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Full Length Research Paper

Causes of low mathematics' achievement in secondary schools case study newly enrolled students at the University of Bakht Alruda

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This research aims to indentify factors that cause low achievement in mathematics in secondary schools. Data was collected from three sources; newly enrolled Students at the Faculty of Economics and Administrative Studies of University of Bakht Alruda, mathematics teachers and National Curriculums Centre in Alduwaim Town. Logistic Regression was used to analyze the data. Teachers pointed out that factors behind low achievement in mathematics are lack of basic elements of mathematics; most of mathematics teachers have low work experience, in addition to their insufficient number, Students showed that gender of mathematics teacher at the third grade of the secondary school; substance of mathematics curriculum (doze), type of admission, the differences in the mathematics curriculums between academic and technical schools and its importance for science, literature, and technical specialization; and finally the number of time the student sat for the exam, were the main factors. The National Centre views low achievement is a result of government policies of which restructuring the general education and devote National Centre's responsibilities to state and local authorities.

Keywords: basics, achievement, training, gender, types of admission, policies

INTRODUCTION

The University of Bakht Erruda was established by a presidential decree in 1996. It comprises faculties of education, medicine, agriculture, economics and administrative sciences, and community development. Mathematics is an important subject taught in many faculties but it was observed that many students perform very low in mathematics. Mathematics achievement can be considered as a measure of success in academic progress. Despite the importance of mathematics it was found that many students face difficulties in learning and teachers suffer in making students understand the subject. Many factors affect the process of achievement of which are the substance of the taught subject, set of drills, teaching methods, and personal characteristics of the teachers. These factors should be considered carefully. The salient proof of low mathematics achievement in Sudan is the adjustments process made on raw scores of Mathematics in the Sudanese certificate where the square root of actual scores is taken and multiplied by 10, for instance 80 was actually 64, 40 was 16 and so on. Another proof was that the ratio of those obtained less than 40 per cent in Linear Algebra, Calculus and Descriptive Statistics of the first year student at the faculty of Economics and Administrative Sciences increased from 37 per cent to 80 per cent during the last five years. This drew the attentions; the quick remedy was to let student attend intensive course of what they studied in the secondary education. Two

tests were carried before and after the intensive course. The results showed under achievement in basic mathematics in the before test where only 36 percent passed the test. Despite slight improvement in the after course they still failed to demonstrate any ability to perform well even in the basic mathematical operations, This raises many questions concerning the roots of the problem weather they are the curriculum, types of admission, state monitoring and evaluation, supervision, basic education, teachers or else. The aim of this research is to identify the causes of low mathematics achievement of newly enrolled students who just completed the secondary school. The identification will be according students, teacher and official points of view.

METHODOLOGY

Data is collected by questionnaire from three sources i.e. newly enrolled students at the Faculty of Economics and Administrative Sciences of University of Bakht Erruda, and mathematics teachers and interview of the head of Mathematics Department at the National Curriculums Centre in Duwaim town. The samples were composed of all 358 newly enrolled students, and 45 mathematics teachers. The student questionnaire contained 13 questions about age, gender, type of school and specialization, degree of mathematics obtained in the Sudanese Certificate, state, type of admission, the importance of mathematics, and sufficiency of taught mathematics. The teachers' questionnaire included socioeconomic information, training, and appropriateness of mathematics curriculum, availability mathematics books, school environment, and causes of low achievement. Paired pilot sample of 20 students and 5 teachers received questionnaires twice. The questionnaires were reviewed by specialists. The reliability was high and the correlation coefficient of the paired sample was 0.93. Kruskal-Wallis, 2Sample t, and Binary Logistic Regression were used. In Binary Logistic Regression models, the dependent variable - y- may take on only two values. The dependent variable might be a dummy variable representing the occurrence of an event, or a choice between two alternatives such as presence or absence. A simple linear regression of on x is not appropriate, since among other things, the implied model of the conditional mean places inappropriate restrictions on the residuals of the model. Furthermore, the fitted value of y from a simple linear regression is not restricted to lie between zero and one. A model with one or more predictors is fit using an iterative-reweighted least squares algorithm to obtain maximum likelihood estimates of the parameters.

