A Path Model to Infer Mathematics Performance: The Interrelated Impact of Motivation, Attitude, Learning Style and Teaching Strategies Variables

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Abstract

The present study aims at exploring predictors influencing mathematics performance. In particular, the research focuses on four subject components such as motivation, attitude towards mathematics, learning style, and teaching strategies. The study respondents have involved a sample of 240 students from Agusan del Sur State College of Agriculture and Technology (ASSCAT). Path analysis will be used to test the direct and indirect relations between the predictors and mathematics performance. Based on the result, the calculation of reproduced correlation through path decompositions and subsequent comparison to the empirical correlation indicated that the path model fits the observed data. Results also revealed that a large proportion of mathematics performance could be predicted from the attitude towards mathematics, learning style, and teaching strategies. Moreover, attitude towards mathematics, learning style, and teaching strategies influence mathematics performance directly and indirectly.

Keywords: Mathematics Performance, Path Analysis, Motivation, Attitude toward Mathematics, Learning Style, Teaching Strategies

1.0 Introduction

Mathematics improvement is at the core of educational strategy worldwide, but in the Philippines, still, learners face difficulties in their math problems. To function in a mathematically literate way in the future, students must have a strong foundation in mathematics. The study of Vintere and Zeidmane (2014) revealed that a high mathematics performance is required to perform a successful professional task. However, the consequences of poor mathematics performance are serious for daily functioning and professional development. Alcuizar (2016) study revealed that poor living conditions and distance of the school affect low academic achievement. It was concluded by the study of Lacour and Tisington (2011) that poverty directly affects academic achievement. Despite such continuing problems, many empirical studies were carried out to explore factors that affect poor performance in mathematics. Although there is substantial research which has investigated the influences of motivation (Amrai et al., 2011; Guay et al., 2010), attitude towards mathematics (Farooq and Shah, 2008; Hemmings et al., 2011), learning style (Yildirim et al., 2008; Awang et al., 2017) and teaching strategies (Tulbure, 2012; Şariçoğan and Sarıçaoğlu, 2008), on the mathematical performance. In general, these studies have looked at the different effects of these components. Hence, we consider its impact on mathematics performance when motivation, attitude towards mathematics, learning style, and teaching strategies are taken together.
and how much each can predict the mathematical performance in an integrated model.

The study of Damavandi et al. (2011) and Ganyaupfu (2013) that the implication of different student learning styles and teaching strategy has a significant effect on the student learning achievement in mathematics. On the other hand, in their study, Mata et al. (2012) study that students can develop their mathematics competence through their attitude towards mathematics since they learn to associate positive experiences. Moreover, self-efficacy boosts the students' mathematics achievement through mathematics motivation that improved the students' mathematics performance (Liu and Koirala, 2009).

Many had studied some factors affecting mathematics performance in the past. However, this study aimed to create a model that would best predict enhancing the students' mathematics performance and establishing the specific cause-and-effect among the motivation, attitude towards mathematics, learning style, and teaching strategies on their mathematics performance. Causal modeling, specifically the path analysis, will be sufficient to address this concern because its sole purpose is to estimate the magnitude and significance of hypothesized causal connections between sets of variables.

2.0 Conceptual/Theoretical Framework

The exogenous variables of this research were Motivation (X₁), Attitude towards Mathematics (X₂), Learning Style (X₃), and Teaching Strategies (X₄). Meanwhile, the Mathematics Performance (Y) was identified as the endogenous variable. This study had looked into the potentials of using these variables based on the following literature reviews:

In the study of Adnan et al. (2013) and Vaishnav (2013), there exists a relationship between learning style and mathematics achievement. Also, the study of Damrongpanit (2014) revealed that students' learning styles and teachers' teaching styles directly affected mathematics performance. Additionally, the study of Shi (2011), announced that learning styles correlated with learning strategies.

According to Skinner's (1945) Learning Theory, achievements vary among individuals for several reasons: the level of performance and aspirations of students depend on factors linked to parents' level of education, family income, and parent's marital status. The theory further emphasizes the importance of motivation, involvement in learning. Also, in his study, Coleman (2009) revealed that students who are motivated and build attitudes toward the subject would be more likely to make an effort and therefore achieved higher scores.

