre-test experiment group
O_4 = post-test control group

The population is all eleventh-grade students of senior high schools majority in Mathematics, and Natural Science consists of seven different groups, from those population researchers take Sampling with use purposive sampling technique so have thirty-eight participants as an experiment and so is a control group that includes three types of learning styles visual, auditory and kinesthetic.

There are two data collection techniques used: instrument objective test, pre-test, and post-test compiled and developed by the researcher with five Linear equations with two variables, then observation technique to record all activities student's in learning related to describe more accurate data. The data obtained were analyzed using descriptive statistics to describe problem-solving abilities based on observation sheets and inferential statistics to prove hypothesis test whether the application of the VAK learning model is effective in improving problem-solving in mathematics learning. In addition, response questionnaires to the experiment group students are given after all the learning series had been carried out.

3. RESULTS

The results of this study intend to focus on describing students' effectiveness of problem-solving toward VAK model learning. This research used one-way ANOVA with IBM SPSS version 20 to analyze the results incomplete data.

Table 1. The Result of Descriptive statistical value pretest and posttest

Statistic	**CONTR VALUE**		**EXP. VALUE**	
	Pre.	**Post**	**Pre.**	**Post**
Subject	38	38	38	38
Lowest	5	25	5	45
Highest	70	95	70	95
Mean	35,79	60,13	36,84	72,37
Standard Dev.	20,845	21,763	20,082	14,966
Varians	434,495	473,631	403,272	223,696

Based on Table 1, the control group's highest and lowest pretest scores are 70 and 5; the average is 35.79 with a deviation standard of 20.845 and a variance of 434.495. The highest and lowest scores for the Posttest, respectively, in the control group, are 95 and 25, an average of 60.13 with a deviation standard of 21.763 and a variance of 473.631, while the highest and lowest scores of the pretest respectively for the experimental group were 70 and 5. The mean obtained is 36.84, a deviation standard of 20,082 and a variance of 403,272. The highest and lowest scores for the Posttest, respectively in the experimental group, were 95 and 45, with an average of 72.37, a deviation standard of 14.966, and a variance of 223.969. If problem-solving abilities are grouped, based on the frequency and percentage of pretests will be included in the low category.

Table 2. Frequency and Percentage Distribution of Mathematics Problem Solving Ability Control Group Pretest

Mastery Level	Category	Pre. Contr.		Post exp.	
		Fr.	(%)	Fr.	(%)
5 – 17	Very Low	10	26,3	11	28,9
18 – 30	Lower	7	18,4	4	10,5
31 – 43	Middle	5	13,2	6	15,8

44 – 56	Higher	8	21,1	9	23,7
57 – 70	Very High	8	21,1	8	21,1
SUM		38	100	38	100

Based on table 2, the problem-solving ability for the pretest in the control group, the highest percentage of 26.3% is in the very low category, while the problem-solving ability in the pretest experimental group has the highest percentage of 28.9% in the very low category. So, it can be concluded that the most significant percentage of problem-solving ability for both the pretest in the experimental and control group is the lowest category.

Table 3. Frequency Distribution of Mathematics Problem Solving Ability Posttest both Control and Experiment Group.

Mastery level	Category	Post control.		Post exp.	
		Fr.	(%)	Fr	(%)
25 – 38	very low	9	23,7	5	13,2
39 – 52	Lower	5	13,2	7	18,4
53 – 66	Middle	9	23,7	6	15,8
67 – 80	Higher	7	18,4	9	23,7
81 – 95	Very High	8	21,1	11	28,9
SUM		38	100	38	100

Based on table 3, the problem-solving ability of the control group for the posttest, the highest percentage of 23.7%, is in the lowest category, while the problem-solving capacity of the experimental group for the post-test is the highest percentage of 28.9% in the very high category. So, it can be concluded that the most significant percentage of students' mathematical problem-solving abilities for the posttest in the control group is in the very low category, while the most significant percentage of problem-solving skills for the posttest in the experimental group is in the very high category.

Table 4. *Test-t*

Post	F	Sig.	Tf	df	Sig-(2-Tailed)
	5,70	0,019	2,856	74	0,006

The hypothesis was analyzed using the independent sample *t-test* based on data-collecting post-tests of both groups, then data processing using SPSS that shows sig. = 0.006 < α = 0.05. *Table 4. Test-t* above, then it can be stated that Ho is rejected. Thus it can be concluded that the mathematical problem-solving ability of students with the treatment learning model is more effective than that one.

Data-collection observation and student response questionnaires to 38 students were given after all the learning series had been carried out, starting from the second up to the sixth meeting. The results of the data analysis of student responses to the learning model with the "Positive" category.

4. DISCUSSIONS

The Visual, Auditory Kinesthetic (VAK) learning model provided students with a clear and operational understanding of the relationship between mathematics and its benefits for their life, which is constructed and developed. The way of problem-solving must be not singular and the same between one student and another, but we had to know that studying mathematics required a process in order students to be more active in learning and provide opportunities to apply mathematical concepts to solve everything in their life.

The data-collecting both control and experiment group pretest show respectively that very low and very high scores were 5 and 70, while the experimental group pretest shows respectively the lowest and the highest was 5 and 70. It stated that no significant difference between the lowest pretest scores in both control and experimental groups.

But on the other cased control group posttest, the lowest and the highest score respectively was 25 and 95, while in the experimental group posttest the lowest and the highest score respectively was 45 and 95. It seems that there was a difference between the lowest score of the control group posttest and the experimental with a difference of 20, but there is not a difference at the highest value.

5. CONCLUSIONS AND SUGGESTIONS

The mathematical problems solving student's ability without the VAK learning model was in the very low category. This was indicated by the percentage gain in the low category of 23.70% with an average score of 60.13 from 38 students; in other cases, the experiment group that applied Visualization, Auditory, and Kinesthetic of learning models was at the very high category. This was indicated by the percentage gain in the high category of 28.90%, with an average score of 72.37 from 38 students. Then observation data show that students' activity in the learning process since applied the model learning were enthusiasm. Based on both sample data-collection after analyzing the effectiveness test, it was concluded that using the learning model effectively increased problem-solving student abilities for senior high school for majority mathematics and science.

The results of this research were expected to aid students in knowing their learning styles and diminish their weaknesses. Students must find out their learning styles and how they chose to obtain the input in the class. So that learners get their gladness to follow the learning process and make them easier to understand related to everything they studied. Furthermore, mathematics teachers should (1) be more careful about diversity in student learning styles, (2) know what is needed by students, (3) wise to create various situations and learning models, (4) be creative and innovative to apply various techniques and strategy. In this study, the researcher hopes that the next researcher should do the research closest to this study and extend it to other variables to reveal every aspect that supports, enhances, and develops the quality of writing skills research, in addition to the limitations of research variables, populations, samples. The author hopes that other researchers will conduct the same study using a broader population and subject.

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