A CORRELATIONAL ANALYSIS ON LEARNING STYLE PREFERENCES AND MATHEMATICS PERFORMANCE OF JUNIOR HIGH SCHOOL STUDENTS

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ABSTRACT

This study aimed to investigate the level of learning style preferences and mathematics performance of junior high school students. A quantitative-descriptive-correlational design was utilized in the study. Mean was used as statistical approach to get the level of learning style preferences in terms of the identified indicators – logical mathematical, kinesthetic, auditory, and visual. To test the significant relationship of the two variables, Pearson-r was employed as statistical. The results indicated that among all indicators of the learning style preferences, auditory got the highest mean while logical mathematical got the lowest. Also, it was found out that there was a significant relationship between learning style preferences and mathematics performance of students using the test scores results in mathematics. Additionally, these findings suggest that logical mathematical learning style should be given focus and emphasis to improve mathematics performance of the students. Moreover, among all the indicators of learning style preferences, it was found out that auditory does not predict Mathematical performance wherein visual, kinesthetic and logical mathematical do. On the other hand, other domains of learning style preferences such as visual, kinesthetic, and logical mathematical are predictors of mathematics performance. The study concluded that the assessing the learning style preferences of the students was helpful in attaining high performance in mathematics. Therefore, it was recommended that teachers should design differentiated lessons and activities which target varied learning style preferences of the students.

Keywords: *learning style preferences, mathematics performance, test scores, descriptive-correlational study linear regression analysis*

INTRODUCTION

The Problem and its Background

One of the most persistent concerns among Mathematics educators worldwide is to enhance students' mathematics performance. Mathematics performance is greatly affected when there is lack of concept, low mathematical skills, or understanding of the fundamental learning styles that may create a negative outlook toward the subject (Gloria, 2015). Identifying learning styles of students leads to the application of suitable and effective

mode of instruction to them (Abrahams, 2015). When students have opportunities to learn in their preferred learning style, they are more likely to be engaged and motivated which leads to increased learning performance.

In the global setting, notably, in South Africa, it was discovered that learning styles related to Mathematics performance. The study found that students who chose to learn visually or kinesthetically performed better in Mathematics than those who were more interested in learning though auditory (Kempen & Kruger, 2019). According to the study, a learning approach that enables a student to select and use the most suitable learning style should consider the fact that learning styles can evolve and change over time. Other factors, such as student motivation and prior knowledge, may be relevant in Mathematics performance (Delima & Amam, 2018).

Looking into the national setting, researchers investigated the records among Filipino students with regards to their academic performance in Mathematics. According to the results that were released on December 03, 2018, from the Program for International Student Assessment (PISA), it revealed that the Philippines achieved an average of 353 points in Mathematical Literacy which is significantly lower than the OECD average (489 points) and is classified as below level 1 proficiency (DepEd, 2019). These records were not good enough because of some possibilities that they do not take practical tests and not be able to familiarize their preferred learning style. Studies about these circumstances prescribed that students would most likely express their low expectations and begin to assume their percentage of failing in Mathematics.

In the local setting, in Andap National High School, more explicitly in the Mathematics Department, the general result of the Mathematics Summative Test of students for the previous school year revealed that most of the students simply have a place with the average level. More forthright, there are learners who have a place with less than the ideal position and they contain 54 percent of the populace. Furthermore, based on data from Mathematics subject teachers on last school year, it was revealed that most students gained an overall average of 72.8 percent in math proficiency level. The alarming facts revealed that students in Andap National High School recorded below average Mathematics Proficiency in previous school year, prompting the researcher to use the information in making the research, with learning styles as the central variable in the study of students' mathematics performance.

Review of Related Literature and Studies

To gain deeper understanding on the concepts used in the research, a review of related literature was given.

Learning Style Preferences. As stated by Faradillah and Hadi (2020), knowledge of the learning styles suggests to both teachers and students. Additionally, students categorize the knowledge preferences that can assist them in using appropriate acquiring knowledge tactics. As a product, it might develop into lifelong independent learners and to enhance the student's actual capacity. Additionally, the teachers created knowledge of the learning preferences of the students and integrated instructional techniques that match the needs of the students' inclinations.

However, learning style preferences arise because of our genetics, life experiences, and the demands of our current setting, according to psychologist David Allen Kolb. Kolb also has developed a theory of Experimental Learning. In his Experimental Learning Theory, learning is viewed as a four-stage cycle. In the first stage, observations and start to develop a general hypothesis about what the information might mean. In the next stage, the learner developed abstract concepts and generalization based on their hypothesis. Finally, the learner puts the implications to test in new situations. The process then returns to the first stage of the experiential theory after this phase (Cherry, 2019). Kolb's cycled theory is based on the concept that individuals undergo a continuous process of interpreting information and implementing improvement of ideas.

Moreso, in another research consisted of seventy-five (75) third year Bachelor of Science in Electronics (BS Ind. Tech) and Bachelor of information Technology (BSIT) of Cagayan State University of Lasam, Philippines, the results of the study show that the students of applied sciences courses preferred visual, group and Kinesthetic as major learning styles while they manifest a moderate level of study habits. They also have a good level of academic achievement. There were significant relationships between learning styles, study habits and academic performance of students in applied science courses (Magalod, 2019).

In as much, Li, et al. (2019) presents that "learners are affected by their: (1) immediate environment (sound, light, temperature, and design); (2) own emotional (motivation, persistence, responsibility and need for structure and

flexibility)1; (3)sociological need (self, pair, peers, team, adult, or varied); and (4) physical needs (perceptual strengths, intake, time, and mobility)" (Banas, 2018). According to the authors indicated above, learning style emphasizes the different aspects (environmental, emotional, physiology, psychology, and sociology) as the main factors on the knowledge intake of individuals and students in the medium of learning.

Moreover, a study was conducted about the effects of perceptual learning styles in the academic performance of students. The locale of the study was in Agusan Del Sur National High School, Philippines, wherein 147 respondents in the General Academic Strand that are identified through systematic sampling are given form of self-assessment questionnaire by Victoria Chislett MSe Alan Chapman 2005. The questionnaire is composed of 30 statements and 10 items that correspond to each of the learning style. The findings revealed that the perceptual learning styles have effects to the academic performance of the students, as this was justified by the results of the decision rule, and that the samples who had determined their learning styles have responded well and did outstandingly in class (Cimermanova, 2018).

In addition, another major proponent of learning styles is Neil Fleming. He proposed the visual, auditory, reading and writing, and Kinesthetic (VARK) learning styles. The most popular current conception of learning styles equates styles with the preferred bodily sense through which one receives information, whether it be visual, auditory, reading and writing, and Kinesthetic (Kirschner, 2017). Fleming's model is associated with strategies in learning an individual by determining and measuring four perceptual references.