Binary logistic regression has also been used to classify observations into one of two categories, and it may give fewer classification errors than discriminant analysis for some cases (Draper 1989).

Literature Review

Education Matters (2004) Forty-one countries, including Canada and all 30 OECD countries, participated in the Programme for International Student Assessment (PISA) in 2003. The primary focus of PISA 2003 was on the mathematics domain, with a secondary focus on reading, science and problem-solving. Science Results of that assessment, which became available in December 2004, showed that Canadian 15-year-olds continue to perform very well in an international context.

Munzire (2009) measured the efficiency of strategy of solving mathematic problems in teaching numbers for pupils and its impact on promoting the skills of brain calculation. She used independent sample t test. She fixed some factors as social and economic level by taking deterministic sample. She found significant differences between the control and experimental groups in the Sultanate of Oman.

Alkarsh (2009) studied the third grade of secondary education by dividing them into three categories according to cumulative average. He found significant difference in the achievement of learning geometry among the three group due to lack of concern, time spent in learning, objects used in teaching, intensive review, and the role of the teacher.

Fifteen Arab countries including Qatar joined the tests Trends in Mathematics and Science Study (TIMSS), the results of which were released by the International Association for the Evaluation of Educational Achievement in (December 2008).TIMSS is one of the world's most influential global assessments of student achievement in math and science. The report shows that Qatar's average proficiencies in mathematics and science rank among the lowest of participating countries. A majority of Qatar's students are classified at proficiency level one (lowest level). At the Eighth Grade level, higher levels of parental education and the presence of books, computers and Internet access in the home were associated with higher mathematics and science achievements. Achievement was highest among students who attended schools that reported few attendance problems, few shortages or inadequate resources. There was a positive association between achievement and students' perception of being safe in school. At both the Fourth and Eighth Grade levels, achievement was highest when principals and teachers had a positive view of the school climate, including high levels of teacher job satisfaction, high expectations for student achievement and parental support.

Veli (2008) examined how geometric concepts are presented in the Turkish elementary mathematics curriculum and the textbooks in terms of sizes and orientations. He showed that the presentation of the geometric shapes and concepts in both curriculum and textbooks was not systematically handled. It seems that a more systematic approach could be applied in designing

Table 1 Percentage of Students got less 40 Scores

Subject	2004/6	2005/8	2005/5	2006/12	2007/12	2008/3	2008/8	2009/3
Linear Algebra	51		64			67	72	
Calculus	37	80		100				71
Descriptive Statistics				69	70		68	

Table 2 Two Sample t for Decrease from Teacher Point of View

Type of School	Total	Mean	Standard Deviation	Standard Error
Academic	14	1.214	0.426	0.11
Technical	5	1.400	0.548	0.24

95% CI for mu (0) - mu (1): (-2.86; 0.66)
T-Test mu (0) = mu (1) (vs not =): T = -0.69 P = 0.52 DF = 5

Table 3 Two Sample t for Reasons

Type of School	Total	Mean	Standard Deviation	Standard Value
Academic	13	1.769	0.439	0.12
Technical	5	1.200	0.447	0.20

95% CI for mu (0) - mu (1): (-2.86; 0.66)
T-Test mu (0) = mu (1) (vs not =): T = -2.43 P = 0.045 DF = 7

Table 4 Kruskal-Wallis Test on Low Achievement

Type of School	Total Number	Median	Mean Ranks	Standard Value
Public	17	1.000	10.3	0.66
Private	2	1.000	7.5	-0.66

H = 0.44 DF = 1 P = 0.507
H = 0.76 DF = 1 P = 0.384 (adjusted for ties)

the activities for geometry learning. Implications for mathematics education, curriculum design, and textbook writing were discussed.

Saudi Arabia Participation in tests Trends in Mathematics and Science Study (TIMSS 2007) showed that parents educational level, owning of computer, homework, self confidence, class size, safety feeling affect students achievement in mathematics.

