

Predictors of the Perceived Difficulties of Senior High School Students' in Elective Mathematics

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ABSTRACT

Elective Mathematics, currently, is one of the important subject requirements for admission into attractive programmes such as medicine, engineering, business, statistics, mathematics, actuarial science, economics, business administration, and architecture, among others in tertiary institutions in Ghana. However, greater proportion of the country's senior high school students are "maths phobic." Therefore, this paper attempted to identify and model the socio-demographic variables that influence students' perceived difficulties in the subject. The study was conducted among 100 randomly selected students from two senior high schools in the Krachie East District of the Volta Region using both primary and secondary data. The Chi – square test, Odds ratio and Fisher's exact model was employed in the SPSS statistical software. The study concluded that respondents' programmes of study, ethnicity, and mothers' highest educational levels were significant predictors of their perceived difficulties in Elective Mathematics.

KEYWORDS: Elective Mathematics, Difficulty, Socio – demographic variables, Chi – square test, Odds ratio, Fisher's exact

INTRODUCTION

"Perceived Difficulty" in Elective Mathematics is the situation whereby students naturally consider the subject to be difficult. These include difficulty in applying formulae, using measurements, writing out phases of calculations, writing numbers, and spatial perception. However, mathematics in general and Elective Mathematics in particular is known as one of the gate-keeping subjects for success in all fields of life. It is a common saying that mathematics is a mother of all subjects and a backbone for development. According to Anamuah-Mensah (2007), the utilisation of science, mathematics and technology has been interlinked with the improvement in productivity and wealth creation of a nation. In the Senior High School level, we have Core and Elective Mathematics. While the Core

Mathematics is studied by all students, the Elective Mathematics is studied by General Science, some Business Accounting, Geography, Agriculture and Technical students only. One of the general aims of teaching mathematics is to communicate effectively using symbols and explanations through logical reasoning (Ministry of Education, Science and Sports [MOESS], 2007). Despite the importance of mathematics in human development, many investigations have shown that students in secondary schools are not very much interested in mathematics (Eshun, 2000; Awanta, 2000).

For example, statistics from the West African Examinations Council (WAEC) on performance of students in Elective Mathematics from 2007 to 2014 has generally been poor.

Table 1. WASSCE Results from 20012-2018

Year	Pass (A1-C6)		Fail (D7-F9)		Total
	No.	%	No.	%	
2012	13,685	36.5	23,817	63.5	37,502
2013	15,352	35.7	27,608	64.3	42,960
2014	17,862	35.7	32,189	64.3	50,051
2015	32,711	68.1	15,304	31.9	48,015
2016	44,185	75.2	14,546	24.8	58,731
2017	63,078	47.0	71,177	53.0	134,255
2018	15,484	20.5	60,135	79.5	75,619

Source: WAEC IT Department, 2018.

STUDY AREA PROFILE

Dambai is the capital of the Krachi East District in the Volta Region of Ghana. The district can be located at the North Western corner of the Volta Region of Ghana and lies between latitudes 7° 40’N and 8° 15’N and longitudes 0° 6’E and 0°20’. In terms of population, the Ghana Statistical Service through its 2010 Population and Housing Census revealed that out of a total of 116,804, 52% were males and the remaining being females. The district has 25 kindergartens (KG) with a total enrolment of 1,994, 52 primary schools with a population of 6,467 and 12 02 Junior High Schools (JHSs) with an enrolment of 1,685 pupils. There are seven trained teachers and 40 attendants in the KG, 160 trained and 15 pupil teachers in primary schools and 78 trained and two pupil teachers in the Junior High Schools. In the two Senior High Schools in the district, students are studying both Core and Elective Mathematics. The performance of the students in these subjects is worrying.