Also, learning styles were discovered to be influenced by the student's learning behavior in acquiring learning information. Aside from listening, reading is a receptive skill that is utilized to retrieve information. People see or hear information from the debate. As a result, reading has become one of the most crucial abilities in learning, with many students still struggling to obtain and comprehend information from a text, particularly in their reading achievement. Reading is often listed first among academic abilities that many languages learners desire to acquire (Renandya & Jacobs, 2016). Reading comprehension is a fantastic approach to get individuals to think about the purpose of what they're reading.

Also, math achievement is a key metric for evaluating the effectiveness of any nation's educational system. Additionally, mathematics is a crucial subject for nations with developing economies because it allows enrolling students in programs leading to careers in engineering, the natural sciences, accounting, and many other fields is essential to promoting economic development. Thus, it is really concerning that according to several studies (Pournara, Hodgen, Adler & Pillay, 2015; Reddy, Winnaar, Visser, Feza-Piyose, Arends, Prinsloo, Mthethwa, Juan & Rogers, 2013), mathematics education in South Africa is in dire need of improvement. The renowned Trends in International Science and Mathematics Study (TIMSS), carried assessed in 2011, discovered that South African students' performance was subpar; students when compared to public schools, independent school students outperformed them in age appropriate.

Consequently, according to Bhagat et al. (2015), the term "learning style" came into use when researchers began looking for ways to combine course presentation and material to match the needs of each learner. From this perspective, learning style is considered a broader term that includes the construct of cognitive style. Also, learning styles can be defined, classified, and identified in many ways.

In addition, Gloria (2015) claims that pupils have low performance in mathematics because of a lack of knowledge, mathematical abilities, or a love and appreciation of the subject's fundamentals. They could foster a pessimistic view on the topic. Depending on their preferred methods of learning, students could continue their education quickly and effectively. Teaching students according to their preferred learning style can assist them in gaining the proficiency required to manage a variety of learning objectives.

Generally, they are over all patterns that provide direction to learning and teaching. Learning style preferences can be also described as a set of factors, behavior, and attitude that facilitate learning for an individual in each situation (Schmeck, 2014). While there is a general definition for learning styles, there are many proponents, however, that contributed to finding proposing paradigms for learning styles.

Similarly, Perna (2014) conducted a study about learning styles and their effect of students learning. The instrument used in the study was the Index of Learning Styles (ILS) inventory by Felder and Silverman, wherein 260 respondents completed in answering the ILS inventory. Results show that learning styles really cause the students to respond differently to various activities or styles of presentations utilized in the class.

Also, teachers of mathematics are faced with the challenging endeavor of developing a constructivist learning environment, considering the educational preferences for styles among the students in the class. According to Hermond (2014), this is one of the most significant learning style models ever created. An individual's approach to learning is defined by how they begin to concentrate, organize, assimilate, and recall fresh information. Apart from sound, individual vs group learning, and learner mobility—all of which are related to the kinesthetic, individual, and group learning styles—teachers may not have much control over these aspects of the classroom environment.

Visual. The use of visual learning styles in classroom instruction is crucial for understanding scientific concepts including content in the curriculum enhances students' comprehension, performance, and achievement in lessons. Visual thinking relies on two processes, namely the use of sight to identify objects, understanding and creating new images by reusing past experiences and imagination. Cognitive processes in the brain rely on memories of previous experiences, including vision and imagination (Abri et al., 2023; Tashtoush et al., 2022).

Similarly, visual modalities allow students with visual learning styles to access generated visual or recalled, including hues, patterns in space, mental imagery, and mental portraits. The signs are presentable and organized look, cool response to stimuli, and rapid speech. Furthermore, organizing for anything well over time, being able to quickly scan through or understand just the broad strokes, like read silently instead of vocally. Additionally, visual learners create a great deal of symbols and images in notes, retain associations in visual form, recall what they see rather than what they hear, and forget spoken instructions more easily than written comprehension. In general, they favor other forms of art than music (Firdausy & Waluyo, 2019).

Additionally, students that learn visually can articulate issues effectively. They can comprehend and clarify the concepts at play in the issue. Furthermore, they can provide a thorough and methodical explanation of the stages involved in completion. Visual learners can perform well when analyzing arguments that are relevant, understandable, and comprehensive. Sometimes they are unable to draw comparisons, leading them to draw incorrect conclusions. Individuals that are visual learning style will perceive or conjure up the words. Additionally, he comprehends artistic issues to a sufficient degree; he merely struggles with spoken guidance and direct communication (Permana & Mulyono, 2017).

In as much, students who learn best by listening adore music and according to Mead (2018), he claims that people can recall the lyrics to songs they hear. Auditory learners can comprehend spoken language with ease guidelines and comprehend a concept. They read aloud instead of in silence. Additionally, auditory learners comprehend that the instructor presents the idea to the class instead of required readings.

Furthermore, according to Robledo (2017), giving in to the desire of materials for an auditory learner should be supplied so they can assist them in learning. For doing so, discussing the topic or inquiring with a student who prefers auditory learning can be beneficial to the student to comprehend the lesson's novel idea. The teachers have been mindful of the learning styles of students and integrated instruction techniques that fit the learning preferences of the students; this would establish a productive learning atmosphere and inspire the learners to succeed academically.

Also, a math instructor who is educating with a visual learning approach could give students a visual dictionary to help them understand mathematical ideas both in English and in their native tongue. According to one study, such a dictionary enhanced the quality of mathematics instruction at school. The usage of suitable mathematics software, which offers a dynamic visualization of concepts, can also help teachers facilitate the learning of visual learners (Bansilal, 2015). Since everyone has a preferred learning style and some students have different preferences, it is also necessary to take other learning styles into account in the classroom possess multiple modes.

In as much, visual learners are typically the most numerous in a classroom (Nel & Nel, 2013). They prefer the representation of knowledge through diagrams, graphs, and other ways of presentation (Fleming, 2015). Auditory learners, who typically account for 20% or fewer of a class (Nel & Nel, 2013), prefer spoken and heard information and hence learn through lectures and group discussions (Fleming, 2015; Jukeviien & Kurilovas, 2014). Learners with a reading/writing learning style prefer knowledge presented in the form of words and learn more successfully by reading and writing (Fleming, 2015; Jukeviien & Kurilovas, 2014).

Consequently, visual learners like handouts (Prithishkumar & Michael, 2014), as well as take notes that are later studied (Fleming, 2015; Khanal, Shah, & Koirala, 2014). A mathematics teacher that uses a visual learning teaching approach may give students with a visual dictionary to illustrate mathematical topics in both English and their native language. According to one study, such a dictionary boosted math learning. Botes and Miji (2010) define school as a place of learning. Similarly, a teacher can help visual learners learn by using proper Mathematics software that enables dynamic visualization of topics (Bansilal, 2015).