As cited by Joyce et al. (2003), the Social Learning Theory explains an individual's behavior is the result of forces operating simultaneously within his environment in life. Within this theory, attitude toward mathematics is determinant in a learning environment that affects their mathematical performance.
The causal model in Figure 1 proposed the Mathematics Performance results from Motivation, Attitude towards Mathematics, Learning Style, and Teaching Strategies. Furthermore, the path analysis was carried out through a multiple linear regression procedure. The causal model will be predicting the direct and indirect effects.

In this study, the model was specified by the following path equations:

\[
\begin{align*}
Y &= \rho_{YX1}X_1 + \rho_{YX2}X_2 + \rho_{YX3}X_3 + \rho_{YX4}X_4 + e_1 \\
X_4 &= \rho_{X4X3}X_1 + \rho_{X4X3}X_3 + e_2 \\
X_3 &= \rho_{X3X1}X_1 + \rho_{X3X2}X_2 + e_3 \\
X_2 &= \rho_{X2X1}X_1 + e_2
\end{align*}
\]
where:

\[ Y = \text{Mathematics Performance} \]
\[ X_1 = \text{Motivation} \]
\[ X_2 = \text{Attitude towards Mathematics} \]
\[ X_3 = \text{Learning Style} \]
\[ X_4 = \text{Teaching Strategies} \]
\[ \rho_{ij} = \text{are the regression coefficient and} \]
\[ e_i = \text{is the disturbance term} \]

3.0 Research Design and Methods

Data for this study came from primary and secondary sources. The first was a survey in four instruments, namely; motivation (Kusurkar et al., 2011) which focus on the perception level of intrinsic and extrinsic motivation, attitude towards mathematics (Orhun, 2007), learning style (Gilakjani, 2012), and teaching strategies (Hamzeh, 2014). The second part was Mathematics Performance which is the Grade Point Average (GPA) of the respondents.

After collecting the data from all sources, the data were checked for further analysis, that is, fit the restriction of range in the data values, outliers, nonlinearity, and non-normality of data to determine the aptness of the generated model. The path analysis was carried out through the multiple regression procedure in statistical software. The causal model will be predicting the direct and indirect effects.

4.0 Results and Discussion

The aptness of the generated model for the said data was evaluated and was tested whether it satisfies the required assumptions. The range of values obtained for variables was considered a restricted range of one or more variables that can reduce the magnitude of relationships. Mahalanobis distance was performed in order to detect the outliers as it can strongly affect the mean and standard deviation of a variable. The linearity assumption was also considered and can best be tested with scatter plots, whether the Mathematics Performance is linearly related to the motivation, attitude towards mathematics, learning style, and teaching strategies.

Moreover, the analysis requires checking whether all variables were normally distributed since it was determined with a goodness of fit test and affected the resulting Path Analysis. The study used the Kolmogorov-Smirnov test in detecting non-normality. Variance Inflation Factor (VIF) values were also applied to test the multicollinearity assumption, and this is to check that the independent variables are not highly correlated with each other. And lastly, the premise of homoscedasticity was considered through the plot of standardized residuals against predicted values since it allows to test of the variance of error terms in the importance of the independent variables. After the basic assumptions had been met, data were analyzed through path analysis.

Figure 2 displays results of the initial path analysis model of Mathematics Performance, motivation, attitude towards mathematics, learning style, and teaching strategies. The obtained regression coefficients in Figure 2 were specified by Equation (1 – 4) through multiple regression.
analysis. Among the four exogenous variables, only the motivation factor was not significantly related to mathematics performance (0.047). The motivation was positively related to attitude towards mathematics (0.531*) and learning style (0.337*). Moreover, learning styles were positively related to teaching strategies (0.209*) and to attitude toward mathematics (0.150*).

