Nonverbal Communication and Mathematics Self-Concept as Predictors of Academic Performance in General Mathematics

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ABSTRACT

The main objective of this study was to determine whether nonverbal communication and mathematics self-concept predict academic performance in General Mathematics of Grade 11 learners. This study employed descriptive and correlational designs. Using the stratified random sampling, 292 Grade 11 learners were selected as respondents from the four selected private schools in Davao City, Philippines. Furthermore, this study used two adapted and one researcher-made summative test questionnaires to gather data, which were analyzed using mean, standard deviation and Pearson r. The results of the study showed that nonverbal communication is manifested most of the time by the teacher, and mathematics self-concept is moderately evident among Grade 11 learners. However, the academic performance in General Mathematics of Grade 11 learners is poor. The results also showed that nonverbal communication and mathematics self-concept have no significant relationship with academic performance in General Mathematics. Hence, nonverbal communication and mathematics self-concept are not predictors of academic performance.

Keywords: Mathematics education, nonverbal communication, mathematic self-concept, academic performance, General Mathematics

INTRODUCTION

Mathematics facilitates the acquisition, organization and application of knowledge as well as the communication of mathematical concepts through picture, graphs, symbol, description, and logical representations. Hence, senior secondary mathematics establishes a solid foundation for students' continuous learning and a framework for the acquisition of new information in a constantly evolving environment (Garcia & Dela Rosa, 2021). However, the poor performance of learners in mathematics has been a global problem, causing emerging countries to take part in programs to strengthen their economies (Mebena et al., 2021). Over the past few years, this underachievement in mathematics has become a problem not just in a few countries but it is every nation’s concern (Capuno et al., 2019).

According to the report of the International Mathematics Union (2020), in most African countries, primary and secondary mathematics education is inadequate, lowering the potential population of brilliant individuals who pursue programs related to mathematics in higher education. In fact, in Tanzania, Africa, Mazana et al. (2020) found that failure rates are typically higher across all levels examined in their study, with lower secondary basic mathematics being the most failed subject, having 75.7% of the overall students' performance level in mathematics. Moreover, in Torino, Italy, Contini et al. (2022) stated that the school closure in the spring of 2020 and the COVID-19 pandemic caused significant mathematics learning losses for Italian children. The learning loss was greater for those with stronger prior mathematical ability among children with low-educated parents.

In Malaysia, Musa and Maat (2021) stated that one of the major challenges for the Malaysian Ministry of Education (MOE) in executing the education roadmap in the domain of mathematics is the deteriorating performance of Malaysian students in mathematics. This concern arises from findings of the Trends in International Mathematics and Science Study (TIMSS) and the Programme for International Student

Assessment (PISA), which shows that Malaysian students performed below average in the mathematics domain when compared to the global average score. Thus, Malaysian students' mathematical proficiency is low and much behind that of learners in highly developed countries particularly in Asia (Musa & Maat, 2021). Additionally, Valenzuela and Benavides (2021) discussed the low mathematics performance of children in Southeast Asian countries based on Southeast Asia Primary Learning Metrics (SEA-PLM) result. In line with the result, the following ASEAN countries have significantly low learner performance in mathematics: Cambodia (19%), Lao PDR (8%), Myanmar (12%), and the Philippines (17%). This data proves that learning mathematics is still a far-off goal in the ASEAN region.

In the Philippines, Bernardo et al. (2022) mentioned that less than 20% of students displayed a minimal competency level in mathematics based on 2018 Programme for International Student Assessment (PISA) scores, while more than 50% indicated extremely poor proficiency, indicating that Filipino students' scores dropped below the PISA's lowest level of proficiency. According to the Department of Education (2019), the degree of poor mathematics performance differed between with averages of 343 and 395, respectively, among pupils in public and private schools. Furthermore, Salimaco (2020) discussed the declining achievement of students in the field of mathematics according to how well they did in the Division of the City of Mati's national career evaluation test. The students only acquire a score of 32.12, which is considered the lowest mean percentage score among other general scholastic aptitude tests.

In Davao City, Timario (2020) highlighted in his study that most students faced difficulties in analyzing word problems in the topic of Business Mathematics, particularly those involving annuities, business loans, and consumer loans, which led to poor performance in their assessments. In addition, Retutas and Rubio (2021) noted in their study that the quality of student performance in statistics is fairly satisfactory, implying most learners possess the basic minimum requisite knowledge, skills, and basic comprehension of statistics, but they still require assistance during task execution.