Furthermore, Alde and Ogbo (2014) stated that there were investigations which found that learners who prefer visual aids have more performance compared to those having kinesthetic and auditory styles of learning. Moreover, Moayyeri's (2015) research revealed that students that prefer visual learning methods outperform people who learn best through tactile and aural means. Like Bosman and Schulze's (2018) work, students with visual Math performance are higher for those with learning styles, kinesthetic and auditory learning modes come next.

Auditory. Based on the study of Kozinsky (2017), he stated that the optimal learning environment for the generation of students because they refuse to be passive learners. Generation Z is a collaborative group and anticipate being completely absorbed in the educational process. In additionally, this generation's predominant learning approach was superior to auditory learning techniques which preferred to be auditory and visual. Malat (2018) believed the learning styles of Generation Z were different other generation.

Also, according to Rahman et al. (2016), auditory learning style is a learning style in which people learn better when they can hear what they are learning. Individuals with an auditory learning style exhibit behaviors such as talking to yourself at work; being easily distracted by a commotion; moving their lips and reading out loud when reading; being glad to read aloud and listen; being able to repeat back and mimic the tone, rhythm, and timbre; finding it difficult to write, but great storytelling; and speaking in a patterned rhythm.

Additionally, teachers are responsible for encouraging students to develop their ideas in relation to mathematics (Ozarka, 2016). Additionally, using audiovisuals and films to teach arithmetic is a fantastic substitute for lectures. It offers a remarkable a tool for students to use self-paced learning, offering a more thorough comprehension of the students in relation to the ideas in mathematics that present a difficulty on their own speed.

However, because many teachers use an aural teaching style, the traditional classroom is best suited to auditory learners. If your child is an auditory learner, you should have no trouble obtaining educational materials to employ when schooling him or her. If the learner does not have visual processing impairments or underlying speech-language issues, teaching reading and writing to an auditory learner is often simple (Naurzalina et. al., 2015). If your child has an auditory learning style and challenges with reading or writing, he should be assessed for any underlying concerns that may be causing his difficulties.

In as much, auditory learners enjoy reading dramas and conversations, but they struggle to read silently and quickly when they are not allowed to vocalize. Students with auditory learning styles frequently rely on the effectiveness of hearing-based learning. According to Maric (2015), auditory learners can memorize more quickly by reading text aloud and listening to tapes. The teacher should pay closer attention to pupils who learn best through verbal exchanges and listening to what the teacher says. In other words, the instructor should always endeavor to include pupils with auditory styles in any discussion, both within and outside the classroom.

On the other hand, because auditory learners have processing strengths in language-based domains, any program that involves reading is likely to be an excellent curriculum choice once they know how to read (Ahmad et. al., 2014). There are various homeschooling math programs that cater to auditory learners. You can teach your youngster using any program that has an aural component that explains the mathematical principles.

Kinesthetic. Martinez (2017) suggests that effective math education requires a combination of communication, social, and emotional skills, as well as playful and performative methods. The challenge is to update and modify existing teaching practices by introducing new interdisciplinary approaches that were not previously supported. Ensemble performances and creative group collaborations can help improve communication skills.

Also, the analysis, which starts with comprehending the problem based on the mathematical ideas involved, can be completed by kinesthetic students. Interviews verify that they can rewrite the data gathered for the sola. Aside from that, they can sketch well but not in detail. They occasionally do not finish as neatly as a pupil who learns by seeing. This is consistent with the findings of Jaenudin et al. (2017) study, which found that kinesthetic learners typically like to go right to the conclusion. They can, however, genuinely describe how to get these solutions, which are typically discovered intuitively.

Additionally, kinesthetic learners find it difficult to concentrate for extended periods of time while listening to lectures, hence it is best to incorporate physical movement into the learning process. Students with a kinesthetic learning style speak more slowly, react physically when others speak to them, touch others to catch their attention, and stand near to them when conversing. They learn by doing and practicing; they memorize by walking and observing; they use their fingers as pointers when reading; they make a lot of body motions; and they use action-packed phrases, such as those found in narrative-heavy books (Wahyuni & Umam, 2017).

In as much, students with a kinesthetic learning style are unique. They absorb information using physical strategies and expressions. Students with kinesthetic learning styles are often easily forgotten when given directions in writing or verbally, because they tend to understand the task better if they try it directly. Therefore, it is necessary to know the intuitive understanding of students who have kinesthetic learning styles in problem-solving and other math problems. The National Council of Teachers, according to the Department of Mathematics, problem solving is a skill in high-level mathematical thinking to develop thinking skills (Ariadi, 2016).

In addition, kinaesthetic learners learn best by moving and interacting (Amran, Bahry, Yusop, & Abdullah, 2011; Jukeviien & Kurilovas, 2014). As learners thrive, they frequently find it difficult to sit still for long periods of time rather than 'chalk and talk' education (Bennett, 2013; Leopold, 2012). Engage students directly in solving mathematical problems based on the students' previous experiences.

More so, the preferred learning technique, however, appeared to be controlled by age and gender, with learners in grades 1 to 3 relying more on the writing style than older grades 4 to 5 learners; and that girls were more adept at aural, visual, and kinesthetic learning than boys. This demonstrates that demographic variables can influence learning style preferences in mathematics.

Logical Mathematical. Mathematics is a scientific subject with static and monotonous topics, relying heavily on numbers and symbols. Studying it requires strong logical thinking skills. To effectively teach diverse subjects, teachers must be efficient and tactful in delivering information and interacting with data in a way that motivates and engages students. This impacted the achievement of math teachers (Wardat et al., 2023).

More so, according to Tashtoush et al. (2023), logical mathematics refers to the brilliance of numbers obtained through arithmetic operations. These students demonstrate a high level of problem-solving, scientific thinking, and mathematical skills. Gardner's theory defines logical mathematical intelligence as the ability to infer, calculate, and analyze patterns. It is used in schools to solve problems and learn how to create things. Logical mathematical intelligence encompasses problem-solving, interpretation, and abstract thinking, as well as arithmetic operations like classification, tabulation, inference, generalization, deduction, conclusion, hypothesis testing, and statistical analysis.

On the other hand, several factors contribute to this, including outdated curricula, outdated topics, insufficient suspense, and separate presentation of concepts to students. Poor mathematics teacher preparation and the use of traditional teaching methods. Considering the foregoing, the purpose of this study is to determine the impact of logical mathematical intelligence on students' academic performance in mathematics (Tashtoush et al., 2023).