**Figure 2:** Initial Causal Factor Models Affecting the Mathematics Performance

Table 1 shows the calculation of observed correlation for the Mathematics Performance model. The magnitude of the Pearson correlation coefficient determines the strength of the correlation. Although there are no concrete rules for assigning the strength of association to particular values, the study had used the general guideline provided by Cohen (1988):

| Coefficient Value | Strength of Association         |
|-------------------|---------------------------------|
| 0.1 < |r| < 0.3       | Small Correlation              |
| 0.3 < |r| < 0.5       | Medium/Moderate Correlation    |
| |r| > 0.5        | Large/Strong Correlation       |
Table 1. Calculation of Observed Correlation for the Mathematics Performance Model

|       | X1       | X2       | X3       | X4       | Y       |
|-------|----------|----------|----------|----------|---------|
| Pearson Correlation | 1        | .531**   | .514**   | .466**   | .512**  |
| N     | 240      | .000     | .000     | .000     | .000    |
| Sig. (2-tailed)    | .000     | .000     | .000     | .000     | .000    |
| Pearson Correlation | .531**   | 1        | .420**   | .435**   | .520**  |
| N     | 240      | .000     | .000     | .000     | .000    |
| Sig. (2-tailed)    | .000     | .000     | .000     | .000     | .000    |
| Pearson Correlation | .514**   | .420**   | 1        | .431**   | .482**  |
| N     | 240      | .000     | .000     | .000     | .000    |
| Sig. (2-tailed)    | .000     | .000     | .000     | .000     | .000    |
| Pearson Correlation | .466**   | .435**   | .431**   | 1        | .881**  |
| N     | 240      | .000     | .000     | .000     | .000    |
| Sig. (2-tailed)    | .000     | .000     | .000     | .000     | .000    |
| Pearson Correlation | .512**   | .520**   | .482**   | .881**   | 1       |
| N     | 240      | .000     | .000     | .000     | .000    |
| Sig. (2-tailed)    | .000     | .000     | .000     | .000     | .000    |

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

Based on the table, motivation (X1), attitude toward mathematics (X2), and teaching strategies (X4) were positively related to Mathematics Performance (Y), which obtained p-values less than 0.05 level of significance. The results revealed the strength of association from these variables was a large/strong correlation. It implies that as the perceived level of motivation, attitude towards mathematics, and teaching strategies increases, then the students' mathematics performance will also increase.

Meanwhile, motivation (X1), attitude towards mathematics (X2), learning style (X3), and teaching strategies (X4) were correlated to each other, which obtained p-values less than 0.05 level of significance. The strength of association from all factors was revealed to have a medium/moderate or large/strong correlation.

To evaluate the model fit in Figure 2, obtaining the reproduced correlations and comparing them to the empirical correlations must be needed to assess the consistency of the model. To determine the reproduced correlation between two variables involves identifying all valid paths between the variables in the model. The complete set of path decompositions and reproduced correlations for the model shown in Figure 2 are presented in Table 2. Causal effects are presented by paths consisting only of causal links; that is, the only one-headed arrow is used to indicate the effect of a variable presumed to be the cause on another variable presumed to be an effect. In this study, a direct effect or a causal path consisting of only one link is denoted by "D", a direct effect consisting of two or more link is denoted by "I", and spurious effect that is any path components resulting from paths that have reversed casual direction at some point is denoted by "S".
### Table 2. Calculation of Initial Reproduced Correlation for the Mathematics Performance Model

