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# The Factors Influence Students' Achievement in Mathematics: A Case for Libyan's Students

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**Abstract:** The purpose of this study is to determine the key factors that influencing Libyan students' achievement in mathematics. A questionnaire of 30 items was distributed for Libyan students in Kuala Lumpur, Malaysia. The total number of the respondents was 201 (74 male and 127 female). One hundred and five students were in grade 4-6, eighty one students grade 7-9 and fifteen students from secondary school. Students were asked to respond to a 5-point Likert scale. Factor analysis technique was used and based on the Eigen values over one, six factors were identified. The combination of items, with loadings greater than 0.50, were considered as separate factors. These factors were Teaching Practices (which was recorded highly on loading), teacher' attribution, classroom climate, students' attitude towards mathematics and students' anxiety, in addition to students' mathematics achievement. Subsequently, confirmatory factor analysis was conducted using the Structural Equation Modelling. The results showed that the teacher' attribution and students' attitude towards mathematics were the highest and lowest factors influencing the students' achievement, respectively. Moreover, the relationship among Teaching Practices and teacher attribution was high (0.68). Generally, good correlations were found among these factors in one hand and student's achievement in mathematics in the other hand.

**Key words:** Mathematics achievement · Teaching Practices · Teacher' attribution · Classroom climate · Attitude towards mathematics · Math anxiety

## INTRODUCTION

There is no doubt that mathematics is one of the most basic pillars of any scientific progress, the teaching of modern mathematics has become necessary of the age of information revolution, as all inventions of cars, trains, computers, missiles, are governed by the laws of mathematics [1]. The importance of mathematics in scientific endeavour is explored by [2] who views mathematics as the 'Queen and Servant" of the sciences. According to [2] mathematics serves physics, chemistry, biology, economics and other sciences. This is means that for a student to master these courses (physics, chemistry, biology and economics) he/she must be well-equipped and familiar with mathematics. Hence, mathematics is considered as backbone of any scientific undertaking, which the students should master prior to their profound in any scientific exercises. It is now well recognized that student and family background characteristics consistently explain a large proportion of the variance in student outcomes [3]. These characteristics include student gender, socio-economic background, prior ability, attitudes, aspirations and beliefs about learning. Classroom influences include the student's opportunities to learn within the classroom which is often a measure of time exposed to a learning situation, the instructional practices that are employed in the classroom, beliefs of the teacher about student learning and pedagogies of teaching, the climate and environment of the classroom [4].

Several factors influence students' achievement in mathematics. Some of these factors are student personal attitudes towards mathematics, classroom climate, mathematics anxiety [5], teachers attribution as lack of experienced mathematics teachers and shortage of qualified mathematics teachers [6], teaching practices and teaching methods [7, 8], students' beliefs and attitudes toward mathematics [9-11]. Furthermore, according to Adeogun and Osifila [12], there are significant impact of inadequate educational resources on students' academic performance. They, Adeogun and Osifila [12], also emphasized that teachers attributions and instructional

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quality as teaching methods are the most important factors affecting student learning. However, ongoing discussions about whether and to what extent teachers make a difference in student learning relative to a range of other factors assumedly affect student learning [13, 14], as well, whether it could have been certain elements of the teaching that can be systematically and causally linked to the student achievement [15].

Mathematics teachers will be able to use the methods appropriate to their experience and reflective of what they believe the mission of mathematics teaching to be [16]. The practice of teaching is crucial to the communicate of values of teachers, the process of classroom management [17] and to enhance student achievement.

Teachers' characteristics and their experiences and behaviours in the classroom, contribute to the educational environment of the students, which in turn will have an impact on student achievement. There is a common assumption with regard to the association among teacher experience and student achievement that is students who taught by the most experienced teachers achieved higher levels. This is because their teachers were mastered the content and obtained classroom management skills to deal with different types of classroom problems. Studies on the relationship between the teachers, experience and student's performance showed contradictory results. A positive relationship between teachers' experiences and student performance was found by Fetler [18], [19] and Bodenhausen [20], while Chhinh and Tabata [21] found a week positive correlation. Moreover, Klecker [22] noted that there is no significant differences in students' achievement by their teachers' years of teaching.

Instructions are mainly related to the characteristics of the classroom. It is about the interaction of the teacher, students and the curriculum. Hiebert and Grouws [23] noted that some teaching features are more effective for promoting skill efficiency than for promoting conceptual understanding. The findings from the studies they reviewed indicated that instruction that emphasizes conceptual development facilitated both skill learning and conceptual understanding, besides, when teaching promotes constructive struggle with mathematics, students' understanding increases. A similar observation was made by Stevenson *et al*. [24], that when students are exposed to rigorous mathematics content, the learning is increased.