Alhirbawi (2004) studies the effect of teaching methods on the fourth grade and their attitudes toward mathematics. She divided the sample into three groups and used One Way Analysis of Variance and Dunkan to find significant difference between the third group and the two other groups.

Faiz (2003) compared two groups of students based on the use of conventional methods and computer in the fourth grade of basic education in learning mathematics. He found significant difference between the two groups so he recommended the use of computers.

Aldosarry (2002) evaluated mathematic curriculum to identify the reasons of low achievements. They proved a significant low achievement among first grade students of the secondary education due to number of subjects, intensity, psychological changes, less memorization, and wrong perception about the difficulty of mathematics and lack of parents follow-up.

Murad (2004) drew a sample of 367 female students from the first grade of secondary education in Mecca of Kingdom of Saudi Arabia, 45 mathematics teachers, and education guidance. She recommended true intent, hard working, and preparation of the suff in sufficient time, appropriateness of questions, collective work and positive participation in decision making.

Farouq (2000) investigated the readability of the fifth grade mathematics textbook in Jordan. The study concluded that the level of the readability was generally very low and it increases when the number of the omitted words decreases. The researchers concluded that there were significant differences between the three tests C1, C2, C3 in the students' achievement in the test itself. They also concluded that there were significant differences between the males and females in the students' achievement in the test itself.

Seple (1978) used to and analysis of variance was used to compare over achiever, achiever and low achiever in mathematics of a sample of 246 of 11 and 12 year old children. It was hypothesized that the measure of mathematics specific anxiety would differentiate the under achiever group from the other two groups strongly than the measure of general test of anxiety. The results confirmed the hypothesis.

Despite the importance of mathematics it is considered a burden to students and teachers. Factors that can have impact on achievement are lack of students to basic elements of mathematics, lack of concern; mathematics is not a necessity, lack of training, methods of teaching,

and the preference of memorization to understanding (Alkarsh 2009).

The current government declared in 1990 set of policies to revolutionize the education by restructuring the general education by merging the elementary education (six years) and general secondary (three years) to be basic education of (8 years) followed by three years in secondary education and then increased the number admitted to universities by establishing Public Universities at each of the 25 states. Before 1990 the National Curriculum Centre (NCC) was responsible of producing curriculum to general education, training of teachers, follow-up of setting curriculums, and providing guidance services. After 1990 the NCC was responsible only for the production of curriculums of general education, the role of monitoring and evaluation was transferred to the states, and the teacher training to localities. Mathematics in basic education is divided into three circles: (first –third grade), (fourth –sixth grade), (seventh and eighth grade). Another major change (Mahamood 2009) was to designate one teacher for first circle pupils aiming to be engaged with them the whole day and change the mode of teaching according to attitudes of pupils i.e. to teach sometimes, send the pupils to the playground, and develop art skills and so on. Those teachers should have special training. But the actual practice was that those teachers concentrated on teaching and nothing else. The designation of one teacher for three consecutive years and many teachers leave psychological effects on the pupils besides the possibility of error accumulation.

Empirical Evidence

Equality of achievement in mathematics in Academic and Technical Schools is accepted since P is greater than 0.05.

The null hypothesis of equality between Achievement of Academic School means and Private is rejected. The main causes of low achievement in mathematics from teacher point of view are lack of basics of mathematics in the basic education.

The null hypothesis of equality of achievement decrease of private and public schools is accepted.