| Reproduced Correlation | Path Decomposition |
|------------------------|--------------------|
| $\hat{r}_{12}$        | $= \rho^2_X \rho^2_Y$ |
|                        | $= 0.531$          |
| $\hat{r}_{13}$        | $= \rho^3_X \rho^2_Y + \rho^2_X \rho^2_Y \rho^3_Y$ |
|                        | $= 0.337 + (0.531)(0.150) = 0.417$ |
| $\hat{r}_{14}$        | $= \rho^2_X \rho^3_Y + \rho^2_X \rho^3_Y + \rho^2_X \rho^3_Y \rho^3_Y$ |
|                        | $= (0.531)(0.150)(0.209) + (0.337)(0.209) = 0.087$ |
| $\hat{r}_{15}$        | $= \rho^4_X \rho^3_Y + \rho^4_X \rho^3_Y + \rho^4_X \rho^3_Y \rho^3_Y + \rho^4_X \rho^3_Y \rho^3_Y \rho^3_Y$ |
|                        | $= 0.047 + (0.531)(0.130) + (0.531)(0.150)(0.070) + (0.531)(0.150)(0.209)(0.772) +$ |
|                        | $= (0.337)(0.070) + (0.337)(0.209)(0.772) = 0.261$ |
| $\hat{r}_{23}$        | $= \rho^3_Y \rho^2_Y + \rho^3_Y \rho^3_Y$ |
|                        | $= 0.150 + (0.531)(0.337) = 0.329$ |
| $\hat{r}_{24}$        | $= \rho^4_Y \rho^3_Y + \rho^4_Y \rho^3_Y \rho^3_Y$ |
|                        | $= (0.150)(0.209) + (0.531)(0.337)(0.209) = 0.069$ |
| $\hat{r}_{25}$        | $= \rho^4_Y \rho^3_Y + \rho^4_Y \rho^3_Y \rho^3_Y \rho^3_Y + \rho^4_Y \rho^3_Y \rho^3_Y \rho^3_Y$ |
|                        | $= 0.130 + (0.150)(0.070) + (0.150)(0.209)(0.772) + (0.531)(0.337)(0.070) +$ |
|                        | $= (0.337)(0.337)(0.209)(0.772) = 0.206$ |
| $\hat{r}_{34}$        | $= \rho^2_X \rho^3_Y$ |
|                        | $= 0.209$          |
| $\hat{r}_{35}$        | $= \rho^3_Y \rho^3_Y + \rho^3_Y \rho^3_Y + \rho^3_Y \rho^3_Y \rho^3_Y + \rho^3_Y \rho^3_Y \rho^3_Y$ |
|                        | $= 0.070 + (0.209)(0.772) + (0.337)(0.047) + (0.337)(0.531)(0.130) + (0.150)(0.130)$ |
|                        | $= 0.290$          |
| $\hat{r}_{45}$        | $= \rho^4_Y \rho^3_Y + \rho^4_Y \rho^3_Y$ |
|                        | $= 0.772 + (0.209)(0.070) = 0.787$ |

D - direct effect, I – indirect effect, S – spurious effect

The set of legitimate paths in Table 2 was used to obtain the reproduced correlation in the initial model in Table 3, making the substitutions of path coefficients given in Figure 2. In assessing the fit of the model in Figure 2, it can be gleaned from Table 3 that seven out of ten reproduced correlations have differences greater than 0.05. Hence, those reproduced correlations that have a difference greater than 0.05 from the empirical correlations indicate that the model is not consistent with the empirical data; thus, it was determined that several paths should be added in the model, and revisions to the model are warranted prior to describing any of the causal effects, since, there are one or more missing paths in the model. Moreover, because the beta coefficient of the path from X1 to X5 is not significant, then it was removed to form the final revised model.
Table 3. Observed and Initial Reproduced Correlations for the Mathematics Performance Model

|       | X₁  | X₂  | X₃  | X₄  | Y   |
|-------|-----|-----|-----|-----|-----|
| **Observed Correlation** |     |     |     |     |     |
| X₁    | 1   |     |     |     |     |
| X₂    | 0.531 | 1   |     |     |     |
| X₃    | 0.514 | 0.420 | 1   |     |     |
| X₄    | 0.466 | 0.435 | 0.431 | 1   |     |
| Y     | 0.512 | 0.520 | 0.482 | 0.881 | 1   |
| **Reproduced Correlation** |     |     |     |     |     |
| X₁    | 1   |     |     |     |     |
| X₂    | 0.531 | 1   |     |     |     |
| X₃    | 0.417 | 0.329* | 1   |     |     |
| X₄    | 0.087* | 0.069* | 0.209* | 1   |     |
| Y     | 0.261* | 0.206* | 0.482 | 0.787* | 1   |

*Difference between reproduced and observed correlation is greater than 0.05.

The revised path diagram, including path coefficients, is presented in Figure 3, and the resulting path decomposition in the revised model is summarized as shown in Table 4. Since the model does not fit the data, consideration should be given to retaining included paths that are regressing X₄ on X₁ and X₄ on X₂.

