Investigating the Causes of the Decline in Mathematics Performance Among High School Students in Iraq: A Teacher's Perspective.

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Abstract

Recent studies indicate that mathematics performance by high school students in the Iraq have declined considerably. There are many reasons that have been advanced for this phenomenon, chief among them, the political turmoil the country has gone through in the recent past. This paper endeavoured to find out specific reasons that teachers perceive to be causing such decline in performance. Data was collected from teachers in 8 major cities of Iraq through an online questionnaire. The results show that mathematics curriculum, lack of proper grounding in the foundation years, lack of concentration among students during lesson time and overcrowding in the classroom contribute to demotivation of students in mathematics leading to poor performance.
Key Words: Mathematics Performance, Descriptive Statistics, Regression, Mathematics Curriculum.

Introduction

The level of mathematics achievement in Kurdistan region and the entire country has steadily declined. Iraq and the larger Arab region used to be the bastion of science and mathematics, especially algebra whose founder, Muhammad ibn Musa al-Khwarizmi, is associated with the region. The glory days of mathematics and science dominance faded away leaving behind a nostalgia that was exacerbated by the war. Several studies in the recent past attest to this phenomenon. Hassan Al-Awaid & Sulaiman, (2013) in their examination of the relationship between mathematics anxiety and mathematics performance among secondary school students in Iraq agree that there is poor performance of mathematics by students in Iraq and anxiety may be one of the causes. This is quite understandable in an environment where students compete for limited resources like perceived good university courses and government sponsorship. Public universities in Iraq are almost free of charge, students pay very little money, if at all. Therefore, this creates very high competition among high school students who sit for Wzary (Waswa Al-kassab & Alhasoo, 2023, January), a standardized national placement examination, to get a seat in few good public universities available. This may cause anxiety in students which leads to poor performance in the subject. A study investigating factors that affect the quality of mathematics education in Iraq determined teachers in Iraq lack the requisite training and credentials to teach mathematics effectively (Al-Mouamin, 2016). The author also found out that learners often time have insufficient knowledge of basic mathematics skills essential for a successful journey of learning mathematics, and that the most challenging obstacle students and teachers face in Iraqi schools is the lack of resources and support for mathematics education. Teacher training and well-equipped classrooms require funding, the budget for education in Iraq, especially in Kurdistan region, is insufficient to cater for that. Therefore, schools and other stakeholders grapple with the little funds available to make do. Despite the country's rich natural resources, the war and perennial political upheavals places it in a precarious position with run-away corruption in every sector.

Other studies cite students' negative attitude towards mathematics and low self-efficacy among them as causes of poor mathematics performance. For instance, Al-Fahdawi, Ali, & Hossain, (2021) while investigating, found that many students in the country had negative attitudes toward mathematics and exhibited low levels of self-efficacy. Students attitude towards mathematics can be influenced by many things, teachers' disposition, availability of resources, and perceived usefulness of the subject are some of them. Therefore, if teachers are not well taken care of, as is the case in the country, their dispositions will be of a negative nature and that automatically reflects in students' behaviour including attitudes towards mathematics. Waswa & Celik, (2021) investigating the effect of online teaching practicum on preservice teachers discovered that teachers' self-efficacy in the region was at best of average strength. Self-drive in the face of scarce resources and no support is almost impossible. Teachers in Iraq face this situation on a daily basis and the situation is unlikely to improve in the foreseeable future. Such circumstances negatively affect the performance of students in any subject, mathematics included.
This study examined sources of decline in mathematics performance among high school students in Iraq. The study specifically sought to identify factors predicting motivation of students to study mathematics.

Design and Methodology

Data was collected from 110 teachers from across major cities of Iraq, including Baghdad, Basra, Erbil, Sulaymaniyah, Duhok, Halabja, Kirkuk, and Soran. An online questionnaire through Google forms was send to teachers and the data collected analyzed through Minitab. Regression analysis and analysis of variance were performed on the data and the results are displayed hereunder.

Results

The study evaluated how five variables; Mathematics Foundation in Early Years (C2), Concentration when doing Mathematics Activities (C3), Mathematics Curriculum (C4), School/Classroom Environment (C5), and Instructors and Instructing Strategies (C6) affect students' Motivation (C1) and interest to study mathematics. Results are stated and displayed in tables and figures as follows.

