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Factorially Derived Cultural Factors of Gaborone Senior Secondary School Students and Mathematics Performance

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More work has been done to try and explain why some students tend to perform better than others. The degeneration of students' performance not only in mathematics but across most subjects in Botswana has been an issue to most stakeholders for quite several years till today.Mathematics performance is closely associated with the scientific and technological innovations worldwide. Countless factors have been analyzed to explain why some students attain higher levels of academic achievement than other students. The purpose of this study was to determine the extent to which cultural factors like gender stereotype, cultural values and language barrier predict the student performance in Mathematics in senior schools in Gaborone, Botswana. Stratified random sampling was used to get a sample size of 300 from senior schools in Gaborone. The inferential survey study used a questionnaire as the main instrument for data collection". The validity as well as the reliability was assured where the reliability index for the independent variables come out to be all more than 70. Informed consent, confidentiality, privacy were assured to the respondents. Statistical Packages for Social Sciences was used in analyzing data. The results from hierarchical sequential regression showed that gender stereotype was a poor predictor. Cultural values and language barrier significantly predicted Mathematics performance even though it was at a low strength. Based on these results, appropriate discussions and recommendations were made.

Keywords: Mathematics performance, language influence, gender stereotype, attitude, cultural value

Introduction

Education is one of the main components that play a key role in the socio-economic, political development and improvement in the human society. Countless factors have been analysed to explain why some students perform better or attain higher levels of academic achievement than other students. The main purpose of this study is to find out the role of cultural factors on the Mathematics performance of secondary school students in Gaborone, Therefore, educators need to recognise the potential of culture in prompting and producing educational achievement in children. It is known that culture is ubiquitous, multidimensional, and complex. The term culture has been defined by many researchers and scholars from their own points of view. For example, [1] a nineteenth-century anthropologist, first defined culture as that complex whole which includes knowledge, belief, art, morals, law, custom, and any other capabilities and habits by man as a member of a society.

According to [2] the academic life of the student cannot be disconnected from the student's home environment. It takes the school and the home to raise a child. Home circumstances are the first and most important influences of school a child will ever have. All things being equal, the kind of care shown to a child at home can be more effective than that shown to the child at school because it is more personalized.

Over the years there has been a declining performance of students in Botswana more especially in secondary schools [3]. The spotlight has been on the declining performance, raising concerns over whether the educational system is failing most learners. However, the challenge of a declining educational performance more especially in Mathematics isn't unique to Botswana. Several countries around the world have over the years battled challenges that affect the output and quality of their educational systems.

2. Theoretical Background

The purpose of this study is to find out the extent to which cultural factors predict Mathematics performance of students in secondary schools in Gaborone. Hence the theory guiding this research was Vygotsky's socio cultural theory of learning. In Vygotsky's theory, mental development such as

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thought, language, and reasoning process are developed through social relationships and interactions. Thus, individual's development is influenced by culture and environment[4].This theory was developed by Lev SemenovichVigotsky (1896-1934) [5] who asserted that humans are capable of altering the environment for their own advantage or purpose. Ways in which individuals construct their world are strongly influenced by cultural factors. At the heart of Vygotsky's theory however, lies the understanding of human cognition and learning as social cultural rather than human phenomena. He explored relationships between language and thought, instruction and development and a host of others [6].

The study was grounded in the theoretical foundation of social cultural theory of learning which helped to shed light on how students could achieve academic success. It is therefore essential that educators pay particular attention to students' cultures and create opportunities for students to make meaningful connections to their lives. For educators to understand the influence of culture it is of importance to note that the cultural factors are a vast majority of factors which encompasses an individual's environment to personal influences of believes motivation and values. It is therefore to adopt the theoretical understanding. The way students construct their world of learning is strongly influenced by cultural factors. Cultural values and family believes play a role in child development. These have an impact in their academic life. Whatever they are taught, the child's level of developing the concept will at the back be fueled by what they believe at home and what their cultural values pursue. The theory also helped in the regression analysis of the data for this study.