Additionally, students who do not follow routine procedures solve math problems faster because their solutions are influenced by prior experience, whether consciously or unconsciously. Furthermore, students with good logical mathematical skills. According to Sa'o et al. (2019), each student's understanding may lead to unique solutions.

Also, it should be emphasized that the approaches to instruction currently employed with students in imparting knowledge and science-related subjects such as mathematics are nothing more than general strategies prepared in advance to suit all students, and the majority of them rely on direct training, which is ineffective for attaining mathematical goals, and uninteresting techniques are used without regard for the students' behaviors, skills, and aspirations. These methods resulted in poor performance on achievement tests for a group of students, as well as alienation, boredom, and negative attitudes toward study materials, teachers, and the school (Al-Masarwa, 2015).

As a result, several studies were recommended, including Hussein's (2015) emphasis on the importance of the logical mathematical intelligence strategy in raising student achievement (Rasheed & Tashtoush, 2023). Possibly one of the reasons for students' low achievement in mathematics is the return to the disadvantages associated with conventional curriculum in mathematics instruction. The traditional curriculum's goal is to improve students' mathematical achievement, with a focus on typical training and memorization. Teaching math skills, memorizing rules and theories through training and repetition without emphasis on comprehension and application (Fannakhosrow et al., 2022).

Furthermore, logical mathematical can aid in problem-solving (Hirza et al., 2014). When faced with a challenging circumstance, students can use their intuition or prior knowledge to make logical decisions. Students can solve math problems intuitively rather than using logical reasoning.

Mathematics Performance. According to Willingham et al. (2021), practice alone will not result in the working memory capacity for efficient math operations. With effort, math performance can be improved aptitude, and IQ. Putting students to the test to see how well they can solve difficulties; one must first grasp mathematical skills and the fundamentals of mathematics.

In addition, Mathematics is the pillar of organized life, it is necessary to understand the other branches of knowledge, that there is no science, art, or specialty without Mathematics as the key to it (Quddsi, 2018). Truly, mathematics is a vital tool in day-to-day life as this discipline enables every person to learn how everything works, seek solutions for complex real-life problems, and become successful in life. But despite the essentiality of Mathematics, there is a common belief that the majority of people, especially students, struggle in Mathematics and consider the subject difficult.

In the Philippines setting, most Filipinos have manifested a decline in Mathematics performance. In the Program for International Student Assessment (PISA) 2018 National Report of the Philippines by the Department of Education (DepEd), it states there that Filipino student achieved an average of 353 points in Mathematical Literacy; this is significantly lower than the OCED average (488 points) and is classified as below 1 proficiency (DepEd, 2019). Another evidence that affirms the poor performance of Filipinos in Mathematics is the study that records the mathematics performance among different countries worldwide, which is the Trends in Mathematics and Science Study (TIMSS).

According to Pecha (2018), mathematics is a creative and visual theme, rather than merely repeating calculations and drills or disjointed processes. Putting knowledge on display helps and links to the deep conceptual understanding for the student's comprehension of math. Since students frequently fail to recognize the significance of the fundamental ideas and principles of the subject, many professors will conclude that many of them lack a solid foundation in mathematics. This is the underlying assumption that the researcher is motivated to create this collection of instructional resources.

Moreover, results showed that Philippines ranked last among 58 participating countries after attaining a score of 297 in Grade 4 Mathematics. International comparison studies have regularly shown that pupils in the United States lag children in other industrialized countries in mathematics achievement since the 1960s (Programme for International Student Assessment (PISA, 2014) and the Third International Mathematics and Science Study (TIMSS). TIMSS identified four benchmark levels to describe what students know and can do in Mathematics and demonstrate the range of performance internationally: Advanced (625), High (550), Intermediate (475), and low (400). It was reported that 19% of Filipino students were on low benchmark, which means that "students have same basic Mathematical knowledge", while the 81% did not reach this level (TIMSS, 2019).

In another hand, poor performance in Mathematics appears to be caused by teachers who lack the knowledge and skills to clearly explain concepts, and a shortage of Mathematics textbooks. Teachers who do not understand mathematics focus on prescribed curricula (Siyepu, 2015). Cognition in learners (Henning, 2015), as well as the fact that most South African learners are English second language learners who struggle to learn Mathematics using English as the medium of instruction. Poor performance in mathematics can also be linked to the teaching style of prolonged mismatches between the teaching style in the classroom and the learning styles of the teacher. Most students can contribute to low academic achievement and negativity toward a subject (Fritz et al., 2020).

Additionally, while understanding mathematical problems, high school students' math learning achievement, and students' ability to solve math problems are all impacted by learning styles, these findings align with research by Hartati (2015) that demonstrates that every student has a unique learning style. Because of this, a teacher's inventiveness is required when presenting mathematical material to ensure that every student has fun while learning in accordance with their preferred method of learning.

With this, to defeat the impoverished the student's mathematics performance, the students to get over the legacy of inadequate teaching methods and perception of oneself in relation to mathematical ideas according to Frodsham (2015). A subpar performance shows that the learner at this level has the minimal level of comprehension, abilities, and information, but needs assistance implementing the idea.

Independent Variable

For many years, educators and researchers have been assessing the different variables that influenced a students' academic achievement in Mathematics. As a study focuses mainly on learning styles, researchers and studies about relationship between learning styles and mathematics are given. The techniques for instruction and educational setting improve the students' learning experience by offering an enhanced accessibility to the instructional resources (Brodsky, 2017). Additionally, providing data to the students in many ways results in a more meaningful educational experience encounter.

More so, according to study of Camposano, et al. (2015), to determine the relationship between the learning styles of grade eight students and their mathematics performance during the first quarter in Los Baños Integrated School, Los Baños, Laguna, the Learning Style Inventory Questionnaire was administered to 187 randomly selected respondents. The data gathered from the questionnaire were analyzed and interpreted using descriptive statistics through frequency counts, percentage and inferential. The results show that there is no significant relationship between the two variables (Camposano et al., 2015).

Furthermore, Adeniji, (2015) sought to explore the distributions of learning styles and their impact on the performance of tertiary mathematics education students in Katsina State. The researchers used the Students Learning Style Rating Scale (SLSRZ) and the Mathematics Achievement Test (MAT) to collect data from 112 NCE 11 Education students who were chosen at random for the study. The study found that most learners applied the Reading and Writing Style, followed by Auditory/Verbal, Visual/Graphic, and Kinesthetic. Furthermore, the chosen learning method of children has little effect on their mathematics performance and is not statistically significant.

In as much, teachers of mathematics should be informed, encouraging, and patient. They should also help students develop positive self-concepts that will reinforce their view that they can learn on their own at home. It is possible that some of the relevant school's teachers don't know enough about mathematics to provide good instruction. According to Pournara et al. (2015), there is a considerable increase in learners' achievement when teachers possess better content understanding.