![Figure 3: Revised Causal Factor Models Affecting the Mathematics Performance](image)

Once a model has been revised, the fit should again be reassessed in order to generate the best model. The results of obtaining the complete set of paths for the revised model are given in Table 4. It can be seen from Table 5 that the results of the revised model are a much better fit than the initial model; that is the there is only one reproduced correlation that has a difference greater than 0.05 from the observed correlation.
Table 4. Calculation of Revised Reproduced Correlation for the Mathematics Performance Model

| Reproduced Correlation | Path Decomposition |
|------------------------|--------------------|
| \( \hat{r}_{12} \)  | \( = \rho_{YX_1} \) |
| \( = 0.531 \)       | (D)                |
| \( \hat{r}_{13} \)  | \( = \rho_{YX_1} + \rho_{X_2} \rho_{YX_2} \) |
| \( = 0.405 + (0.531)(0.204) = 0.513 \) | (D) (I)             |
| \( \hat{r}_{14} \)  | \( = \rho_{YX_1} \rho_{YX_2} + \rho_{X_2} \rho_{YX_3} + \rho_{X_2} \rho_{X_3} \rho_{YX_3} + \rho_{X_2} \rho_{X_3} \rho_{X_4} \rho_{YX_4} \) |
| \( = 0.239 + (0.531)(0.204)(0.217) + (0.531)(0.216)(0.405)(0.217) = 0.465 \) | (D) (I) (I) (I)   |
| \( \hat{r}_{15} \)  | \( = \rho_{YX_1} \rho_{YX_2} + \rho_{X_2} \rho_{YX_3} + \rho_{X_2} \rho_{X_3} \rho_{YX_3} + \rho_{X_2} \rho_{X_3} \rho_{X_4} \rho_{YX_4} \) |
| \( = 0.394 \)       | (D) (I) (I) (I)   |
| \( \hat{r}_{23} \)  | \( = \rho_{YX_2} + \rho_{X_3} \rho_{YX_3} \) |
| \( = 0.204 + (0.531)(0.405) = 0.419 \) | (D) (S)            |
| \( \hat{r}_{24} \)  | \( = \rho_{YX_2} + \rho_{X_3} \rho_{YX_3} + \rho_{X_2} \rho_{X_3} \rho_{YX_3} + \rho_{X_2} \rho_{X_3} \rho_{X_4} \rho_{YX_4} \) |
| \( = 0.434 \)       | (D) (I) (I) (I)   |
| \( \hat{r}_{25} \)  | \( = \rho_{YX_2} + \rho_{X_3} \rho_{YX_3} + \rho_{X_2} \rho_{X_3} \rho_{YX_3} + \rho_{X_2} \rho_{X_3} \rho_{X_4} \rho_{YX_4} \) |
| \( = 0.519 \)       | (D) (I) (I) (I)   |
| \( \hat{r}_{34} \)  | \( = \rho_{YX_3} + \rho_{X_4} \rho_{YX_4} + \rho_{X_3} \rho_{YX_3} + \rho_{X_3} \rho_{X_4} \rho_{YX_4} \) |
| \( = 0.404 \)       | (D) (S) (S) (S)   |
| \( \hat{r}_{35} \)  | \( = \rho_{YX_3} + \rho_{X_4} \rho_{YX_4} + \rho_{X_3} \rho_{YX_3} + \rho_{X_3} \rho_{X_4} \rho_{YX_4} \) |
| \( = 0.468 \)       | (D) (I) (I) (I)   |
| \( \hat{r}_{45} \)  | \( = \rho_{YX_4} + \rho_{X_5} \rho_{YX_5} + \rho_{X_4} \rho_{X_5} \rho_{YX_5} + \rho_{X_4} \rho_{X_5} \rho_{YX_5} \rho_{YX_5} \rho_{YX_5} \rho_{YX_5} \rho_{YX_5} \rho_{YX_5} \rho_{YX_5} \rho_{YX_5} \rho_{YX_5} \rho_{YX_5} \rho_{YX_5} \rho_{YX_5} \rho_{YX_5} \rho_{YX_5}) \) |
| \( = 0.906 \)       | (D) (S) (S) (S)   |

D - direct effect, I – indirect effect, S – spurious effect
Mathematics Performance had a positive direct effect on attitudes towards mathematics, learning style, and a very strong relation was found between mathematics performance and teaching strategies. Furthermore, motivation, attitude towards mathematics, and learning style affected learning style positively. Finally, learning style was directly related to motivation and attitude towards mathematics, and motivation directly positively related to attitude towards mathematics. The study of Areepattamannil and Kaur (2012) found out that positive affect towards mathematics influenced mathematics achievement. It dramatically impacts students' mathematics achievement when teaching strategies coincide with their learning style (Tebabal & Kahssay, 2011).