Descriptive Statistics

Variable	N	Mean	StDev	Coefvar	Median	Mode
Motivation	110	18.400	3.605	19.59	18.000	18
Foundation	110	24.482	4.294	17.54	25.000	27
Concentration	110	19.809	3.796	19.17	19.500	18
Curriculum	110	12.664	2.893	22.85	13.000	14
Classroom	110	27.136	4.868	17.94	27.000	25, 29
Instructors	110	32.700	6.364	19.46	33.000	35

Data in the table suggest that students generally rate their instructors and/or instructing practices and classroom experience more positively than other aspects of their academic experience, such as concentration during mathematics activities, and the mathematics curriculum. For instance, the mean value for Instructors is 32.7, indicating a higher overall rating. Similarly, Classroom has a mean of 27.136, suggesting a relatively positive experience. This implies that instructors and their instructing practices together with classroom experience have stronger effect on students' motivation to study mathematics. The table also clearly shows that there is more variation in students' experiences with the curriculum whose coefficient of variation is greatest at 22.85. Perhaps the most interesting aspect of the table is the bimodal display of classroom experiences, which suggests existence of two distinct groups of students with different experiences in this variable.

Correlations between Variables

Variable 1	Variable 2	Correlation	95% CI for ρ	P-Value
Foundation	Motivation	0.528	(0.378, 0.651)	0.000
Concentration	Motivation	0.443	(0.279, 0.582)	0.000
Curriculum	Motivation	0.555	(0.410, 0.672)	0.000
Classroom	Motivation	0.645	(0.520, 0.742)	0.000
Instructors	Motivation	0.671	(0.553, 0.762)	0.000
Concentration	Foundation	0.387	(0.215, 0.535)	0.000
Curriculum	Foundation	0.581	(0.442, 0.693)	0.000
Classroom	Foundation	0.574	(0.433, 0.687)	0.000
Instructors	Foundation	0.497	(0.342, 0.626)	0.000
Curriculum	Concentration	0.420	(0.253, 0.563)	0.000
Classroom	Concentration	0.465	(0.304, 0.600)	0.000
Instructors	Concentration	0.496	(0.341, 0.625)	0.000
Classroom	Curriculum	0.590	(0.453, 0.700)	0.000
Instructors	Curriculum	0.625	(0.496, 0.727)	0.000
Instructors	Classroom	0.704	(0.596, 0.788)	0.000

The table clearly show that motivation is positively correlated with all other variables, having the strongest positive correlation of 0.671 instructors followed by classroom (0.645), but has the least correlation with concentration (0.443). The table also shows correlation between different pairs of variables indicating their interdependence on each other.

Regression Analysis for All Variables

The regression equation

$$C_1 = 1.63 + 0.1206C_2 + 0.0676C_3 + 0.110C_4 + 0.1745C_5 + 0.1942C_6$$

Table of Regression Coefficients

Variable	Coef	SE Coef	T-Value	P-Value	VIF
Constant	1.63	1.67	0.98	0.330	
Foundation	0.1206	0.0738	1.63	0.105	1.74
Concentration	0.0676	0.0750	0.90	0.369	1.41
Curriculum	0.110	0.118	0.93	0.354	2.01
Classroom	0.1745	0.0759	2.30*	0.024	2.37
Instructors	0.1942	0.0585	3.32*	0.001	2.40

* Means significant

The regression equation indicates that all independent variables have positive correlations with the dependent variable. Classroom/school environment and instructors and instructional techniques are statistically significant, hence have the strongest positive association with motivation with coefficients of 0.1745 and 0.1942, respectively. This means that a positive increase in the classroom/school environment together with improved instructional methods leads to higher motivation in students. The table further singles out mathematics foundation in early years as a variable that is not statistically significant with a p-value of 0.105, all other variables are not statistically significant at a significance level of 0.05. It is noteworthy to mention that there was significant multicollinearity among the variables some of them having a Variance Inflation Factor value 2.37 and 2.40 respectively, which might affect the model.

Analysis of Variance Table

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	5	762.27	152.455	24.24**	0.000
Error	104	654.13	6.290		
Total	109	1416.40			

** Means highly significant

The table above indicates that the regression model was highly fit for the data with F-value of 24.24 and P-value 0.000.