In addition, Kolb's Learning Style Inventory was used to characterize learners' learning styles, and they were then classified as converging, deriving, assimilators, or accommodators depending on their preferred learning styles. The researcher examined all four experiential groups to see if they were all on the same page prior to the Algebra study. Before being post-tested, each learning type group was assigned to a separate classroom and taught the same content using appropriate teaching approaches. The Post-test scores revealed a substantial variation in the performance and learning style of Grade 11 students (Silas, 2014). A favorable atmosphere for learning in the Math classes are crucial, with qualified teachers who are sympathetic and helpful. Teachers must use visual media creatively and think of innovative methods for students to interact with physical items to enhance their learning to support visual and kinesthetic learning styles.

In as much, a study by Adnan, et al. (2014) was conducted with the objective of determining the relationship between the different learning styles and mathematics achievement among students at High Performance School. Three hundred sixty-two (362) students were randomly selected to be the respondents of the study. The instrument used to determine the preferred learning style of students is in the form of a self-assessment questionnaire while the achievements test was based on the respondents' final year examination grade. The findings revealed that all the relationships between all the dimensions of learning style and mathematics achievement are found to have a week relationship.

According to what was discovered of the preceding inquiries, students' learning styles had little influence on their mathematical performance. However, one of the previously cited studies discovered a relationship between learning styles and mathematical performance. The explanation for the contradicting results is that there could have been other factors influencing mathematics performance outside their preferred learning styles

Conceptual Framework

This study is anchored in Experiential Learning Theory of David Kolb (1984). It gives emphasis on the significance of helping students to determine their learning strengths and shortcomings. It is believed that students can design more effective learning strategies after they understand their learning type. A visual learner, for example, would utilize flashcards or mind maps to assist them acquire new information. Overall, Kolb's learning styles hypothesis is

a helpful tool for understanding and improving learning. People can learn more efficiently and realize their full potential by understanding their own learning type as well as the learning styles of others.

The learning styles serve as the independent variable. With VAKL model as research indicators: Visual, Auditory, Kinesthetic, and Logical Mathematical of Prithishkumar & Michael (2014). It is suggested that the four learning styles in VAKL reflect the experience of the students to have knowledge of their preferred learning style, then they got to maximize their learning potential, which eventually led them the upper hand in performing well in Mathematics. Through this study, the learning style preferences of the students will be assessed and evaluated if VAKL significantly predict mathematics performance.

On the other hand, the dependent variable of the study is the mathematics performance which utilized a researcher-made 40-item test questionnaire. This was validated by the panel of experts and administered to the research respondents.

The central focus of this study was to determine how significant the learning style preferences of students towards their mathematics performance were. This objective was achieved by determining the learning styles and Mathematics performance of students through survey methods and correlate them using the suitable statistical tool.

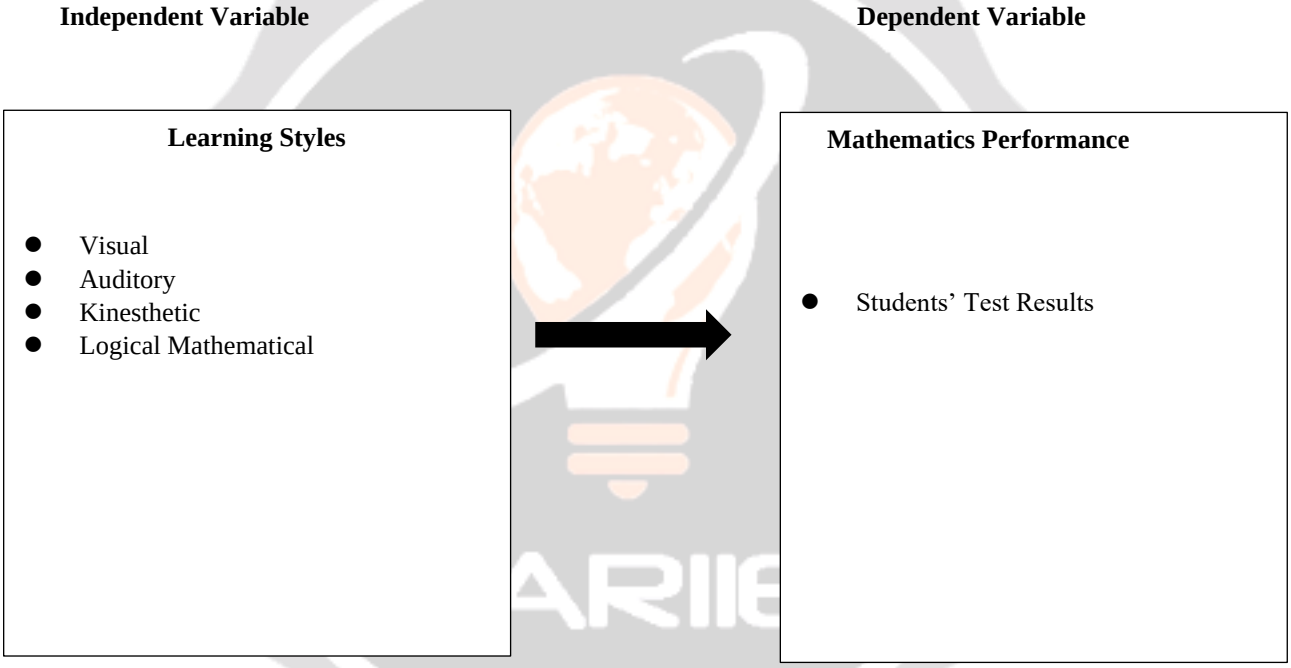

Figure 1. Conceptual Framework

Statement of the Problem

This study sought to answer the following questions:

1. What is the level of students' learning styles in terms of:
   1.1 visual;
   1.2 auditory;
   1.3 kinesthetic, and
   1.4 logical mathematical?
2. What is the level of Mathematics Performance of the students in terms of:

2.1 students' test results?

3. Is there a significant relationship between learning styles and mathematics performance of students in terms of:
   3.1 students' test results?
4. What domain of learning style preferences predicts mathematics performance?

Null Hypothesis

$H_{O1:}$ There is no significant relationship between learning style preferences and Mathematics performance among junior high school students.

$H_{O2:}$ There is no domain of learning style preferences that predicts Mathematics performance of junior high school students.

Scope and Delimitation of the Study

The study focused on assessing the level of learning style preferences of students in terms of logical mathematical, kinesthetic, auditory, and visual. This also measured the significant relationship between the learning style preferences and the mathematics performance among grade 9 students of Andap National High School and New Bataan National High School in terms of the test results in mathematics. This research undertaking was conducted in the school year 2023-2024. The respondents in this study were the selected grade 9 students of Andap National High School and New Bataan National High School. There were 195 respondents who participated this study based on the calculated sample size using Raosoft Sample Calculator.