Moreover, Mathematics had indirect effects on motivation (0.394), Attitude toward Mathematics (0.221), and Learning Style (0.084). Teaching Strategies had an indirect effect on motivation (0.226), and Attitude towards Mathematics (0.044). Finally, learning style had an indirect effect on motivation (0.108).

R-squared indicated that 80.5% of the variance in the Mathematics Performance was accounted for the independent variables. The model explains 29.9% of the variance in teaching strategies, 29.4% of the variance in learning style, and, finally, 28.2% in attitudes towards mathematics.
### Table 6. Summary of Causal Effects for Revised Model (Mathematics Performance)

| Outcome                          | Determinants                      | Causal Effects |
|----------------------------------|-----------------------------------|----------------|
|                                  | Direct               | Indirect       | Total           |
| Mathematics Performance          | Motivation                | -              | 0.394           | 0.394           |
| \(R^2 = 0.805\)                  | Attitude Towards Mathematics  | 0.145          | 0.221           | 0.366           |
|                                  | Learning Style            | 0.170          | 0.084           | 0.254           |
|                                  | Teaching Strategies        | 0.782          | -               | 0.782           |
| Teaching Strategies              | Motivation                | 0.239          | 0.226           | 0.465           |
| \(R^2 = 0.299\)                  | Attitude Towards Mathematics| 0.216          | 0.044           | 0.260           |
|                                  | Learning Style            | 0.217          | -               | 0.217           |
| Learning Style                   | Motivation                | 0.405          | 0.108           | 0.513           |
| \(R^2 = 0.294\)                  | Attitude Towards Mathematics| 0.204          | -               | 0.204           |
| Attitude Towards Mathematics     | Motivation                | 0.531          | -               | 0.531           |
| \(R^2 = 0.282\)                  |                                  |                |                 |                 |

### 5.0 Conclusions

The present study provided an empirical test of a causal model concerning motivation, attitude towards mathematics, learning style, teaching strategies, and mathematics performance. As relationships, the strength of association from all factors of mathematics performance was revealed to have a medium/moderate or large/strong correlation. Results also reveal that a large proportion of mathematics performance can be directly predicted from the attitude towards mathematics, learning style, and teaching strategies. Moreover, attitude towards mathematics, learning style, and teaching strategies influence mathematics performance directly and indirectly.

In conclusion, if the students build their attitude toward mathematics, they would be more likely to do their learning style and cope with the teachers' teaching strategies and therefore enhanced their mathematics performance.
6.0 Literature Cited

Adnan, M., Lee Abdulla, M. F. N., Ahmad, C. N. C., Puteh, M., Zawawi, Y. Z., & Maat, S. M. (2013). Learning style and mathematics achievement among high performance school students. World Applied Sciences Journal, 28(3), 392-399. DOI: 10.5829/idosi.wasj.2013.28.03.643

Amrai, K., Motlagh, S. E., Zalani, H. A., & Parhon, H. (2011). The relationship between academic motivation and academic achievement students. Procedia-Social and Behavioral Sciences, 15, 399-402.

Alcuizar, R. (2016). Determinants of low academic performance for pupils in upland barangays, Iligan City, Philippines. International Journal of Physical Education, Sports and Health, 2016; 3(2): 321-325

Areeptattamannil, S., & Kaur, B. (2012). Influences of Self-Perceived Competence in Mathematics and Positive Affect toward Mathematics on Mathematics Achievement of Adolescents in Singapore. Mathematics Education Research Group of Australasia.

Awang, H., Abd Samad, N., Faiz, N. M., Roddin, R., & Kankia, J. D. (2017, August). Relationship between the learning styles preferences and academic achievement. In IOP Conference Series: Materials Science and Engineering (Vol. 226, No. 1, p. 012193). IOP Publishing.

Coleman, B. (2009). From home to school: The relationship between parental involvement, student motivation, and academic achievement. Honors Thesis, the 32 University of Southern Mississippi, Department of Curriculum, Instruction, and Special Education.