Math anxiety is another factor that was shown, experimentally, to influence students' mathematics achievement. According to Ashcraft [25] mathematics anxiety is a feeling of tension, apprehension, or fear that interferes with one's performance in mathematics. Many studies on mathematics anxiety were supported the opinion that there is a weak relation between mathematics anxiety and students' achievement in mathematics, as shown, for examples, by [26-29]. These studies are also emphasized the importance of the potential effects that mathematics anxiety put on mathematics performance. In addition, the classroom climate such as the number of students in the classroom and the commitment of the students calms and quiet in the classroom, were also influence the students' achievement. Some research has suggested that there is significant impacts of pupil-teacher ratio diminution on test scores in some contexts [30, 31]. In contrast, Banerjee *et al*. [32] explained that there is no effect of the reduction in pupil-teacher ratio achieved through the hiring of a remedial education teacher for students who remained with the regular (civil service) teacher.

Table 1: Respondents' Profile

| Type | N | Factor | Frequency | (%) |
|---|---|---|---|---|
| Gender | 201 | Female | 127 | 63.2 |
| | | Male | 74.0 | 36.8 |
| Age | 201 | "9 - 11" | 99.0 | 49.3 |
| | | "12-14" | 86.0 | 42.8 |
| | | More than 14 | 16.0 | 8.00 |
| Class | 201 | Class 4-6 | 105 | 52.2 |
| | | Class 7-9 | 81.0 | 40.3 |
| | | Secondary | 15.0 | 7.50 |

Factor Analysis is a statistical method used to identify the number of (factors) contained in a set of observed variables and to identify the subset of variables that corresponds to each of these factors. The factors are referred to as latent variables. The observed variables are referred to as factor indicators [33]. According to De Coster [34] there are two types of factor analysis; the first factor is the exploratory factor analysis (EFA), which attempts to discover the nature of the constructs influencing a set of responses and the second factor is the confirmatory factor analysis (CFA) that tests whether a specified set of constructs is influencing responses in a predicted way. Therefore, the aimed of this study was to determine the key factors that influencing the achievement of Libyan students in mathematics, where both types of factor analysis, EFA and CFA, were applied.

**Methodology:** A total of 201 respondents were participated in this study. The respondents are students from Libyan school in Kuala Lumpur, Malaysia. One hundred and five students are in grade 4-6; eighty one students are in grade 7-9; and fifteen students are in secondary school. Out of the 201 sample, 63.2% are females and 36.8% are males (as shown in Table 1).

The respondents were given a questionnaire which consists of demographic information and it consisted of 30 items about Teaching Practices, teacher attribution, classroom climate, students' attitude towards mathematics and students' anxiety in addition to students' mathematics achievement. The students' mathematics achievement was measured by students' mid-term exams and final exams scores in the last semester. They are required to answer these 30 items with a 5-point Likert scale ranging from 1 (strongly agree) to 5 (strongly disagree). The instrument was administered by the researcher and the respondents were given ample time to answer the survey.

However, the number of items was reduced to 25 items due to low factor loading during the EFA process. After CFA the items were reduced to twenty items, eleven items of Teaching Practices and methods, three items of teacher attribution, two items of classroom climate, two items of students' attitude towards mathematics and two items of students' anxiety.

## RESULTS

This study is used both exploratory factor analysis and confirmatory factor analyses to validate the underlying hypothesized structure of students' mathematics achievement factors. This was gone using SPSS 18.0 and AMOS 18.0 computer software packages.

**Reliability:** The items were ranked on a five-point Likert scale; 1 = strongly agree, 2 = agree, 3 = moderately agree, 4 = disagree and 5 = strongly disagree. [33], the value of Cronbach alpha should be at least 0.70 for any research using the survey method. The reliability coefficient of this study items was 0.902 and each of the subscales showed reliability values ranging from 0.733 to 0.910. Thus, the variables of students' mathematics achievement resulted in acceptable value of internal consistency for this study.