Significance of the Study

Being a crucial aspect of learning, gaining a deeper understanding regarding different learning styles is of utmost importance to the following beneficiaries. The result of the study provided feedback and benefited the following:

Students. The results of the study could help students who are struggling to comprehend mathematics because of a possible incompatibility between the teaching approach and the students' learning style. This research would enable them to tailor their techniques or methods to their preferred learning styles. When they employ their learning style preferences, they would be able to obtain more comprehension and master their learning and skills. Students who understand their learning styles might take a more strategic approach to problem solving.

Teachers. The results of the study would be significant for teachers for them to be able to alter their teaching approaches based on their students' capabilities and preferences, as well as to create an environment that harnesses the students' learning style preferences. Teachers could utilize information about students' learning styles to identify pupils who may struggle with math. These students could then receive further assistance and resources. Teachers could use information about students' learning styles to produce differentiated education, which would be revealed in the results of the study, to develop differentiated instruction. This would also assist them in providing a variety of learning experiences and activities to satisfy the requirements of all students in the classroom.

Social Administration. The results of the study could assist school administrators improved student results in mathematics by understanding their students' learning patterns. Allocating resources to teacher professional development on how to differentiate instruction depending on learning types may also be considered. They could also buy educational resources that are tailored to different learning styles.

Department of Education. The results of the study would be used as bases for the enhancement of programs and policies in dealing with students' learning style preferences in designing the curriculum and learning resource contents. The Department of Education would be informed of the performance of the students in Mathematics with regards to its correlation to learning preferences of students.

Future Researchers. The results of the study would provide references for researchers who would conduct similar study in other research locale in the future. The results of the study would give those factual ideas and significant knowledge as research inclusion and concerns.

Chapter 2

METHODOLOGY

In this chapter, the discussions of the research design, the research locale, the population and sample, the research instrument, the data collection and the statistical tools are presented.

Research Design

The quantitative-descriptive-correlational research method was employed in this study, along with the use of an adapted questionnaire. The study collected data through a questionnaire-based survey method, opting for a quantitative research methodology. The descriptive design helped the researcher in obtaining and analyzing descriptive information such as the level of learning style preferences of the respondents of the study. Descriptive research entails collections of quantitative data that may be tabulated along a scale in numerical forms, such as test scores. It will involve gathering data, identifying occurrences and then arranging, tabulating, displaying, and summarizing the data collected (Glass & Hopkins, 1984).

The correlational design was utilized to determine whether the independent variable of the study, learning styles, has significant correlation with the dependent variable, mathematics performance. It looked to see if an increase or decrease in one variable corresponded to an up or down in another (Tan, 2014). Correlating the variables in the study will demonstrate its significance in the outcome based on the objectives of the study and supporting theories. This study strictly adheres to the National Ethical Guidelines (2017).

Research Respondents

The Raosoft Sample Population Calculator was used in this study to calculate the sample size and total number of respondents needed in the research. To obtain a sample for each part, the researcher used universal sampling technique to get the sample size of the respondents from Andap National High School. Also, simple random sampling technique was used to get the sample size of New Bataan National High School. The researcher employed the Raosoft population sample calculator, which yielded a sample size of 195 out of 395 with a margin of error of 0.05 and a degree of confidence of 95%. There were 60 respondents in Andap National High School and 135 respondents in New Bataan National High School which had a total of 195. The RAND function in Microsoft Excel, as well as the sort and filter tools, was used to generate random numbers and determine the correct number of answers.

Research Instruments

The researcher used an adapted questionnaire as a primary tool in the collection of data needed in the study, particularly the survey method in the pursuit of data collection.

Barsch Learning Preference Inventory Questionnaire. The modified Barsch Learning Preference Inventory is used in the second part of the questionnaire to collect data on the respondents' preferred learning style. The logical mathematical questionnaire was made up of 25 items. The rest of the learning styles was made up of 28 items that are further broken into 7 statements for each Learning Style (kinesthetic, auditory, and visual). The researcher altered certain statements to make them more contextualized and relevant to the study. On an ordinal likert scale, response categories range from 1 to 5. The rating scale is from 1 to 5 in which 1- never, 2- rarely, 3- sometimes, 4- often, and 5- always. The following parameter limits, descriptive equivalent, and interpretation will be considered for interpretation:

Statistical Treatment of Data

In contemplation of generating a systematic data treatment, the researcher interpreted the data using Statistical Package for Social Sciences (SPSS) and employ the following statistical tools: mean and pearson-r moment correlation.

Mean. It was employed to measure the level of learning style preferences of students and their mathematics performance.

Pearson Correlation. This statistical treatment was employed to identify the significant relationship between learning style preferences and mathematics performance of students.

Multiple Linear Regression. This was used to determine whether learning style preferences significantly predict mathematics performance.

Chapter III

RESULTS

This chapter presents the results obtained from the collected data and the subsequent analyses and interpretation based on the problems presented.

Level of Learning Styles Preferences

This section presents the results to the first statement of the problem that examines the level of students' learning styles in terms of logical mathematical, kinesthetic, auditory and visual.

Visual. Table 5 presents the level of students' learning styles in terms of visual.

Indicated in Table 5 are the categories under visual learning style. The category 'I like to write things down or take notes for visual review' shows the highest mean score of 4.1 and 'I am good at working and solving jigsaw puzzles and mazes' shows the lowest mean score of 2.8. Overall, it has a mean rating of 3.4 implying this indicator in auditory is interpreted as moderately agree.

Table 5
Level of Learning Styles Preferences in terms of Visual

Visual	Mean	Interpretation
1. I like to write things down or take notes for visual review.	4.1	Agree
2. I obtain information on Mathematics subject by reading relevant materials.	3.3	Moderately Agree
3. I am good at working and solving jigsaw puzzles and mazes.	2.8	Moderately Agree
4. I am skillful and enjoy developing and making graphs and charts.	3.1	Moderately Agree
5. I can understand and follow direction using maps.	3.5	Agree
6. I feel the best way to remember is to picture it in my head.	3.8	Agree
7. I can better understand a news article by reading about in the paper than by listening to the radio.	3.4	Moderately Agree
OVERALL MEAN	**3.4**	**Moderately Agree**

Auditory. Table 4 presents the level of students' learning styles in terms of auditory.

Table 4 presents the categories under auditory learning style. The category 'I do better at Mathematics by learning to lectures and discussions' shows the highest mean score of 3.8 and 'I prefer listening to the news on the

radio than reading about it on a newspaper' shows the lowest mean score of 3.4, respectively. Overall, it has a mean rating of 3.6 implying this indicator in auditory is interpreted as agree.