Damavandi, A. J., Mahyuddin, R., Elias, H., Daud, S., & Shabani, J. (2011). Academic Achievement of Students with Different Learning Styles. International Journal of Psychological Studies, 3(2), 186-192.http://dx.doi.org/10.5539/ijps.v3n2p186

Damrongpanit, S. (2014). An Interaction of learning and teaching styles influencing mathematic achievements of ninth-grade students: A multilevel approach. Educational Research and Reviews, 9(19), 771.

Farooq, M. S., & Shah, S. Z. U. (2008). STUDENTS'ATTITUDE TOWARDS MATHEMATICS. Pakistan Economic and Social Review, 75-83.

Ganyaupfu, E. M. (2013). Teaching methods and students academic performance. International Journal of Humanities and Social Science Invention, 2(9), 29-35.

Gilakjani, A. P. (2012). Visual, auditory, kinaesthetic learning styles and their impacts on English language teaching. Journal of studies in education, 2(1), 104-113.

Guay, F., Ratelle, C. F., Roy, A., & Litalien, D. (2010). Academic self-concept, autonomous academic motivation, and academic achievement: Mediating and additive effects. Learning and Individual Differences, 20(6), 644-653.

Hamze, Mohammad AbdelWahab H. (2014). Teaching Strategies Used by Mathematics Teachers in the Jordan Public Schools and Their Relationship with Some Variables. American Journal of Educational Research, vol. 2, no. 6 (2014): 331-340. doi: 10.12691/education-2-6-1

Hemmings, B., Grootenboer, P., & Kay, R. (2011). Predicting mathematics achievement: The influence of prior achievement and attitudes. International Journal of Science and Mathematics Education, 9(3), 691-705.
Joyce, B., Weil, M., & Calhoun, E. (2003). Models of teaching.
Kusukar, R., Croiset, G., Kruitwagen, C., & Ten Cate, O. (2011). Validity Evidence for the Measurement of the Strength of Motivation for Medical School. Advances in Health Sciences Education, 16(2), 183-195.
Lacour, M., & Tissington, L. D. (2011). The effects of poverty on academic achievement. Educational Research and Reviews, 6(7), 522-527.
Liu, X., & Koirala, H. (2009). The effect of Mathematics self-efficacy on mathematics achievement of high school student.
Mata, M., Monteiro, V and Peixoto, F. (2012). Attitudes towards Mathematics: Effects of Individual, Motivational, and Social Support Factors. Child Development Research. Volume 2012 (2012), Article ID 876028
Orhun, N. (2007). An investigation into the mathematics achievement and attitude towards mathematics with respect to learning style according to gender. International Journal of Mathematical Education in Science and Technology, 38(3), 321-333.
Sariçoban, A., & Sarıcaoğlu, A. (2008). THE EFFECT OF THE RELATIONSHIP BETWEEN LEARNING AND TEACHING STRATEGIES ON ACADEMIC ACHIEVEMENT. Novitas-Royal, 2(2).
Shi, C. (2011). A Study of the Relationship between Cognitive Styles and Learning Strategies. Higher Education Studies, 1(1), 20-26.
Skinner, B. F. (1945). Cognitive science and behaviorism. British Journal of Psychology, 76(3), 291-301.
Tebabal, A., & Kahssay, G. (2011). The effects of student-centered approach in improving students' graphical interpretation skills and conceptual understanding of kinematical motion. Latin-American Journal of Physics Education, 5(2), 9.
Tulbure, C. (2012). Learning styles, teaching strategies and academic achievement in higher education: A cross-sectional investigation. Procedia-Social and Behavioral Sciences, 33, 398-402.
Vaishnav, R. S. (2013). Learning style and academic achievement of secondary school students. Voice of Research, 1(4), 1-4.
Vintere, A., & Zeidmane, A. (2014). Research in Mathematical competence in Engineers' professional activities. Engineering for rural development, 497-504.
Yildirim, O., Acar, A. C., Bull, S., & Sevinc, L. (2008). Relationships between teachers’ perceived leadership style, students’ learning style, and academic achievement: A study on high school students. Educational Psychology, 28(1), 73-81.