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An Analysis of the Factors Influencing Achievement in Mathematics Geometry in Canadian High Schools

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Abstract

This paper explored analysis of the factors influencing achievement in mathematics geometry among secondary school students. This study used descriptive survey design. Simple random sampling technique was further applied to obtain Mathematics teachers, students and principals targeted in this research equals to 258 staff. The study sampled 157 respondents. The collected data was analyzed using descriptive statistics, correlation, and regression analysis through the statistical package for social science (SPSS) version 21. The data collected were analyzed using descriptive statistics and multiple regression. The results of the findings indicated that the teaching strategies was more correlated with Geometry achievement in Grassland in Alberta province (r = 0.522; p= 0.000). Multiple linear regression analysis showed that teaching strategies contributed to 69.9% of variation on the performance, hence plays a vital role in teaching strategies in Canadian high schools. Additionally, it was further inferred that teaching strategies increases positive attitudes toward Geometry achievement.

Keywords: Teaching strategies; mathematics achievement and high school.

1.Introduction

Education is a very important key element in nation building. If we want to improve the country, we must improve the educational system [1]. The educational system, particularly science and mathematics programs in the secondary and tertiary levels has been beset by insurmountable problems for a long time. Foremost among these include the great variation in academic standards that exist between the best and the worst in the Philippine educational system. The Philippines underwent a lot of transitions in terms of its educational system but the truth is, not much was really changed at all [2]. [3] stated that the number of research studies conducted in mathematics education over the past three decades has increased dramatically. The resulting research base spans a broad range of content, grade levels and research methodologies.

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The results from these studies, together with relevant findings from research in other domains, such as cognitive psychology, are used to identify the successful teaching strategies and practices.Today, knowledge is very easy to reach and it is executed very quickly. Students can reach all kind of information wherever and whenever they want. Parallel to these dizzying developments, it has brought out some needs in the field of education and training and brought many innovations together. The leading one, among these needs, has been recognition of the fact that students are distinguished from each other and they have individual characteristics that contribute to their achievement. Individual characteristics are actually the individual differences that come from the birth of the individual. The students differ from one another in their approach to learning as they are different from each other. This should be taken into account in the education process. For this reason, it is necessary to establish and develop new learning and teaching environments where individual differences are at the forefront. One of the individual differences is the style of learning. Style is explained as a form, doing or expression that are unique to the individual's own life [4].One of the most fundamental subject areas of mathematics and one of the conceptual milestones is geometry [5]. One can express geometry as a subdiscipline that focuses on concepts such as point, line, plane, space, and the relationship between these concepts that are the subjects of mathematics. Students are unconsciously embracing the geometric concepts and shapes around them before they begin school life. Geometry is a science that allows students to gain the ability to see, and that allows them to reach the solution by thinking and visualizing the shape in their mind [6]. The students' ability to understand the concepts taught in the geometry lesson, to establish a relation between shape and its features, to understand, express geometry problems and apply the solution techniques varies due to individual differences. In this direction, the teacher needs to know which way the student prefers to learn; that means the learning styles of each student in the classroom.In Canada, indicators of student and school performance and characteristics of students and schools have been collected as part of international, national, and provincial assessment programs [7]. These programs have yielded large datasets containing measures of achievement of significant learning outcomes in the areas of reading, writing, numeracy, and science, as well as indices of student, home, and school characteristics or correlates. Although for Canadian schools where a substantial amount of the score variance can be accounted for by the classroom, the majority of these assessment programs do not permit the analysis of data at the class level [8]. Consequently, the results reported are restricted to the student and school levels [9]. It is against that background that this study attempted to assess factors influencing achievement in Mathematics Geometry in Canadian high schools.

This study sought to achieve the following research hypothesis:

H_{O1}: There is no significance between teaching strategies and Geometry achievement in Canadian high schools

2.Methodology

This study evaluated factors influencing Mathematics in Canadian high schools. The researcher used descriptive research survey design in building up this project work the choice of this research design was considered appropriate because of its advantages of identifying attributes of a large population from a group of individuals. The design was suitable for the study as the study sought factors influencing Mathematics in Mathematics in Canadian high schools.

This study was conducted in Grassland in Alberta District in Canada in 6 selected high schools. It is one of the thirteen provinces and territories of Canada. It is a part of Western Canada and is one of the three prairie provinces. Alberta is bordered by British Columbia to the west, Saskatchewan to the east, the Northwest Territories to the north, and the U.S. state of Montana to the south [10].