Table 4
Level of Learning Styles Preferences in terms of Auditory

Auditory	Mean	Interpretation
1. I require explanations of diagrams, graphs or visual directions.	3.6	Agree
2. I can tell if sounds match when presented with pairs of sounds.	3.5	Agree
3. I do better at Mathematics by learning to lectures and discussions.	3.8	Agree
4. I follow oral directions better than those written ones.	3.6	Agree
5. I prefer listening to the news on the radio than reading about it on a newspaper	3.4	Moderately Agree
6. I would rather listen to a good lecture or speech than read about the same material in a textbook.	3.6	Agree
7. I learn to spell better by repeating the letters out loud than by writing the word on paper.	3.7	Agree
OVERALL MEAN	**3.6**	**Agree**

Kinesthetic. Table 3 presents the level of students' learning styles in terms of kinesthetic.

The category 'I find ease in using calculator' has the highest mean of 3.8 with a descriptive rating of agree. Next, the category 'I remember best when I have my hands-on experience' got same descriptive rating of agree. Meanwhile, the categories 'I learn by using trial and error during solving complex mathematical equations and problems' and 'I enjoy manipulating toys' both have the descriptive rating of moderately agree. The category 'I use hand techniques in calculating mathematical equations and problems' got the lowest mean of 3.0 with a descriptive rating of moderately agree.

Overall, the indicator 'kinesthetic' got an overall weighted mean of 3.5 interpreted as moderately agree. The result indicated that among the categories, the grade 9 students seldom use hand techniques in calculating equations and solving mathematical problems.

Table 3
Level of Learning Styles Preferences in terms of Kinesthetic

Kinesthetic	Mean	Descriptive Rating
1. I enjoy manipulating toys.	3.5	Moderately Agree
2. I remember best when I have my hands-on experience.	3.8	Agree
3. I learn by using trial and error during solving complex mathematical equations and problems.	3.5	Moderately Agree
4. I learn best by demonstrating how to solve mathematical problems.	3.6	Agree
5. I use hand techniques in calculating mathematical equations and problems.	3.0	Moderately Agree
6. I find ease in using calculator.	3.8	Agree
7. I focus on applications and details before theories and abstract concepts.	3.4	Moderately Agree

OVERALL MEAN	**3.5**	**Moderately Agree**

Logical Mathematical. Table 2 presents the result of the level of students' learning styles of grade 9 students in terms of logical mathematical.

It can be gleaned from the table that the category 'I like to collect things and learn everything about a subject' got the highest mean of 4.2 and the descriptive rating of agree. This was followed by 'I have curiosity in space sciences, galaxies and stars' with a mean of 3.8 and the descriptive rating of agree. 'I love discovering how things work' came closely with a mean of 3.8. The next categories, which are 'I play crosswords puzzles' and 'I have a desire to learn science matters' earned the mean of 3.7 with the descriptive rating of agree. Meanwhile, the category that got the lowest mean was 'I know how tennis game runs are calculated' with the mean of 2.2 and the descriptive rating of disagree.

The indicator, logical mathematical, got an overall weighted mean of 3.2, with a descriptive rating of moderately agree. The result revealed that logical mathematical learning style needs more reinforcement and emphasis among students in learning mathematics lessons.

Table 2
Level of Learning Styles Preferences in terms of Logical Mathematical

Logical Mathematical	Mean	Descriptive Rating
1. I used to learn arithmetic and mathematics easily such as addition, multiplication and fractions.	3.6	Agree
2. At school, I had an interest in arithmetic and mathematics.	3.4	Moderately Agree
3. I do well in advanced mathematics classes, such as algebra and calculus.	2.7	Moderately Agree
4. I have a desire to learn science matters.	3.7	Agree
5. I have always wanted to solve scientific problems.	3.1	Moderately Agree
6. I know and play chess.	2.5	Moderately Agree
7. I play crosswords puzzles.	3.7	agree
8. I am good at solving jigsaw puzzles.	2.8	Moderately Agree
9. I manage my cash expense budget well.	3.5	Moderately Agree
10. My memory is good at memorizing phone numbers and address.	3.2	Moderately Agree
11. I can perform calculations such as addition, subtraction, multiplication and division mentally.	3.2	Moderately Agree
12. I love discovering how things work.	3.8	Agree
13. I am proficient in project work that uses arithmetic and mathematics.	2.7	Moderately Agree
14. I enjoy working with numbers such as calculating the rate of oil exchange per kilometer or calculating the cost of things.	2.7	Moderately Agree
15. I have the ability to plan activities.	3.3	Moderately Agree
16. I have curiosity in space sciences, galaxies and stars.	3.8	Agree
17. I have persistent tendency to keep things organized.	3.5	Moderately Agree
18. I want to fix household appliances and mechanical faults.	2.9	Disagree
19. I know how tennis game runs are calculated.	2.2	Disagree
20. I am skillful at choosing passwords for emails.	3.3	Moderately Agree
21. I prefer to make transactions digital, not paper.	2.8	Moderately Agree
22. I often admire computer operations.	3.3	Moderately Agree
23. I love everything related to nature such as animals, plants, fishes, and the like.	4.2	Agree
24. I like to collect things and learn everything about a subject.	3.7	

		Agree
25. I learn more in an organized environment.	3.7	Agree
OVERALL MEAN	**3.2**	**Moderately Agree**

Summary on the Level of Learning Style Preferences in Terms of Specified Indicators

Presented in Table 6 is the level of students' learning style preferences based on the identified four indicators – logical mathematical, kinesthetic, auditory, and visual.

Reflected in Table 6 is the summary on the level of students' learning style preferences which obtained an overall mean score of 3.4. This implies that grade 9 students apply learning styles seldom in performing mathematics subject. The indicator auditory reported the highest mean score of 3.6 with a descriptive equivalent of agree while logical mathematical has the lowest mean score of 3.2 with a descriptive equivalent of moderately agree.

Table 6
Summary on the Level of Learning Styles Preferences in terms of the Specified Indicators

Indicators	Mean	Interpretation
Logical Mathematical	3.2	Moderately Agree
Kinesthetic	3.5	Moderately Agree
Auditory	3.6	Agree
Visual	3.4	Moderately Agree
Overall Mean	**3.4**	Moderately Agree

Level of Mathematics Performance of Students

Table 7 presents the level of mathematics performance in terms of students' test results.

As indicated in Table 7, the level of mathematics performance is measured through proficiency level of the test score results in the Math test conducted. The proficiency level of the students' test results is 78.9 percent with a descriptive equivalent of fairly satisfactory.