PROBLEM STATEMENT

The importance of mathematics to an individual and society is acknowledged worldwide (Githua, 2013). With a particular reference to Senior High school students in the Krachie East District, their performance in Elective Mathematics is a pain in the necks of their respective school authorities every year. Statistics available from two schools in the district say that out of a total number of 1,552 Elective Mathematics students who wrote WASSCE between years 2005 and 2012, only 575 passed. This represents 37%. Specifically, in the Oti Senior High Technical School, out of the 964 candidates, 399 representing 41.4% passed the subject, while 176 passed out a total of 585 representing 30.1% (GES, 2012). The above scenario is disturbing and, therefore, calls for an in-depth exploration into the reasons for this poor performance among students in the subject in the district. Uniquely, this thesis will employ a contingency table technique to study the determinants of perceived difficulties in the subject.

OBJECTIVES OF THE STUDY

The main objective of the study is to model the determinants of perceived difficulties of students studying Elective Mathematics in Senior High Schools in the Krachie East District. The study has the following specific objectives:

- to determine the significant determinants that influence students’ perceived difficulties in the subject; and
- to model the determinants of perceived difficulties students encounter in Elective Mathematics.

METHODOLOGY

Data Sources and Analysis

Primary data were gathered from 100 randomly selected Elective Mathematic students from two Senior High Schools in the Krachie East District of the Volta Region. The test of association was tested by using Chi-square test for the variable “How do you perceive Elective Mathematics?” with options like “Difficult” and “Not difficult” on several dependent variables.

Presentation of Results and Discussion

The preliminary analysis presents the demographic information of the respondents. All the 100 Elective Mathematics students were made up of 50 each from Oti Senior High/Technical and Asukwakwa Senior High Schools who were randomly selected for the study completed and returned their copies of the questionnaire for analysis. This resulted in the study achieving a 100% retrieval rate.

Preliminary Analysis: Test of Association using the Chi-Square or Fisher’s Exact Tests

This section deals with the establishment of associations between the various socio-demographic variables and students’ perceived difficulties in Elective Mathematics. The study employed the Chi-square test, odds ratio and Fisher’s exact test (if necessary) to determine the association between 11 demographic characteristics of the students and their perceived difficulties in the subject.

Table 2: School and perceived difficulty in Elective Mathematics

School	Perceived difficulty in the subject		
	Difficulty	Not difficult	Total
Oti	22 (25.5)	28 (24.5)	50
Asukwakwa	29 (25.5)	21 (24.5)	50
Total	51	49	100

Estimated expected frequencies for hypothesis of independence are in parentheses

The contingency table reveals that among the 51 students who perceived Elective Mathematics to be difficult, 29 representing about 58% were from Asukwakwa SHS, while the remaining 22 representing 42% were Oti Senior High/Technical School. A test of independence produced a Chi-square value of 1.961 with a *p*-value of .161. Therefore, we fail to reject the null hypothesis that a student’s school

and his perceived difficulty in Elective Mathematics were independent. This means that a student’s perceived difficulty in the subject was irrespective of his/her school. Furthermore, the odds ratio computed as, $OR = \frac{22 \times 21}{29 \times 28} = 0.57$, means the odds of perceiving Elective mathematics as difficult rather than not difficult were 43% lower for

students from Oti Senior High Technical School than for Asukwakwa SHS students.

Table 3: Gender and perceived difficulty in Elective Mathematics

Gender	Perceived difficulty in the subject		
	Difficulty	Not difficult	Total
Males	31 (27.5)	23 (26.5)	54
Females	20 (23.5)	26 (22.5)	46
Total	51	49	100

Estimated expected frequencies for hypothesis of independence are in parentheses

In terms of the association between gender and perceived difficulties in Elective Mathematics, a Chi-square value of 1.929 and an associated *p*-value of .165 were obtained; indicating that there was no significant association between them. The implication of this result is that difficulty in the subject among the students was no gender-based. The odds

ratio, $OR=31*26/20*23=1.75$, means that the odds of perceiving Elective mathematics as difficult rather than not difficult were 75% higher among the males compared to their female counterparts. Thus, male students perceived Elective Mathematics as more difficult than the females.