In this study, the accessible population comprised two hundred and forty (240) form three students and twelve (12) Mathematics teachers and 6 principals from the selected schools. This was because the students have covered most of the topics in form two geometry syllabuses. The total population was 258 persons. In addition, the study used the following formula proposed by using [11] to determine the sample size because that is too large waste scarce resources and could expose more participants than necessary to any related risk. Thus, the study used Yamane formula to calculate a sample size because it is the most appropriate for this study.

Using Yamane formulae

$$\boldsymbol{n = \frac{N}{1 + (N)(e^2)}}$$

Where:

n = sample size

N = the population size

e = the acceptable sampling error (5%) at 95% confidence level

Thus; $n = 258/ (1+258) (0.05)^2$

n=156.8=157 respondents

In this study the researcher used questionnaires for the students and interview guide for the principals and documentary review as secondary data. Closed –ended questions were used where the answers were divided into categories such discrete, distinct and relatively few in number. It is easier for respondents to answer because they had only to choose categories. In that way a chance for irrelevant answers is limited to the minimum, because appropriate answer categories were provided. The main respondents were being teachers that was given the questionnaire as they were enough time to respond to the questions based on specific objectives.

The questionnaire used as the research instrument was subjected to face its validation. This research instrument (questionnaire) adopted was adequately checked and validated by the supervisor his contributions and corrections were included into the final draft of the research instrument used. After the data was collected, the researcher turned to the task of analysing. The analysis required a number of closely related operations such as establishment of categories, the application of those categories to raw data through coding, tabulation and drawing statistical

inferences. The researcher classified raw data into purposefully and usable categories. Descriptive statistics and inferential statistics were used for data analysis. Quantitative data was analysed to obtain frequencies, percentages and averages. The frequency table was constructed to show the understanding of geometry concept. Items difficult and discrimination techniques were also used analyse the understanding the content of the text. Data collected on both questionnaires were used to answer the question of whether teaching learning strategies, student study habit, resources, their availability and the school curriculum implementation enhance the understanding of the Mathematics geometry concept, and to what extent they do so. The analysis was done using SPSS program. Correlation and regression analysis were conducted to ascertain the relationship between the study variables. The regression model to be tested is:

The regression model to be tested is: $Y=\beta 0+\beta 1X_1+\varepsilon$

Whereby Y =level of achievement in Geometry

a= Constant

X_1 = teaching strategies

ε = error term

β1, represent regression coefficients. These helped in the generalization of the findings on the relationship between organizational culture and employee performance. Multiple regression analysis will be computed to establish whether the research questions will be statistically supported or not at a 95% confidence level.

3. Findings and discussion

3.1. Findings

In this study the research sampled 157 respondents of selected high schools in Alberta Province in Canada. The data collected from the respondents were analyzed in tabular form with simple percentage for easy understanding. A total of 120 questionnaires were distributed and 5 high school principals were interviewed.

3.1.1 Descriptive Statistics

In this research the study attempted to determine factors influencing achievement in mathematics geometry in Canadian high schools. The respondents were asked to rate the statements by indicating the extent to which they apply to their organization in 5-point Likert scale as shown on: 5. Strongly Agree (SA), 4Agree(A), 3. Neutral (N), 2. Disagree (D) and 1. Strongly Disagree (SD). Besides, the mean and deviation were used for interpretation of the findings where mean (M) is the average of group of scores and it is sensitive to extreme score when the population samples are small. Moreover, the standard deviation (SD) was also used to measure the variability in those statistics as it shows how much variation is there from the average (mean).

Table 1: Level of agreement on teaching strategies and level of achievement in Geometry

Statements	Mean	Std Dev
Using instructional methods in teaching geometry leads to excellence in mathematics	4.5	0.71
Using instructional methods in teaching geometry ensures students grasp geometry concepts	4.2	0.68
Using instructional methods in teaching geometry enables students to apply the geometry concepts in problem solving	4.2	0.75
Using instructional methods in teaching geometry enables students to do their assignments with easy	3.9	0.96