Binary Logistic Regression from Teachers Point of View

```
Link Function:  Logit
Response Information
Variable Value       Count
Decrease 2               5 (Event)
         1              14
         Total          19
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The number 1 means there is a low achievement in mathematics 2 means none.

The null hypothesis that the estimated coefficient of Teachers number (Teacher), work experience (Experience) and the constant are drawn from population with zero coefficients is rejected.

Log-Likelihood = -6.276

Test that all slopes are zero: G = 9.348; DF = 2; P-Value = 0.009

The null hypothesis that all estimated coefficients are drawn form a population with zero coefficients is rejected.

Binary Logistic Regression from Student Point of View

The estimated coefficients of the explanatory variables: specialization of students (classify), type of admission i.e. general, state, private (type),; gender of teacher in the third grade (third), sufficiency of mathematics (doze) , number of time sat for Exam (number), and the constant are significantly different from zero. The odd ration of all estimated coefficients are greater than 1 except the type of admission which indicate that the low level of admission (general) is related to the highest level of those got high scores in mathematics (dependent variables),

Log-Likelihood = -194.846

Test that all slopes are zero: G = 32.190; DF = 5; P-Value = 0.000

The null hypothesis above is rejected since the P-Value is less than 0.05.

DISCUSSION

Lack of differences among all types of schools in terms of existence of low achievement in mathematic, i.e. between public and private schools on the one hand, and the academic and technical schools on the other hand indicate that there are real causes behind this matter. The most significant causes of low achievement as is viewed by teachers are that: students lack basic elements of mathematics since the basic education; insufficient number of mathematics teachers due to attraction of qualified mathematic teacher by the schools in the capital and big cities where private schools can pay more than the public and failure of local authorities to employ sufficient number of teachers; low work experience of mathematic teachers. Since the odd ratio showed in the results above is greater than one this means that whenever the number of teachers becomes low, a decrease in achievement is more likely. The negative relationship between work experience and low achievement is acceptable which means an increase in

Logistic Regression Table

Predictor	Coef	StDev	Z	P	Odds Ratio	95% CI Lower	95% CI Upper
Constant	−5.877	3.363	−1.75	0.081			
Teacher	8.647	5.005	1.73	0.084	5690.99	0.31	1.04E+08
Experience	−0.8764	0.5338	−1.64	0.101	0.42	0.15	1.19

Goodness-of-Fit Tests

Method	Chi-Square	DF	P
Pearson	2.825	8	0.945
Deviance	3.188	8	0.922
Hosmer-Lemeshow	2.825	8	0.945

All tests proof the goodness of fit since the probabilities attached are less than 0.05.

Measures of Association

(Between the Response Variable and Predicted Probabilities)

Pairs	Number	Percent	Summary Measures	
Concordant	61	87.1%	Somers' D	0.80
Discordant	5	7.1%	Goodman-Kruskal Gamma	0.85
Ties	4	5.7%	Kendall's Tau-a	0.33
Total	70	100.0%		

87.1 is the percentage of concordant pairs response variable and predicted probabilities.

Link Function: Logit

Response Information

Variable	Value	Count
degree1	1	109 (Event)
	0	225
	Total	334

334 cases were used
24 cases contained missing values

The number 0 indicates low achievement (less than 40 scores), and 1 (40 and above).

Logistic Regression Table

Predictor	Coef	StDev	Z	P	Odds Ratio	95% CI Lower	95% CI Upper
Constant	−2.3240	0.8828	−2.63	0.008			
Classify	0.7775	0.3583	2.17	0.030	2.18	1.08	4.39
Type	−0.6480	0.1705	−3.80	0.000	0.52	0.37	0.73
Third	0.5167	0.2414	2.14	0.032	1.68	1.04	2.69
Doze	0.5147	0.2861	1.80	0.072	1.67	0.95	2.93
Number	0.3446	0.1930	1.79	0.074	1.41	0.97	2.06

Goodness-of-Fit Tests

Method	Chi-Square	DF	P
Pearson	59.048	63	0.618
Deviance	69.708	63	0.262