Theoretical Framework

This study is founded on the notion of Chaudhry and Arif (2012), who found a strong correlation between teachers' nonverbal communication and students' academic performance. Additionally, Irungu et al. (2019) found out in their research that teachers' use of nonverbal communication positively and statistically influences students' academic performance. The result indicates that if teachers use nonverbal communication effectively, learning is likely to be enhanced, which will ultimately increase the learners' academic achievement. Furthermore, Behjat et al. (2014) highlighted the results of their investigation into the effects of nonverbal communication on secondary school students, which shows that nonverbal communication is used to improve the quality learning during the teaching and learning process. Hence, increasing learners' academic performance.

Moreover, this is further anchored on Shavelson et al. (1976) hierarchical model of self-concept, which posits that self-concept is a significant construct in education because of its relationship to academic achievement. Moreover, Timmerman et al. (2016) discovered a strong correlation between mathematical self-concept and mathematical achievement. Which means that students perform better on mathematics tasks when they believe more strongly in their own mathematical abilities and accomplishments.

Furthermore, Derrac (2019) emphasized that majority of students who have low self-concepts in mathematics also perform at a level that is generally regarded as satisfactory. This led to the conclusion that student self-concept in mathematics and academic performance in mathematics are positively significant. In the study conducted by Recebido (2022) it was revealed there was a substantial association between students' self-concept along learning, organized, and dynamic dimensions and their academic success in mathematics. This means that student's self-concept relatively positive or negative significantly affect their academic performance of students in mathematics. Lastly, Ghazvini (2011), indicated a positive connection between self-concept and academic performance. As previously stated, self-concept positively predicts general mathematical performance. As a result, throughout the educational process, enough and sufficient attention to self-concept is required.

The primary goal of this study was to examine if nonverbal communication and mathematics self-concept significantly influence academic performance in mathematics of learners in Grade 11 from selected private schools in Davao City.

Statement Of The Problem

The following questions were specifically addressed by this study:

1. What is the extent of nonverbal communication in terms of:

1.1 facial expression;

1.2 eye contact;

1.3 body movements;

1.4 pitch of voice; and

1.5 spatial distance?

2. What is the level of mathematics self-concept of students in terms of:

2.1 learned;

2.2 organized; and

2.3 dynamic?

3. What is the level of Grade 11 learners' academic performance in General Mathematics?

4. Is there a significant relationship between:

4.1 nonverbal communication and academic performance of students in General Mathematics?

4.2 mathematics self-concept and academic performance of students in General Mathematics?

5. Does nonverbal communication and mathematics self-concept significantly predict academic performance of students in General Mathematics?

METHOD

This study used a quantitative research approach with descriptive and correlational designs. According to Adedoyin (2020) the methodical analysis of phenomena through the collection of numerical data and the use of scientific, statistical, or computational methodologies is known as quantitative research. Furthermore, quantitative research is a formal, objective, strict, deductive approach, and organized methods of acquiring and improving information for addressing problems (Mohajan, 2020). Its designs are either experimental or non-experimental and look for dependable and accurate measurements (Rahman, 2017).

Descriptive research is a study approach in which data is gathered qualitatively and examined quantitatively. Furthermore, descriptive research refers to the scientific process in which the sampled population is observed in its natural surroundings (Bhattacharya, 2020). As emphasized by Rillo and Alieto (2020) to make adequate and accurate interpretations of the data, descriptive research includes collecting, analyzing, classifying, and tabulating data regarding present events, practices, techniques, trends, and cause-and-effect linkages, with or without the use of minimum statistical approaches.

On the other hand, according to Cherry (2022) a research method known as a correlational study investigates the relationships between two or more variables. Correlational studies are also non-experimental, which

implies that the researcher does not alter or control any variables. Additionally, as cited by Asenahabi (2019) correlational statistics are used in non-experimental quantitative designs known as correlational research to evaluate and define the strength of a link between variables or scoring sets. This research methodology is used to investigate the associations between respondents' attributes and reported behaviors and views (Asenahabi, 2019).

The respondents of this study were those students enrolled in Grade 11 senior high school program in the four selected private schools in Davao City, Philippine in General Mathematics course. In identifying the sample size, the researcher used the online Raosoft Sample Size Calculator set at 95% confidence level and a 5% margin of error. Thus, from a population of 1, 207, a sample of 292 was obtained.

Moreover, the researcher used stratified random sampling to divide the entire population into strata from the four selected private schools in Davao City. In selecting the respondents per school, random samples were then drawn from each stratum to ensure adequate sampling of all groups. Hence, there were 96 out of 404 students in School A, 9 out of 35 in School B, 47 out of 190 in School C, and 140 out of 578 in School D.

Stratified random sampling increases sample representativeness by dividing the study population into strata to ensure adequate sampling of all groups (Howell et al., 2020). This approach reduces sampling bias; allows researchers to estimate within and between strata outcomes; and improves accuracy of results (Elfill & Negida, 2017).