Source: Field research, 2023

As shown in Table 1, the results relate to the four statements assessing factors influencing achievement in mathematics geometry among Canadian high schools. The results show that for the first statement, the majority of respondents strongly agreed that using instructional methods in teaching geometry leads to excellence in mathematics, with a mean value of 4.5, and a high positive correlation standard deviation of 0.71. The second statement asked respondents whether Using instructional methods in teaching geometry ensures students grasp geometry concepts. The results showed that the majority of respondents strongly agreed with this statement (M=4.2, SD=0.68). For the third statement, using instructional methods in teaching geometry enables students to apply the geometry concepts in problem solving, the majority of respondents agreed with this statement, with a mean of 4.2 and a very positive and high standard deviation correlation of 0.75. The fourth statement asked whether using instructional methods in teaching geometry enables students to do their assignments with easy. Respondents strongly agreed with this statement, with an average mean of 3.9 and a very strong positive standard correlation of 0.96. From the results, it implies that the majority of respondents strongly agreed and agreed that all of the above are key elements of factors influencing achievement in mathematics geometry in Canadian high schools.

Table 2: Teaching methods mostly used when teaching geometry

Teaching methods	Mean	Std
Instructional Methods	4.68	0.47
Discussion Methods	4.56	0.60
Participatory Teaching Approach	4.54	0.67
Drawing and Modelling (Use of games and puzzles)	4.15	0.71

Source: Field research, 2023

The Table 2 above indicates teaching methods mostly used when teaching geometry. On the first item it is seen that the majority of respondents agreed that instructional methods is the first teaching methods with a mean of 4.68 and weak and positive standard deviation of 0.47. On the second statement discussion methods was strongly

agreed by respondents with a mean score of 4.56 and positive and strong deviation of 0.60. The third item which is participatory Teaching Approach was strongly agreed by respondents with a mean of 4.54 and a standard deviation of 0.67. From the results, it implies that the majority of respondents strongly agreed and agreed that all of the above are key elements of teaching methods used in achievement geometry in Canadian high schools.

Table 3: Distribution of Score Means of Students' Geometry Course Achievements

Teaching methods	N	Mean	Std
Assimilating	120	4.28	0.87
Converging	120	4.13	0.73
Accommodating	120	3.44	0.82
Diverging	120	4.92	1.08

Source: Field research, 2023

When the Table 3 that shows the distribution of the score means of students' geometry course achievements according to learning styles is analysed, it is seen that the students with the diverging learning style have higher mean (4.92). The most important characteristics of students in this learning style is their ability to think. It is expected that students with this style of learning will be successful in a course in which the ability to think is on the top level as geometry. In Table 3, it is seen that the students with the diverging learning style have a higher mean of geometry course achievement than the students with the other styles. The students with assimilative learning style have the second highest mean of the geometric course means (4.28). The most distinctive feature of the students with this learning style are understanding and creating conceptual models. In a course such as geometry in which conceptual models, definitions and terms are intertwined, the fact that students with this learning style have a high achievement in geometry courses supports the characteristics of students with this style. Having abstract concepts in mathematics and geometry courses makes these courses difficult and incomprehensible among students. Focusing on abstract concepts and ideas, one of the characteristics of students with assimilative learning style, shows that students with assimilative learning style can understand and learn the geometry course.

These findings are in agreement with [12] who pointed Geometry is also a course that has aesthetic and visuality in itself. In geometry lesson, it is important to be able to see and express the features of shapes and relationships between these features and use them in problem solving. Students with diverging learning style are those who revise concrete situations in many respects and organize relationships in a meaningful way

3.1.2. Correlation analysis

The findings of the correlations between the independent variables and the dependent variables are summarized and presented in Table 4

Table 4: Correlation between teaching strategies and level of achievement of Geometry

		Teaching strategies	Geometry achievement
Teaching strategies	Pearson Correlation	1	
	Sig. (2-tailed)		
	N	120	
Geometry achievement	Pearson Correlation	.522**	1
	Sig. (2-tailed)	.000	
	N	120	120

**. Correlation is significant at the 0.01 level (2-tailed).

According to the findings reported in Table 4, the Pearson correlation analysis showed that Teaching strategies (r=0.522, p=0.000) is positively and significantly related to level of achievement of Geometry in Canadian high schools. The correlation was deemed to be statistically significant since the p-value was less than 5%. The findings therefore showed that there is a positive and statistically significant relationship between teaching strategies and level of achievement in Canadian high schools.