Hosmer-Lemeshow	8.938	6	0.177

All tests assure the goodness of fit since the attached probability is less than 0.05.

work experience leads to a decrease in low achievement.

Causes from students' point of view are: different course contents in academic and technical schools which in turn treat mathematics as unessential subject; state admission that offers allowance of 5% to secondary school students from the same state of the university which to some extent discourage them to study hard; gender of mathematics teacher specifically at the third grade affects very much achievement since the records show that number of female teachers absentees is larger

Measures of Association

(Between the Response Variable and Predicted Probabilities)

Pairs	Number	Percent	Summary Measures	
Concordant	15924	64.9%	Somers' D	0.35
Discordant	7218	29.4%	Goodman-Kruskal Gamma	0.38
Ties	1383	5.6%	Kendall's Tau-a	0.16
Total	24525	100.0%		

The ratio of concordant pair is 64.9 per cent.

than that of males; incompletion mathematics curriculum; substance (doze) of mathematics taught to student in basic (primary) and secondary schools is relatively low; lack of paying attention to solving drills and home works; and finally the number of time sitting for the exams makes the difference. The odd ratios are greater than one except for type of school which means that whenever the number of teachers becomes low, a decrease in achievement is more likely. The negative relationship between type of school and low achievement is reasonable which means low achievement is more of students in private admission followed state admission and less in the general.

The official point of view represented by the NCC is that the adopted policies towards revolutionizing and restructuring general education resulted in a loss of one year; teachers of intermediate schools were given the chance to teach at the Secondary level without proper training; in addition to the failure of local and state authorities to handle well in the newly assigned responsibilities. Despite fewer Changes in mathematics curriculums in primary and basic education, insufficient teachers' training, and disparity between the setting of curriculum and monitoring and evaluation led to low achievement.

CONCLUSION AND RECOMMENDATIONS

The aim of this research was to identify the causes of low achievement in mathematics in General education. A sample of 357 of newly enrolled students at the Faculty of Economics and Administrative Sciences of the Bakht Erruda University was drawn besides 45 mathematics teachers. The main causes of low achievement from the specialist's point of view were low number of teacher and lack of experience since the qualified teachers are attracted by the private schools in the capital town. The causes from the student's point of view were insufficient doze due to incomplete curriculum, lack of interest in solving drills, differences in teaching between pubic and private schools, gender of mathematic teachers female teachers have special circumstances, and the number of time sitting for Sudanese Certificate. It is recommended to recruit sufficient numbers of teachers, intensify training, reunify the processes of curriculum setting, teacher's training, and monitoring and evaluation under the authority of NCC, eliminate the differences between public, and private schools in one hand and academic and technical education on the other hand, encourage students to follow appropriate ways of studying, concern more about curriculum completion and solving the attached drills, and to ensure the importance of mathematics in all types of schools.

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Appendix

View Point of Teachers

Dependent Variable: DECREASE					
Method: ML - Binary Probit					
Date: 02/04/10 Time: 09:19					
Sample: 1 19					
Included observations: 19					
Convergence achieved after 6 iterations					
Covariance matrix computed using second derivatives					
Variable	Coefficient	Std. Error	z-Statistic	Prob.	