RESULTS AND DISCUSSION

Shown in Table 1 is a summary of the extent of nonverbal communication. Of all the indicators, facial expression obtained the highest mean of 4.00 and is followed by body movements with a mean of 3.82. In contrast, eye contact and spatial distance obtained the lowest mean of 3.73. The indicators have the same descriptive equivalent of highly extensive, which means that the extent of nonverbal communication is manifested most of the time.

Table 1. Summary of the Extent of Nonverbal Communication in General Mathematics

Indicators	Mean	SD	Description
Facial Expression	4.00	0.58	Highly Extensive
Eye Contact	3.73	0.70	Highly Extensive
Body Movements	3.82	0.69	Highly Extensive
Pitch of Voice	3.76	0.60	Highly Extensive
Spatial Distance	3.73	0.72	Highly Extensive
Overall Mean	3.81	0.50	Highly Extensive

Furthermore, the overall mean of this variable is 3.81 with a descriptive equivalent of highly extensive, which indicates that the extent of nonverbal communication is manifested most of the time. The dispersion of nonverbal communication based on the responses of the Grade 11 learners revealed that the standard deviation is 0.50. This means that most of the respondents have similar responses, which implies that nonverbal communication is more likely to be close to the mean.

The findings indicate that teachers' nonverbal communication positively improves the teaching and learning process; it makes learners attentive in class, makes learners understand the lesson more effectively, and makes the classroom environment more conducive and comfortable for learning. Moreover, learners observed that the teachers used a variety of ways to ensure the teaching and learning process was alive, encouraging, and engaging, as evident in their nonverbal communication. These results are in line with the claim of Baroona (2020), who emphasized that there are many types of nonverbal communication used and that they play a crucial role in the teaching and learning process. These are the teacher’s smile, voice intonation, posture, how the teacher dresses, hand gestures, head gestures, and the distance that exists between the teacher and the students, which can be a tool for teachers to attract students’ interest and attention to actively participate in the class discussions. Nonverbal communication can be a medium for teachers to use that will enhance students'

interest in learning and their understanding (Baroona, 2020). Subsequently, nonverbal cues reveal feelings, enhancing the students' interaction with the instructor, the course, and the material being taught. This helps teachers build the best possible relationships with students and foster a happy learning environment, all of which have a beneficial effect on engagement, efficient learning, and a sense of group cohesiveness and belonging (Molero et al., 2022).

In addition, the summary of Grade 11 learners' self-concept in mathematics is presented in Table 2 below. Dynamics acquired the highest mean of 3.35 of all the measures, followed by organized with a mean of 3.13 and learned with a mean of 3.10. The descriptive equivalent for each indication is moderate, which proposes that each indicator is moderately evident.

Table 2. Summary on the Level of Mathematics Self-Concept of Grade 11 Learner

Indicators	Mean	SD	Description
Learned	3.10	0.90	Moderate
Organized	3.13	0.80	Moderate
Dynamics	3.35	0.83	Moderate
Overall Mean	3.19	0.80	Moderate

Consequently, it has an overall mean of 3.19 and a descriptive equivalent of moderate, indicating that learners in Grade 11 have a moderately evident level of mathematical self-concept. The dispersion of mathematics self-concept based on the responses of the Grade 11 learners concurred that the standard deviation is 0.80, which indicates that most of the respondents have similar responses.

It is evident in the results that most of the Grade 11 learners agreed that even if the work in mathematics is hard, they can still learn it, and in learning mathematics, it gives them meaning to learn mathematical activities. Similarly, most of the students have difficulties with math, but they know they can handle it if they try, and for them, mathematics helps to find a new way of finding things. It is also evident that students can do practically all the work in mathematics if they do not give up. Lastly, for them, mathematics is essential for the future.

These results are supported by the claim of Rameli and Kosnin (2016), who highlighted that students viewed mathematics as too difficult and complicated to learn; therefore, teachers must ensure that their students understand the importance of each mathematical task or activity offered to them. When students appreciate the tasks, they are more likely to be persistent and eager to continue longer to complete the mathematics exercises because they recognize the value of mathematics in their lives and future endeavors (Rameli & Kosnin, 2016). Furthermore, Rahman (2021) cited that students have a modest perception of how well they are at mathematics. Despite the importance of the subject, students find it a little difficult to deal with mathematical problems, but they are still persistent in learning its concepts. Understanding the students' mathematical self-concept is essential since it provides a foundation for cultivating the students' learning interests and passion in the subject (Lee & Kung, 2018).