Table 4: Age and perceived difficulty in Elective Mathematics

Age	Perceived difficulty in the subject		
	Difficulty	Not difficult	Total
Less than 15 years	3 (1.5)	0 (0.0)	3
15-18 years	17 (13.8)	10 (13.2)	27
19-22 years	27 (31.1)	34 (29.9)	61
23 years and above	4 (4.6)	5 (4.4)	9
Total	51	49	100

Estimated expected frequencies for hypothesis of independence are in parentheses

The data in Table 4, reveals that out of the 51 students who perceived Elective Mathematics to be difficult, 27 (52.9%) were aged 19-22 years and 17 (33.3%) were between 15-18 years. However, a test of independence between age of the

students and perceived difficult in the subject showed that there was no significant association between them since the Chi-square and *p*-values of 5.691 and .128, respectively were obtained.

Table 5: Programme of study-perceived difficulty contingency table

Programme of study	Perceived difficulty in the subject		
	Difficulty	Not difficult	Total
Business	28 (36.2)	43 (34.8)	71
General Arts	4 (2.6)	1 (2.4)	5
Technical	3 (1.5)	0 (1.5)	3
Agricultural Science	16 (10.7)	5 (10.3)	21
Total	51	49	100

Estimated expected frequencies for hypothesis of independence are in parentheses

Out of the 51 students who perceived Elective Mathematics as difficult, most (54.9%) of them studied Business, 16 (31.4%) studied Agricultural Science and the remaining were General Arts and Technical students as shown in Table 4.4. A further analysis using the Chi-square test produced a value of 13.696 with 3 degrees of freedom and a *p*-value of .000.

This means that programme of study and perceived difficulty in Elective Mathematics were associated. The implication is that students studying certain course do perceived Elective Mathematics more difficult than the others. It, therefore, means that programme of study could be a significant predictor of difficulty in the study.

Table 6: Ethnicity-perceived difficulty contingency table

Ethnicity	Perceived difficulty in the subject		
	Difficulty	Not difficult	Total
Nchunbang	10 (11.2)	12 (10.8)	22
Konkomba	12 (9.2)	6 (8.8)	18
Frafra	3 (2.9)	12 (7.7)	15

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Dangme	9 (6.6)	4 (6.6)	13
Asante	2 (4.6)	7 (4.4)	9
Ewe	9 (6.1)	3 (5.9)	12
Krachi	6 (5.6)	5 (5.4)	11
Total	51	49	100

Estimated expected frequencies for hypothesis of independence are in parentheses

Using the Fisher’s exact test, a p -value of .001 was obtained. This called for the rejection of the null hypothesis of independence. Ethnic background of the students significant

determined their perception about Elective Mathematics. The study would, therefore, include ethnicity in the model as a potential determinant of difficulty in the subject.

Table 7: Residential status and perceived difficulty in Elective Mathematics

Status	Perceived difficulty in the subject		Total
	Difficulty	Not difficult	
Boarder	5 (5.1)	5 (4.9)	10
Day	46 (45.9)	44 (44.1)	90
Total	51	49	100

Estimated expected frequencies for hypothesis of independence are in parentheses

From Table 4, it can be seen that overwhelming majority of the students (90%) were day students. Among those who perceived Elective Mathematics to be difficult, 46 (90.2%) were day students, while the remaining 5 (8.8%) were boarders. To determine if there was any association between the two variables, a Chi-square test of independence was performed and a value of 0.004 with an associated p -value of .947 was obtained. This means that the two variables

were not statistically dependent. Since residential status and perceived difficulty were not associated, the model will not include residential status as a predictor. Similarly, the study obtained a calculated odds ratio of 0.96; implying that the odds of perceiving Elective Mathematics as difficult versus not difficult was 4% less likely among the boarders than the day students.