Motivation versus Foundation, Concentration, Curriculum, and Classroom

The regression equation below measures the relationship between motivation, independent variable, and mathematics foundation in early years, concentration during mathematics lessons, curriculum, and school/classroom environment as independent variables. The equation depicts motivation as having a positive relationship with all the independent variables. In the absence of instructors and instructional strategies variable, classroom environment appears to have a strong influence on motivation.

$$C_1 = 2.20 + 0.1229C_2 + 0.1203C_3 + 0.230C_4 + 0.2908C_5$$

Table of Coefficients

Variable	Coef	SE Coef	T-Value	P-Value	VIF
Motivation (Constant)	2.20	1.74	1.27	0.208	
Foundation	0.1229	0.0772	1.59	0.115	1.74
Concentration	0.1203	0.0768	1.57	0.120	1.34
Curriculum	0.230	0.117	1.97	0.052	1.82
Classroom	0.2908	0.0705	4.12**	0.000	1.86

The table further solidifies the information provided by the regression equation that among all the motivation predictors, classroom environment seems to have the strongest statistically significant influence with a coefficient of 0.2908 at p-value of 0.000. The table also affirms that all the other predictors of have positive influences that are not statistically significant.

Analysis of Variance Table

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	4	692.87	173.217	25.14**	0.000
Error	105	723.53	6.891		
Total	109	1416.40			

The analysis of variance performed clearly indicate that the overall regression model with F-value of 25.14 is statistically significant at p-value 0.000. That is, the model fits the data very well with at least one predictor, classroom environment, having a statistically significant influence. However, this table also shows that mathematics foundation in early years and concentration during mathematics are not statistically significant predictors of motivation. Interesting to note is the Lack-of-fit F-value of 42.53 and p-value of 0.005 which tells us that the model does not fit the data well, suggesting that there may be other predictors of motivation that are left out of this model. Indeed, the strongest predictor as earlier determined is instructors and instructional strategies variable which is excluded from this model.

Motivation versus Foundation, Concentration, Curriculum, and Instructors

In this regression analysis, school/classroom environment was excluded in measuring the prediction power of foundation of mathematics in early years, concentration during mathematics lessons, curriculum, and instructors and instructional strategies have on motivation of students to study mathematics. The equation clearly shows that instructors and instructional strategies remains the strongest predictor of motivation.

$$C_1 = 2.34 + 0.1671C_2 + 0.0880C_3 + 0.146C_4 + 0.2562C_6$$

Table of Regression Coefficients

Variable	Coef	SE Coef	T-Value	P-Value	VIF
Constant	2.34	1.67	1.40	0.165	
Foundation	0.1671	0.0724	2.31*	0.023	1.61
Concentration	0.0880	0.0760	1.16	0.250	1.39
Curriculum	0.146	0.119	1.23	0.221	1.97
Instructors	0.2562	0.0529	4.84**	0.000	1.89

Further investigation from the table of coefficients above reveals an interesting twist, that in the absence of school/classroom environment variable, foundation of mathematics in early years becomes a statistically significant predictor of motivation. This variable, as the table indicates, has a coefficient of 0.1671 and a p-value of less than 0.05. However, concentration during mathematics lessons and the curriculum remains statistically insignificant in predicting motivation. Instructors and instructional strategies variable again turn out as the strongest predictor of motivation with a coefficient of 0.2562, and p-value of 0.000. The predictor variables in this model are not affected by multicollinearity as indicated by the VIF values which are very low.

Analysis of Variance Table

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	4	729.05	182.264	27.84**	0.000
Error	105	687.35	6.546		
Total	109	1416.40			

The F-value, 27.84, is very high suggesting that the model has highly significant effect ($P < 0.05$), indicating that at least one of the predictors has a significant impact on motivation. The table further affirms that both instructors and instructional strategies and foundation of mathematics in early years are positive predictors of motivation with the former having the strongest prediction power. The Lack-of-fit F-value of 40.40 and a P-value of 0.005 indicates that this model does not fit the data well. This clearly shows that foundation of mathematics in early years, despite being statistically significant in this model, it is not as strong a predictor of motivation as school/classroom environment is.

Motivation versus Foundation, Classroom, and Instructors

$$C_1 = 2.08 + 0.1518C_2 + 0.1938C_5 + 0.2246C_6$$

In this model, two variables that have consistently been found not to be statistically significant predictors of motivation, the curriculum and concentration during mathematics lessons, have been excluded.