Table 7
Level of Mathematics Performance

Variable	Proficiency Level	Remarks
Mathematics Performance	78.9%	Fairly Satisfactory

CP=Mean/HPS x 100%

Test of Null Hypothesis

Table 8 presents the relationship between the level of students' learning styles and mathematics performance.

It can be gleamed from the table that the students' learning style preferences and the mathematics performance show a significant correlation reflecting from the $p < .05$ and p-value of 0.004. This implies that when the level of learning styles increases, the mathematics performance also increases; and, when the level of students' learning style decreases, the mathematics performance also decreases. Hence, it indicates that there is a significant relationship between learning styles and mathematics performance of grade 9 students.

Table 8
Relationship between the Learning Styles Preferences and Mathematics Performance

Variables	Mean	Standard Deviation	p-value	Correlation coefficient	Remarks
Learning Style Preferences	3.32	0.679	0.004	0.4	Significant
Mathematics Performance	79.06	8.87			

Domains of Learning Style Preferences that Predict Mathematics Performance

Table 9 presents the domains of learning style preferences that predict mathematics performance. The results show that auditory learning style is the only domain that does not predict mathematics performance. It has a p-value of .888 which is greater than the alpha level of 0.05 which signifies that there is no significant relationship between auditory learning style to mathematics performance of the students. On the other hand, other domains of learning style preferences such as visual, kinesthetic, and logical mathematical are predictors of mathematics performance.

Table 9
Domains of Learning Style Preferences that Predict Mathematics Performance

Model	Unstandardized Coefficients		Standards Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	5.283	1.574		3.355	.001
Visual	6.054	.344	.464	17.593	.000
Auditory	-.013	.088	-.003	-.142	.888
Kinesthetic	6.659	.400	.442	16.641	.000
Logical Mathematical	6.003	.509	.303	11.785	.

Chapter IV

DISCUSSIONS AND CONCLUSION

Discussions

Level of Learning Styles Preferences in terms of Logical Mathematical. The level of students' learning styles manifested by the grade 9 students as indicated by logical mathematical was moderately agree.

The result implied that the logical mathematical learning style of students needs to be reinforced. This requires students to instill strong logical thinking skills. Students must be efficient and tactful in learning and interacting with data that needs logical-mathematical understanding.

In the research made by Wardat et al. (2023), it was revealed that students should really invest in learning with the application of logical mathematical learning style which is critical for best learning outcomes. The other implication is that when students do not follow logical procedures in solving math problems, their solutions could be influenced by prior experiences and will not be able to display good logical mathematical skills (Sa'o et al., 2019).

Level of Learning Styles Preferences in terms of Kinesthetic. The level of students' learning styles manifested by the grade 9 students as indicated by kinesthetic was manifested moderately agree with an overall mean.

In learning mathematics, effective activities should not be only focusing so much on cognitive learning but also it should be combined with playful and performative methods. Based on the result, students learn best when

hands-on experiences are provided. The challenge here for the teachers is on updating and modifying existing teaching practices by integrating kinesthetic approaches that will support students' learning style.

In Ariadi's (2016) study, it was found that intuitive understanding of the students who have kinesthetic learning styles in solving math problems should be assessed and known. In addition, Jukeviien and Kurilovas (2014) also reported that the students' motivation in having high mathematics performance is also measured in having kinesthetic activities in which they could learn best by moving and interacting.

Level of Students' Learning Styles in terms of Auditory. The level of students' learning styles as indicated by auditory had resulted agree with an overall mean.

As resulted in this study, students prefer to do better and learn more through lectures and discussions. They require explanations of diagrams, graphs or visual directions for them to grasp the idea and answers in the topic presented. As an advantage, majority of teachers nowadays apply aural teaching style in which auditory learners could benefit.

As supported by the study of Maric (2015), he emphasized that students who prefer auditory learning frequently rely on hearing-based learning and traditional approaches in the classroom. However, when they are not allowed to vocalize, they struggle to read silently and quickly (Naurzalina et al., 2015). In this sense, the teacher should devise a strategy that would assess any underlying concerns that may cause the students to perform poorly.

Level of Students' Learning Styles in terms of Visual. The level of students' learning styles as indicated by visual resulted moderately agree with an overall mean.

It is crucial to use visual learning styles in the classroom instruction. Understanding mathematics concepts increases students' performance and engagement in the lessons. Learners like to write things down or take notes for visual review as revealed in the study. Visual thinking really accompanied by cognitive processes to understand and create new learning images.

As stated by Fleming (2015), the most numerous learners in the classroom are using visual learning style. Students feel the best way to remember is to picture topics in their head. They prefer the representation of knowledge through diagrams, graphs and the like (Abri et al., 2023).

Summary of the Level of Learning Styles Preferences in terms of the Specified Indicators. Auditory got the highest mean among the indicators. Students do better at Mathematics by learning to lectures and discussions. They are more likely to agree that they followed oral directions better than that of written ones. Logical mathematical learning style obtained the lowest mean score among the indicators. In this indicator, students should invest in high level of problem solving and mathematical skills. Aside from that, students are challenged in abstract thinking, statistical analysis, and arithmetic operations.

Research investigated evidence of the level of learning styles and mathematics performance that are particularly relevant to the students. Li et al. (2019) stated that learners are affected by their motivation to learn, persistence to solve mathematical problems, and need for structure and learning flexibility. Learning styles emphasize the different aspects of learning and the knowledge intake of students in the medium of learning (Banas, 2018).

Relationship between the Learning Styles Preferences and the Mathematics Performance. The result shows that there is a relationship between the learning style preferences and mathematics performance of junior high school students which has a correlation value. This indicates a significant correlation of the learning style preferences and mathematics performance.

As supported by Kirschner (2017), learning style preferences of students equate with the preferred learning senses through which receive information, whether it be logical mathematical, kinesthetic, auditory or visual. These learning styles associate to what strategies in learning a student prefer by determining and measuring mathematics performance.

Conclusion

Based on the results, it indicated that learning style preferences and mathematics performance are significantly related. If students' learning style is addressed in teaching mathematics lessons, they would perform better in the activities provided by the teachers. Auditory learning style is highly manifested by the students in learning mathematical activities. It is perceived that the the students would rather listen to a good lecture or speech than read about the same material in a textbook.

On the other hand, logical mathematical got the lowest mean. Poor performance of students in mathematics is caused by ineffective techniques employed that disregard students' learning style preferences. Based on the result, students are not that proficient in project work that uses arithmetic and mathematics. Logical mathematical learning

style of the students' needs to be given more attention and focus for them to develop higher thinking skills and logical knowledge.

Moreover, it is essential to design learning activities that cater different learning styles of students. It is important to understand that learning styles are not rigid categories students inherently possess.

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