In Table 3, students' academic performance in General Mathematics is reflected. This shows that the average percentage score of students in the summative test is 33.33, which is low in terms of description. Hence, it signifies that the mathematics performance of Grade 11 learners is poor. Moreover, the dispersion of the scores is 7.90, which indicates that most of the students got low scores in the summative test. So, this means that the academic performance of Grade 11 learners in general mathematics is more likely to converge to the mean.

Table 3. Level of Grade 11 Learners' Academic Performance in General Mathematics

Indicator	Mean	SD	Descriptive Equivalent
Mean Percentage Score	33.30	7.90	Low

The results obtained were from the data gathered through a 40-item researcher-made summative test in general mathematics topics. The summative test was aligned with the Department of Education's Most Essential Learning Competencies (MELCS). According to Almerino et al. (2020) that the students still lack the abilities

to reach the minimum standards of mathematics competencies in the Philippines based on the results of their study.

Moreover, in the study of Chand et al. (2021), it was discovered that students believe the existing mathematics curriculum for grades 11 and 12 is ineffective. This implied that an inadequate mathematics curriculum is a significant element considered to be significantly related to students' poor performance in the mathematics curriculum in senior secondary schools.

On the other hand, Table 4 shows the relationship of nonverbal communication and mathematics self-concept towards the academic performance of students in General Mathematics. Based on the table, the computed r-value for nonverbal communication is -0.053, which means a negligible correlation, and a p-value of 0.368, which is beyond the 0.05 level of significance. Similarly, the computed r-value for mathematics self-concept is 0.012, which is a negligible statistical connection, and the p-value is 0.832, which is also beyond the 0.05 level of significance. Based on this statistical evidence, the findings of the study fail to reject the null hypotheses.

Table 4. Relationship Between Nonverbal Communication and Mathematics Self-Concept towards the Academic Performance of Students in General Mathematics

Independent Variables	Academic Performance in General Mathematics		
	r	p-value	Remarks
Nonverbal Communication	-0.053	0.368	Not significant
Mathematics Self-Concept	0.012	0.832	Not significant

Hence, nonverbal communication and mathematical self-concept do not have a significant relationship with the academic performance of students in general mathematics ($p>0.05$). Therefore, nonverbal communication and mathematical self-concept are not significantly associated with the poor academic performance of students in general mathematics. The result contradicts the findings of Dustin (2015), who emphasized that nonverbal communication has a positive impact on a student's academic achievement.

In the same context, this result disconfirmed the claim of Sutiyatno (2018) that nonverbal communication significantly improves student achievement. Meanwhile, the result also negates the claim of Schow (2022) that there is a moderately high relationship between mathematical self-concept and mathematics achievement among students. Similarly, it disproves the findings of Gonzales (2019), who stressed that mathematics self-concept is a construct that plays a fundamental role in students' academic performance.

Overall, the result of this study contradicts the findings of Chaudhry and Arif (2012), who stated a strong correlation between teachers' nonverbal communication and students' academic performance. Also, the proposition of Irungu et al. (2019), who found out that teachers' use of nonverbal communication positively and statistically influences students' academic performance, Moreover, it denies the hierarchical model of self-concept by Shavelson et al. (1976) and the statement of Timmerman et al. (2016), who discovered a strong relationship between students' mathematical self-concept and mathematical achievement. Lastly, it disconfirms the claim of Recebido (2022) about the significant association between students' self-concept along learning, organized, and dynamic dimensions and their academic success in mathematics.

Nonverbal communication and mathematics self-concept do have a significant relationship with the academic performance of students; thus, multiple regression analysis was not carried out in this investigation. A linear relationship between nonverbal communication and mathematics self-concept towards the academic performance of students was not satisfied. Generally, the result of this investigation negates the claim of Behjat et al. (2014) highlighted the effects of nonverbal communication on academic performance, which shows that nonverbal communication is used to improve the quality learning during the teaching and learning process. Hence, increasing learners' academic performance. Additionally, the results also negate Bringula et al. (2021), who stated that mathematics self-concept significantly predicts the self-perceived competence of a student in an academic domain in general (e.g., mathematics). Lastly, the result invalidates the proposition of Ruijia et al. (2022), who found out that mathematics self-concept has a significant positive predictive effect on the math achievement of students.

CONCLUSIONS

The conclusions were reached based on the findings of the study.

1. Nonverbal communication is manifested most of the time by the teacher.
2. Mathematics self-concept is moderately evident among Grade 11 learners.
3. The academic performance in General Mathematics of Grade 11 learners is poor.
4. Nonverbal communication and mathematics self-concept do not have a significant relationship with academic performance of Grade 11 learners in General Mathematics.
5. Nonverbal communication and mathematics self-concept are not significant predictors of academic performance of Grade 11 leaners in General Mathematics.

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