Table of Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF
Motivation	2.08	1.57	1.32	0.188	
Foundation	0.1518	0.0691	2.20*	0.030	1.53
Classroom	0.1938	0.0745	2.60*	0.011	2.29
Instructors	0.2246	0.0538	4.17**	0.000	2.04

All the variables in this model are shown to be statistically significant predictors of motivation since the p-values for all of them are less than 0.05. Instructors and instruction strategies is still portrayed as the strongest predictor with a coefficient of 0.2246 and p-value of 0.000. The model also shows no multicollinearity among variables with all VIF values below 5.

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	3	750.79	250.264	39.86**	0.000
Foundation	1	30.27	30.268	4.82*	0.030
Classroom	1	42.44	42.438	6.76*	0.011
Instructors	1	109.33	109.335	17.41**	0.000
Error	106	665.61	6.279		
Lack-of-Fit	102	663.11	6.501	10.40*	0.017
Pure Error	4	2.50	0.625		
Total	109	1416.40			

The table confirms that the model as a whole is statistically significant with an F-value of 39.86 and p-value of 0.000, therefore it can be used to predict motivation of students. Even though all the variables are shown to be predictors of motivation, and the overall model is also significant, the Lack-of-Fit p-value (0.017) is statistically significant indicating that the model may not fit the data well.

Motivation versus Foundation, Concentration, and Instructors

$C_1 = 2.28 + 0.2010C_2 + 0.0971C_3 + 0.2837C_6$

This model excluded the curriculum and school/classroom environment. The equation suggests that foundation of mathematics in early years and instructors and their instructional strategies are good predictors of motivation, whereas concentration during mathematics lessons is not.

Table of Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	2.28	1.68	1.36	0.177	
Foundation	0.2010	0.0671	3.00**	0.003	1.38
Concentration	0.0971	0.0759	1.28	0.203	1.37
Instructors	0.2837	0.0481	5.90**	0.000	1.55

The table of coefficients supports the equation predictions as is shown that both foundation of mathematics in early years and instructors and their instructional strategies have p-values less than 0.05 indicating that they are statistically significant predictors of motivation, as opposed to concentration during mathematics lessons that has a p-value of 0.203. indeed, with the low VIF values, multicollinearity is not a significant concern in this model.

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	3	719.13	239.711	36.44**	0.000
Error	106	697.27	6.578		
Total	109	719	1416.40		

The table indicates that the regression model is statistically significant in predicting motivation with a coefficient of 36.44 and p-value of 0.000. Again, only 2 variables, foundation of mathematics in early years and instructors and their instructional strategies are good predictors of motivation, but concentration during mathematics lessons is not a good predictor as it has a p-value of 0.203. This model does not seem to fit the data well because the Lack-of-Fit F-value of 40.59 and p-value of 0.005 provides evidence for that.

Motivation versus Foundation and Instructors

$C_1 = 3.05 + 0.2070C_2 + 0.3071C_6$

This model utilized only two variables that appear to strongly predict motivation, early years foundation in mathematics and instructors and instructional strategies.

Table of Regression Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	3.05	1.57	1.94	0.055	
Foundation	0.2170	0.0661	3.28**	0.001	1.33
Instructors	0.3071	0.0446	6.88**	0.000	1.33

As it can be seen from the equation and table, both variables appear to be statistically significant predictors of motivation with p-values 0.001 and 0.000 for foundation and instructors respectively. The VIF values for both variables suggest the lack of multicollinearity between them prompting the conclusion that the model is fit for the data.

Analysis of Variance Table

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	2	708.35	354.177	53.52**	0.000
Error	107	708.05	6.617		
Total	109	1416.40			

The table indicates a very high F-value of 53.53 suggesting that the variables are highly statistically significant at p-value 0.000. Again, this analysis of variance shows that these variables are strong predictors of motivation.

Discussion and Conclusion

The results for this study are very clear and fundamental in the development and improvement of mathematics teaching and learning. The study used regression models and One-way Analysis of variance to determine and examine predicting factors of students' motivation to learn mathematics. The factors analyzed include students' foundation of mathematics in early years, the mathematics curriculum, students' concentration in class during mathematics lessons, school/classroom environment, and instructors and their pedagogical strategies. All these variables were found to have a positive relation with motivation on varying degrees.