3. Statement of the Problem and Purpose of the Study

Low mathematics performance in Botswana has been an issue for quite some time by the parents, policy makers, the media and other key stakeholders. In addition, no study has been carried out to determine the influence of cultural factors on mathematics performance in Botswana. Culture plays an important role in modelling ones' perception of the world and hence through evolution contribute towards knowledge [7,8].
The purpose of the study is to determine the level to which cultural factors among final year senior secondary school (SSS) students predict their actual performance during final junior secondary school mathematics examination performance in 2016. The main question guiding this study is to what extent do cultural factors predict student mathematics performance of Gaborone senior secondary?

4. Alternative Hypothesis

There is a statistical significance of cultural factors in predicting mathematics performance.

5. Literature Review

In research, studies are conducted with an in-depth analysis, insight and intensive logical thinking. The contributions of the earlier researches are of great help to define the scope of further research as well as to provide an input to the researcher about all the areas which have been studied and to examine the gaps in the existing practices applicable to the problem under study.
A related study [8] was conducted on stereotypical gendering in secondary schools and its effect of performance in Tanzania. The main purpose of the study was to assess teachers' and students' perception of gendering process over girls and boys at secondary schools. Specifically the study aimed at examining the impact of socialization to the students' academic performance in secondary schools. A total of 182 respondents were interviewed by the use of semi structured questionnaires, focus group discussion and direct observations were employed to obtain the required information. The use of multiple methods for data collection is of a great importance as the researchers were able to collect the in-depth data of the problem under study [8].

Results showed that the common gender stereotypes in secondary schools includes 'boys are intelligent', 'boys prefer studying Mathematics and science subjects', 'girls prefer studying art subjects', and 'girls are inferior'. The study revealed that the existing negative stereotyping notions and prejudices amongst students and teachers over girl students. The findings of this study corroborates with one of the objectives of this study which would find out how gender factors like stereotyping affect the leaners performance. In another related inferential study, [9] concluded that if the student's teachers are motivated enough to have a positive perception towards teaching, then it follows that they will be able to pass that position to their students creating a sustainable positive view regarding teaching for those who would like to take it up as their career. Students' image of their attributional panaches might help them improve their academic performance.

The issue of gender roles was found to be significantly affecting the performance of students in Kenya. This was shown in the study conducted by [10] who sought to establish the domestic gender roles and their effect on pupils' academic performance in public primary schools in Garba Tula district. Five research questions guided their study and their sample comprised of 17 head teachers, 187 teachers and 217 pupils. A large sample size is appropriate in cases where the inferences are to be made. Hence, this was strength for their study. They used questionnaires and document analysis to gather data for the study. The study revealed that there was a relationship between pupils' involvement in the domestic roles and academic performance. The more the pupils were

involved in the domestic roles, the more they were late for schools, the more they were not able to complete assignments and therefore the more their education was affected. Findings revealed that girls were involved more than boys in domestic chores. The study also concluded that gender roles had a significant relationship on the students' academic performance. There were differences in involvement of boys and girls in the domestic gender roles where girls were the most affected.

In Botswana, a study was conducted by [11] to investigate the student academic performance for junior secondary schools. The major purpose of the study was to investigate factors which contribute to the decline in students' academic performance in junior secondary schools in Botswana since 2010. The study was quantitative and used the positivist paradigm. Questionnaires were used to gather data from two hundred participants and some documents were analysed to supplement the information collected through the questionnaire. Data were analysed using the computer package known as Statistical Package for the Social Sciences (SPSS). The use of SPSS in the analysis of data is of importance as it is able to show the descriptive statistics as well as test the relationship between variables. This is supported by the current study as it will use SPSS in the data analysis. The outcomes of the study showed language barrier as one of the factors affecting academic performance in schools. Many students enter the classroom not fluent in the languages of instruction and then they perform poorly [11].