These findings are similar with [13] specified that teaching should not merely focus on dispensing rules, definitions and procedures for learners to memorize, but should also actively engage learners as primary participants. The methods used in teaching Mathematics are instrumental in determining one's performance.

3.1.3. Multiple Regression

The study used multiple regression to test the following hypothesis:

H_{01} There is no significance between teaching strategies and Geometry achievement in Canadian high school

Table 5: Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.836[a]	.699	.689	.25384

a. Predictors: (Constant),teaching strategies

Table 5 shows the quantity of variance that is explained by the predictor variables. The first statistic, R is the multiple correlation coefficient between all the predictor variables and dependent variable. In this model, the value is 0.836, which indicates that there is a great deal of variance shared by the independent variables and dependent variables. The next value, R Square=0.699, is simply the squared value of R. Adjusted R square =0.699, indicating that approximately 69.9% of the variance in the supply chain performance is explained by the logistics

management practices. The Std. Error of the estimate is 0.25384, which means that, on average, the predicted values from the model are expected to deviate from the actual values by approximately .25384.

Table 6: Analysis of Variance (ANOVA)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	14.344	3	4.781	74.204	.000[b]
	Residual	6.186	96	.064		
	Total	20.530	99			

a. Dependent Variable: teaching strategies

b. Predictors: (Constant), Geometry achievement

Table 6 indicated standard regression which provides the significance of the prediction of individual predictor variables on the dependent variable. That variable is teaching strategies. The table shows the output analysis and whether there it has a statistically significant difference group mean. As seen, the model (F=74.204, p=0.000) was found to be significant at 5% since the p-value (p=0.000) was less than the 5% threshold Therefore, teaching strategies significantly influence Geometry achievement.

Table 7: Regression coefficients and significance of the independent variable

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.094	.200		5.479	.000
	Teaching strategies	.196	.071	.248	2.772	.007

a. Dependent Variable: Geometry achievement

Source: Field research, 2023

Information presented in Table 7 evidenced that all the indicator variables used in this research to study the teaching strategies were all statistically significant. This implied that they individually have significant contributions Geometry achievement. The regression model was thus formulated as $Y=1.094+ 0.196 X_2 +\varepsilon$ Where y= level of achievement of Geometry, X_1, represented the teaching strategies. The regression coefficients are useful to know which of the different independent variables is more important in contributing to the Geometry achievement. They are used in comparison of effect of any independent variable on the dependent variable.

3.2. Discussion

From the findings, the study found that teaching strategies affects Geometry achievement when When using instructional methods in teaching geometry leads to excellence in mathematics, when using instructional methods

in teaching geometry ensures students grasp geometry concepts, when using instructional methods in teaching geometry enables students to apply the geometry concepts in problem solving and using instructional methods in teaching geometry enables students to do their assignments with easy and regarding methods used Geometry, discussion method, assignment method and drawing methods were found to have positive relation with the level of achievement in geometry test. Discussion method, assignment and drawing are example of learner centered approach that most literature shows that they positively affect the level of achievement in geometry tests.

These findings are supported with to [1] discussion method can be effective and successful when the following preparations are made by the teacher and the learners: the learners given adequate time to search for information on the topic; the teacher avails the documents or assists the learners by suggesting sources of information; and the learners to be organized in appropriate groups and choose group leaders to record the points raised during discussion.

4. Conclusion and Recommendations

4.1. Conclusion

This study concluded that the strategies used by teachers in learning/teaching geometry contribute to the level of performance in geometry test. Teachers used strategies that motivate students to excel in geometry. Methods that are learner centered where learners are at the center of classroom activities, including discussions is associated with high performance. Teachers should adopt methods that allow students to be at the centre of the learning process while they remain as reference point to aid the learning process. Therefore, based on the findings, hypothesis testing results show that teaching strategies in have an effect on Geometry achievement. The research hypothesis was tested; verified and then it is rejected referring to the statistical (regression analysis) findings and then according to the research, the correlation of 69.9% categorized as positive and very high correlation; this leads to confirm that there is significant relationship between teaching strategies and Geometry achievement.

4.2. Recommendations

It was recommended that teachers need to encourage students to form small discussion groups so that each individual student can have a platform to express their ideas and learn from each other. This will encourage consultations among students and with the teachers and eventually boost mastery of the geometry concepts. Besides, teachers should demonstrate enough geometry examples from different texts to the students before giving them assignments.

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