Instructors and Instructional Strategies

Results in this study consistently show instructors and pedagogical strategies as the strongest predictor of students' motivation towards mathematics. This result is consistent with Wang & Eccles, (2013) also found that instructional strategies were associated with higher motivational levels towards mathematics. The result also confirms Burić & Kim, (2020) who analyzed teacher self-efficacy, instructional quality, and student motivational beliefs and found instructional quality to be positively associated to students' motivational beliefs. It is commonly acknowledged that pedagogical strategies that personalize instructions, engage the learner actively, provide regular and timely feedback, and promote mastery-oriented mindset are most likely to enhance students' motivation to study mathematics.

However, such instructional strategies are not being fully enforced in Iraq, especially in the semi-autonomous Kurdistan region. Most teachers in the region are demoralized by inconsistency in their remunerations, lack of support from stakeholders for continuous professional development, and to some extent the perennial political turmoil that interrupt smooth teaching and learning. This result, therefore, may partly explain the prevalent poor mathematics achievement among high school students in the region.

School/Classroom Environment

School and/or classroom environment as predictor of students' motivation to study mathematics came out strongly in the study. The variable also consistently appeared second after instructors and instructional strategies in its power to predict motivation. This result confirms Skaalvik & Skaalvik, (2018) and Wang & Eccles, (2013) who found that students' perceptions of their school's environment, especially the academic climate, was an important predictor of students' academic engagement and motivation to study mathematics. This result brings to the fore the importance school and/or classroom environment plays in shaping students' motivation to study mathematics. Within the school and/or classroom environment, instructors and their dispositions, resources such as books technological appliances and well-equipped classrooms, the number of students in class and their social interactions, and the general school culture all underwrite a positive learning environment that motivates learners to study and achieve well in mathematics. In Iraq, most especially in Kurdistan, the school/classroom environment is not conducive for learners. Classrooms are congested and ill-equipped, teachers are underpaid and not on regular basis, therefore, the ultimate school culture is not one that promotes students' motivation to study. Hence the dismal performance in mathematics by high school students in the region.

Foundation of Mathematics in Early Years

Students' early years foundation in mathematics was found not to be a strong predictor of motivation. It became statistically significant only after school/classroom environment was excluded from the model. This result is consistent with Akkaya & Dundar, (2015) who Investigated the relationship between secondary school students' early mathematics achievement and their attitudes towards mathematics and found no relationship between early years mathematics achievement and students' attitude towards mathematics. In Iraq, the current students are just one generation after the war, whereas the current teachers lived through the war and therefore may not consider foundation in a subject before deciding to take it. The fact that they have an opportunity to be in class at all is what matters for most of them.

Concentration in Class During Mathematics Lessons

The level of attentiveness during mathematics lessons was found not to be a strong predictor of students' motivation to learn mathematics in this study. Several other studies concur that whereas concentration during mathematics lessons may be important in issues like academic achievement and classroom management, it does not strongly predictor students' motivation to learn mathematics (Lin & Gan, 2018: Bakker, Denessen & Brus-Laeven, 2017: Wang, Lin & Wang, 2016). Concentration in class may be affected by external factors including technology such as mobile phones in the classroom, the teacher's pedagogical style, students' interest, and perceived usefulness of the subject. Therefore, with such many factors moderating concentration, it cannot be a strong predictor of motivation.

The Curriculum

Results indicate that Mathematics curriculum is not a strong predictor of students' motivation to study mathematics. This result confirms studies by Dicke, Lachner & Spiel, (2015) and Kucsera & Zsolnai, (2017) who found that despite the curriculum's importance in the general learning and teaching of mathematics, it is not a significant predictor of students' motivation to study the subject. In Kurdistan region, for instance, there's no well outlined government sanctioned mathematics curriculum for the entire K-12 system. The educational stakeholders, including the government agree on mathematics textbooks for each grade level that must be followed strictly in lieu of the curriculum. This narrows the scope of teachers and confines them to a single textbook, unlike in curriculum context where teachers can use a variety of textbooks as long are the contents of the textbooks are within the proscribed curriculum. This practice may impede proper teaching and learning of mathematics which leads to poor performance of the subject in the country.

Recommendations

In view of the findings from this study, it is imperative for education stakeholders in the country to bear in mind the importance of well-trained mathematics instructors who can use current pedagogical methods to deliver mathematics lessons through guiding learners with ease. The government and other education providers must invest in proper, well equipped, and spacious classrooms that are conducive for learning. Decongested and modernized classrooms will motivate both teachers and students to teach and learn mathematics respectively.

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