Table 8: Fathers’ educational level-perceived difficulty contingency table

Educational level	Perceived difficulty in the subject		Total
	Difficulty	Not difficult	
No formal education	27 (23.5)	19 (22.5)	46
Basic	12 (17.3)	22 (16.7)	34
Secondary	5 (3.1)	1 (2.9)	6
Poly/Coll. of Educ/Nurs Trg.	4 (4.6)	5 (4.4)	9
University	3 (2.6)	2 (2.4)	5
Total	51	49	100

Estimated expected frequencies for hypothesis of independence are in parentheses

It can be seen from Table 8, that as many as 46 representing 46% of the respondents had fathers with no formal education and 34 representing 34% with basic education. Also, 6 of them had fathers who attained secondary education, 9 and 5 had their fathers with having polytechnic or teacher training and university education, respectively. As to whether or not father’s educational level and student

perceived difficulties in Elective Mathematics were associated, the Fisher’s exact test a p -value of .000; indicating that these two variables were associated. The implication is that father’ educational level is a strong predictor of student’s difficulties in the subject. Therefore, this variable should be included in the model for predicting student’s perceived difficulties in Elective Mathematics.

Table 9: Mothers’ educational level-perceived difficulty contingency table

Educational level	Perceived difficulty in the subject		Total
	Difficulty	Not difficult	
No formal education	28 (33.2)	37 (31.8)	65
Basic	10 (9.7)	9 (9.3)	19
Secondary	13 (8.2)	3 (7.8)	16
Total	51	49	100

Estimated expected frequencies for hypothesis of independence are in parentheses

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Similar to the results in Table 9, Table 8 also reveals that 65 representing 65% of the respondents had mothers with no formal education. Nineteen and 16 of them respectively had mothers who had obtained basic and secondary levels of education. A test of independence was conducted and a Chi-square value of 7.512 and a *p*-value of .023 were obtained.

The results indicate that there was a significant association between mother’s educational attainment and a student’s perceived difficulties in Elective Mathematics. Therefore, it can be predicted that mothers’ educational level may significantly influence students’ perceived difficulties in the subject, hence should be included in the model.

Table 10: Fathers’ occupations and perceived difficulty in Elective Mathematics

Occupation	Perceived difficulty in the subject		Total
	Difficulty	Not difficult	
Farmers	34 (28.6)	22 (27.4)	56
Drivers	4 (3.1)	2 (2.9)	6
Businessmen/Traders	4 (9.7)	15 (9.3)	19
Fishermen	9 (6.1)	3 (5.9)	12
Civil/public servants	0 (3.6)	7 (3.4)	7
Total	51	49	100

Estimated expected frequencies for hypothesis of independence are in parentheses

Among the students, a large proportion of them (68%) had their fathers who were farmers and fishermen, 19 representing 19% of the fathers were businessmen or traders. The remaining were either drivers or civil/public servants. A test for independence produced a Chi-square

value of 19.574 with 4 degrees of freedom and a *p*-value of .001.

This means that the occupation of fathers could be a factor in explaining students’ difficulties in Elective Mathematics.

Table 11: Mothers’ occupations and perceived difficulty in subject

Occupation	Perceived difficulty in the subject		Total
	Difficulty	Not difficult	
Farmers	32 (28.0)	23 (27.0)	55
Traders	10 (16.8)	23 (16.2)	33
Fishmongers	9 (6.1)	3 (5.9)	12
Total	51	49	100

Estimated expected frequencies for hypothesis of independence are in parentheses

From Table 11, 55 representing 55% of the students had farming mothers while 33 representing 33% were traders. Also, 12 representing 12% of the students’ mothers were fishmongers. A null hypothesis of no dependence between mothers’ occupations and perceived difficulties in Elective

Mathematics was rejected since a Chi-square and *p*-values of 9.558 and .008 were realized. This means that mothers’ occupations significantly influenced how their wards perceived the subject.