Table 2: Items of students' achievement in mathematics with factors loading obtained from EFA process

| | | Loading | | | | | |
|---|---|---|---|---|---|---|---|
| Factors | Items | 1 | 2 | 3 | 4 | 5 | 6 |
| Teaching method and teaching practise (TPM) | TPM1 | 0.804 | | | | | |
| | TPM2 | 0.787 | | | | | |
| | TPM3 | 0.772 | | | | | |
| | TPM4 | 0.750 | | | | | |
| | TPM5 | 0.705 | | | | | |
| | TPM6 | 0.695 | | | | | |
| | TPM7 | 0.693 | | | | | |
| | TPM8 | 0.642 | | | | | |
| | TPM9 | 0.617 | | | | | |
| | TPM10 | 0.541 | | | | | |
| | TPM11 | 0.533 | | | | | |
| | TPM13 | 0.502 | | | | | |
| Classroom climate (CLR) | CL1 | | 0.829 | | | | |
| | CL2 | | 0.671 | | | | |
| | CL3 | | 0.668 | | | | |
| | CL4 | | 0.641 | | | | |
| Students' Mathematics Achievement (ACHI) | GR2 | | | 0.842 | | | |
| | GR1 | | | 0.816 | | | |
| Students attitude towards mathematics (SATM) | ATM1 | | | | 0.865 | | |
| | ATM2 | | | | 0.841 | | |
| Students' anxiety (ANXI) | ANX1 | | | | | 0.833 | |
| | ANX2 | | | | | 0.749 | |
| Teachers attribution and characteristic(TAC) | TC1 | | | | | | 0.721 |
| | TC2 | | | | | | 0.601 |

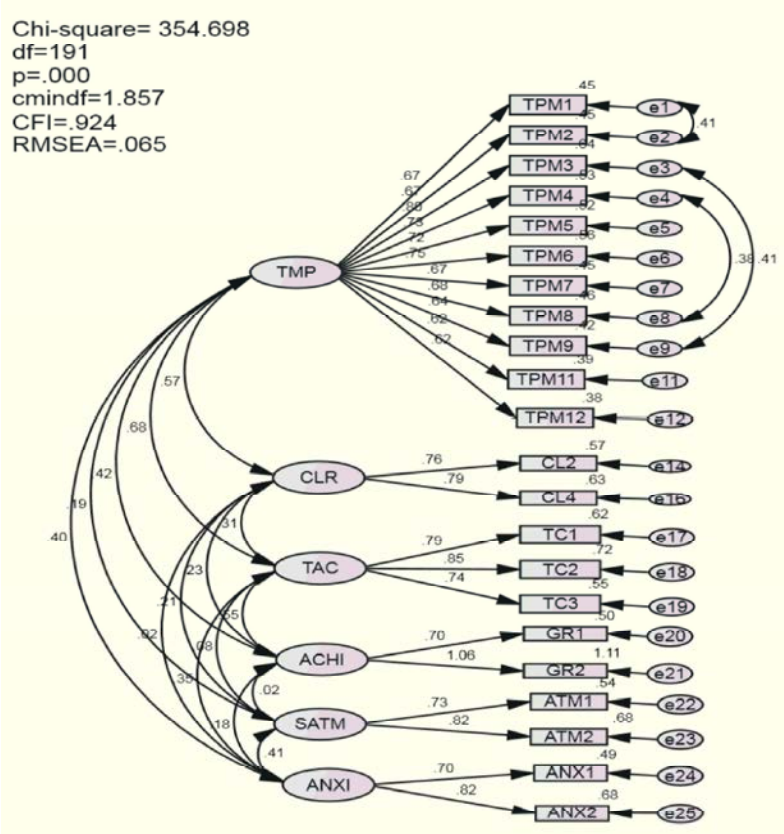


Fig. 1: The finalized measurement model of CFA

Table 3: The results of CFA on students' mathematics achievement (n = 201)

| Fit Statistics | Df | P | CMINDF | CFI | RMSEA |
|---|---|---|---|---|---|
| Value | 191 | 0.000 | 1.857 | 0.924 | 0.065 |

**Exploratory Factor Analysis (EFA):** An exploratory factor analysis occurred prior to the confirmatory factor analysis. The EFA was intended to reduce the number of items in the instrument in order to maximize the explained variance and identify the appropriate number of items in each of the variables' factors [35].

The Kaiser Meyer-Olkin measure of sampling adequacy (KMO) value was equivalent to 0.856, which is considered excellent based on the suggested criteria for KMO value by Hair *et al*., [33]. The correlation between most of the items was found higher than 0.2. The significance of Bartlett's test of sphericity (p=0.000) supported the evidence that the items can be factored.

Using a varimax orthogonal rotation, sex factors with a factor loading higher than 0.5 were formed. Table 2 shows loading factors of students' achievement in mathematics.

As shown in Table 2, the factor analysis identified six common factors, i.e., factor 1, 2, 3, 4, 5 and 6. Where, factor one is Teaching method and teaching practise (TPM) and it is contained 12 items. The minimum and maximum loading for this factor were 0.502 and 0.804, respectively. The second factor is the Classroom climate (CLR) with four items and it is loading between 0.641 and 0.829. The third factor is Students' Mathematics Achievement (ACHI) with two items and their loading was 0.842 and 0.816. The fourth factor was Students attitude towards mathematics (SATM) contained two items with loading of 0.865 and 0.841. The fifth factor is Students' anxiety (ANXI) which contained two items with loading of 0.833 and 0.749. The last factor is the Teachers attribution and characteristic (TAC) with two items and their loading were 0.721 and 0.601.