EXPERIENCE	0.527328	0.311557	1.692554	0.0905	
TEACHER	5.218340	2.948940	1.769565	0.0768	
C	-6.864750	4.106277	-1.671770	0.0946	
Mean dependent var	0.736842	S.D. dependent var		0.452414	
S.E. of regression	0.369473	Akaike info criterion		0.966431	
Sum squared resid	2.184166	Schwarz criterion		1.115553	
Log likelihood	-6.181091	Hannan-Quinn criter.		0.991668	
Restr. log likelihood	-10.95035	Avg. log likelihood		-0.325321	
LR statistic (2 df)	9.538515	McFadden R-squared		0.435535	
Probability(LR stat)	0.008487				
Obs with Dep=0	5	Total obs		19	
Obs with Dep=1	14				
H-L Statistic:	1.8866	Prob. Chi-Sq(8)	0.9843		
Andrews Statistic:	8.6129	Prob. Chi-Sq(10)	0.5692		

Dependent Variable: DECREASE						
Method: ML - Binary Probit						
Date: 02/04/10 Time: 09:19						
Sample: 1 19						
Included observations: 19						
Prediction Evaluation (success cutoff C = 0.5)						
	Estimated Equation			Constant Probability		
	Dep=0	Dep=1	Total	Dep=0	Dep=1	Total
P(Dep=1)<=C	3	2	5	0	0	0
P(Dep=1)>C	2	12	14	5	14	19
Total	5	14	19	5	14	19
Correct	3	12	15	0	14	14
% Correct	60.00	85.71	78.95	0.00	100.00	73.68
% Incorrect	40.00	14.29	21.05	100.00	0.00	26.32
Total Gain*	60.00	-14.29	5.26			
Percent Gain**	60.00	NA	20.00			
	Estimated Equation			Constant Probability		
	Dep=0	Dep=1	Total	Dep=0	Dep=1	Total
E(# of Dep=0)	2.87	2.04	4.91	1.32	3.68	5.00
E(# of Dep=1)	2.13	11.96	14.09	3.68	10.32	14.00
Total	5.00	14.00	19.00	5.00	14.00	19.00
Correct	2.87	11.96	14.83	1.32	10.32	11.63
% Correct	57.32	85.42	78.03	26.32	73.68	61.22
% Incorrect	42.68	14.58	21.97	73.68	26.32	38.78
Total Gain*	31.01	11.74	16.81			
Percent Gain**	42.08	44.61	43.34			
*Change in "% Correct" from default (constant probability) specification						
**Percent of incorrect (default) prediction corrected by equation						

View Point of Students

Dependent Variable: RR					
Method: ML - Binary Probit					
Date: 02/04/10 Time: 09:22					
Sample: 1 358					
Included observations: 334					
Excluded observations: 24					
Convergence achieved after 4 iterations					
Covariance matrix computed using second derivatives					
Variable		Coefficient	Std. Error	z-Statistic	Prob.
DOZE		0.322339	0.172952	1.863743	0.0624
THIRD		0.314331	0.143100	2.196580	0.0281
CLASSIFICATION		0.489739	0.216108	2.266183	0.0234
TYPE		-0.380553	0.099489	-3.825067	0.0001
C		-1.111313	0.496224	-2.239539	0.0251
Mean dependent var		0.326347	S.D. dependent var		0.469580
S.E. of regression		0.452913	Akaike info criterion		1.205553
Sum squared resid		67.48772	Schwarz criterion		1.262606
Log likelihood		-196.3274	Hannan-Quinn criter.		1.228301
Restr. log likelihood		-210.9416	Avg. log likelihood		-0.587807
LR statistic (4 df)		29.22840	McFadden R-squared		0.069281
Probability(LR stat)		7.03E-06			
Obs with Dep=0		225	Total obs		334
Obs with Dep=1		109			
H-L Statistic:	10.7701	Prob. Chi-Sq(8)		0.2151	
Andrews Statistic:	12.1238	Prob. Chi-Sq(10)		0.2769	

Dependent Variable: RR						
Method: ML - Binary Probit						
Date: 02/04/10 Time: 09:22						
Sample: 1 358						
Included observations: 334						
Excluded observations: 24						
Prediction Evaluation (success cutoff C = 0.5)						
	Estimated Equation			Constant Probability		
	Dep=0	Dep=1	Total	Dep=0	Dep=1	Total
P(Dep=1)<=C	211	88	299	225	109	334
P(Dep=1)>C	14	21	35	0	0	0
Total	225	109	334	225	109	334
Correct	211	21	232	225	0	225
% Correct	93.78	19.27	69.46	100.00	0.00	67.37
% Incorrect	6.22	80.73	30.54	0.00	100.00	32.63
Total Gain*	-6.22	19.27	2.10			
Percent Gain**	NA	19.27	6.42			
	Estimated Equation			Constant Probability		
	Dep=0	Dep=1	Total	Dep=0	Dep=1	Total
E(# of Dep=0)	157.65	67.35	225.00	151.57	73.43	225.00
E(# of Dep=1)	67.35	41.65	109.00	73.43	35.57	109.00
Total	225.00	109.00	334.00	225.00	109.00	334.00
Correct	157.65	41.65	199.29	151.57	35.57	187.14
% Correct	70.06	38.21	59.67	67.37	32.63	56.03
% Incorrect	29.94	61.79	40.33	32.63	67.37	43.97
Total Gain*	2.70	5.57	3.64			
Percent Gain**	8.27	8.27	8.27			
*Change in "% Correct" from default (constant probability) specification						
**Percent of incorrect (default) prediction corrected by equation						