Table 12: Basic school attended-perceived difficulty contingency table

Basic school	Perceived difficulty in the subject		Total
	Difficulty	Not difficult	
Government	38 (40.8)	42 (39.2)	80
Private	13 (10.2)	7 (9.8)	20
Total	51	49	100

Estimated expected frequencies for hypothesis of independence are in parentheses

The results in Table 12, indicate that 80 representing 80% of the students attended government basic schools. The remaining 20 representing 20% had their basic education in private schools. A Chi-square test value of 1.981 with a corresponding *p*-value of 0.161 was obtained. Therefore, we do not reject the null hypothesis of basic schools attended by the students was statistically independent of their perceived difficulties in the subject. An odds ratio,

$OR = \frac{38 \times 7}{13 \times 42} = 0.49$, was ascertained. This means that the odds of perceiving Elective mathematics as difficult rather than not difficult were 51% lower among products of government basic schools compared to their counterparts from private schools.

The study also collated the terminal Elective Mathematics examination scores of the respondents. These scores were then categorized and a cross-tabulation was constructed to

see the association or otherwise between their performance in examinations and how they perceived the subject. Tab112

presents the details.

Table 13: Scores-perceived difficulty contingency table

Score	Perceived difficulty in the subject		Total
	Difficulty	Not difficult	
31-40	3 (3.6)	4 (3.4)	7
41-50	13 (13.3)	13 (12.8)	26
51-60	12 (12.8)	13 (12.2)	25
61-70	16 (13.8)	11 (13.2)	27
71-80	7 (6.6)	6 (6.4)	13
81-90	0 (1.0)	2 (1.0)	2
Total	51	49	100

Estimated expected frequencies for hypothesis of independence are in parentheses

It can be seen that the modal score of the students in Elective Mathematics during the last term was 61-70%. Thus, 27 representing 27% of the students obtained scores within that interval. Similarly, 26% and 25% of them scored between 41-50% and 51-60%, respectively. Thirteen representing 13% and 2 (2%) of the students respectively had 71-80% and 81-90% in their examinations. A test of independence revealed that there was a significant association between their scores and their perceived difficulties in the subject. This is because the Fisher’s exact test produced a *p*-value of .001. This means that we should reject the null hypothesis of independence, and include the respondents’ examination scores in Elective Mathematics in the model for predicting perceived difficulties in the subject.

CONCLUSIONS AND RECOMMENDATION

The objective of this research was to identify significant demographic predictors of students’ perceived difficulties in Elective Mathematics, and finally, to develop a model for predicting the probability of a student perceiving Elective Mathematics as difficult. The following conclusions were drawn from the analyses:

- The significant predictors of a student’s perceived difficulty in Elective Mathematics were the programme of study, ethnicity, and mother’s highest educational levels.
- Variables such as a student’s gender, age, residential status, father’s educational levels, the basic school they attended as well as their examination scores were not significant predictors of a student’s perceived difficulties in the subject.

On the basis of the findings of the research, the following recommendations were made:

- School authorities should devise more innovative methods of teaching the subject across all programmes. This will ensure that, for example, Business and General Arts, would have positive perception about the subject like their General Science and Technical students who also study related subject like Physics.

- Mothers in particular should strive to educate themselves to the highest level since it serves as a source of encouragement to their wards do well in subjects like Elective Mathematics at the senior high school level.
- Any strategies to encourage students to have positive perception about the study of Elective Mathematics should not pay much credence to the student’s gender, age, residential status, father’s educational level, and the basic school attended. This is because they do not significantly influence their perceptions about the subject.
- There could be workshops and seminars for the students on how to cultivate positive mindset about Elective Mathematics.
- Efforts should be made to change the mind-set of students that students of certain ethnic background are good at mathematics than the others.
- School authorities and GES should regularly organize workshop for Elective Mathematics teachers on simple, but effective ways of teaching of the subject at that level.
- The study will in future employ the regression model to delve into the current result and determine in the predictors identify in the model now can be ascertain.

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