**Confirmatory Factor Analysis (CFA):** A confirmatory factor analysis was performed to confirm the findings of the exploratory factor analysis. Using the data collected from a sample of 201 respondents, a six-factor measurement model for students' mathematics

achievement factors was tested using AMOS 18.0 computer programme. The standardized output was applied to inform the parameter estimation of the model [36]. The measurement model of students' mathematics achievement factors contained both observed (measured) variables and latent constructs.

In order to measure the goodness-off fitted model, statistical measures such as chi-square test, the relative chi-square (=chi-square/degree of freedom), Comparative Fit Index (CFI) and Root Mean Square of Error Approximation (RMSEA) were used [33]. To achieve the fitness of the model the relative chi-square (CMINDF) must be between 1 and 5, the CFI value must exceed 0.90. The RMSEA value must be lower than 0.08 to indicate an acceptable fit to the data [37]. Table 3 shows the results of the confirmatory factor analysis (CFA) on the six-factor model of students' mathematics achievement factors, which reflect a close-fit model and indicated the good-fit of the model.

Figure 1 shows the final measurement model of students' mathematics achievement. This model indicated to the relations between observed variables and latent variables. The observed variables and the latent variables were represented by the Rectangles and the ellipses, respectively. One item from Teaching Practices and methods, 2 items from classroom climate and 1 item from students' attitude towards mathematics were dropped due to their low loading factors. The model creates covariance between TM1 and TM2, TM3 and TM9 and TM4 and TM8. These covariance are created through the modification index produced by the AMOS analysis in order to reduce the chi square value and achieve the acceptable model fit [33]. Regression weights for all observed variables are greater than 0.5 and were significant at $p = 0.00$.

The acceptable model fit was obtained since all the chosen fit statistics verified to the requirement. While, all the factors have acceptable reliability value, each factor can be measured individually depending on the nature of the research.

## DISCUSSION

This study was performed to identify the key factors that influencing students' achievement in mathematics and to evaluate the reliability and validity of the students' mathematics achievement instrument by employing both exploratory and confirmatory factor analyses to Libyan students in Malaysia. The analyses indicated six factors on students' mathematics achievement. The measurement model has yielded three factors that include Teaching Practices, teacher attribution, classroom climate, students' attitude towards mathematics and students' anxiety in addition to students' mathematics achievement.

Analysis of the correlations among the variables was carried out to examine the existence of associations among the factors Teaching Practices, teacher attribution, classroom climate, students' attitude towards mathematics and students' anxiety with students' mathematics achievement.

The highest correlation among these factors and student was between teacher attribution and their characteristic on one hand and students' achievement on the other hand ($r = 0.55$). This implies that when teacher attribution and their characteristic improved, especially for the experience of teachers; the students' achievement also was raised. This was spotted by Darling-Hammond [19]. The result showed that the teaching practices influenced positively the students' achievement ($r = 0.39$). It is also indicated that there was a strong relationship among teacher characteristic and teachers' practices ($r = 0.67$), i.e., when teachers have good experience and high qualification, their practices in classroom were increased. The lowest correlation ($r = 0.021$) was between students' achievement and students' attitude towards mathematics. There was almost no relationship between students' attitude towards mathematics (SATM) and students' anxiety (ANXI) with students' mathematics achievement. The results also showed positive relationships between teacher attributions and their characteristic with teaching methods and teaching practices, classroom climate (CLR) and students' anxiety. However, there was a very low relationship among teacher attributions and their characteristics and students' attitude towards mathematics. The students' attitude towards mathematics were weakly correlated with students' achievement, teaching methods and teaching practices, teacher attribution and classroom climate, whereas correlated positively and high with students' anxiety.

## CONCLUSION

This study is aimed to determine the key factors that influencing Libyan students' achievement in mathematics, where an exploratory and confirmatory factor analyses were carried out. The study showed a positive relationship between teacher attribution and their characteristics (TAC) such as teaching experience and

students' achievement (ACHI) and a significance positive relationship between students' achievement and teaching methods and Teaching practices (TMP). The relationship between teaching methods and teaching practices and all factors were high and positive, though a low and positive relationship with students' attitude towards mathematics was observed. Classroom climate was correlated weakly almost with all factors. The outputs of the study may enable teachers to identify the gaps in their instructional methodology and assist educational authorities to prepare educational development programs, particularly those designed to enhance teaching effectiveness.

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