Cultural identities and values play a key role in determining academic achievement. Many times, family values and

Table 1. Factor loadings and communalities based on a principal components analysis with oblimin rotation for 12 items

	Components			
	Gender stereotype	**Language influence**	**Cultural value**	**H^2**
	□□□□□□	□□□□□□	□□□□□□	
Developing skills in Mathematics is expected more for boys than for girls	.816			685
There are other subjects meant for girls, Math is a boy' subject	.922			.856
There is something about Maths that makes it a male-only subject	.843			.717
I accept the fact that when it comes to subjects at school, mathematics is in the males domain	.837			.691
Using foreign language to teach Maths has made it more difficult		.627		.405
Teaching Maths in English makes Maths learning more difficult		.664		.447
I would have been doing better in Maths if it were taught in my home language		.820		.676
Maths would have been easier if it were taught in my local language		.826		.68
In my culture skill in Maths is not deemed to be very important			.660	.46
In my culture, a lot of emphasis is placed on our performing well in Maths			.805	.64
My culture values skill in Maths more than skill in other subjects			.791	.618
Since in my culture one can be successfully without any skill in Maths, the subject is not necessarily that important			.688	.495

expectations are established through examples exhibited by parental figures [12]. The culture shock can also hinder a student's ability to adjust to new academic settings, which may result in academic losses or undesirable behaviours in the classroom. The importance placed on education by the parental figure as well as by the dominant culture in general has a direct effect on progress in an academic environment. Often times, the examples set by parents are the greatest predictors for future successes in their children [12].

In conclusion, the review of literature has provided a backing for the research objective that there is a link between cultural factors being predictors of Mathematics performance. The researcher would therefore like to go ahead and statistically establish the relationship between cultural factors and Mathematics performance among Gaborone senior secondary school students.

6. Methodology and Research Design

The study was a quantitative inferential survey by surveying with a questionnaire instrument the perceptions of a sample of students to language as a barrier, cultural values and gender typing mathematics as a male subject to predict mathematics performance during 2016 examinations. The Likert scale format with six values ranging from 'very strongly agree to very strongly disagree' was used. The 12 items of cultural factors on Mathematics performance were subjected to principal component analysis and preliminary tests were made to make sure that no violations of assumptions were made. This was done to check the suitability of data for factor analysis. Firstly, the sample size of 300 was appropriate. According to [13], sample size should be more than 200 and in some cases, sample size may be considered for 5 observations per variable. The sample size should be large enough to yield reliable estimates of correlations among the variables. This was not violated. Also, the sample was homogeneous. So, reliability analysis was conducted to check the homogeneity between variables. Cronbach's alpha results using SPSS showed the presence of the internal validity of the data. For the three factors thereof, the reliability index showed .888, .721 and .723 for gender stereotype, language barrier and cultural value factors respectively which showed a good consistency of data (see Table 1)

These assumption of factorability was tested which indicates that there are at least some correlations amongst the variables so that coherent factors can be identified. Basically, there should be some degree of collinearity among the variables but not an extreme degree or singularity among the variables. The factorability of the 12 items was examined again by correlating the variables to check the linearity. It was observed that all the 12 items correlated at least .3 with at least one other item, suggesting reasonable factorability.

Finally, the communalities were all above .3 (see Table 1); further confirming that each item shared some common variance with other items. Given these overall indicators, factor analysis was deemed to be suitable with all 12 items. Principal components analysis was used because the primary purpose was to identify and compute composite scores for the factors underlying the cultural factors. The results therefore showed that the Initial eigenvalues indicated that the first three factors explained 26%, 18%, and 17% of the variance respectively. The three factor solution, which explained 61% of the variance. For the final stage, a principal components factor analysis of the remaining 12 items, using oblimin rotations, was conducted, with three factors explaining 61% of the variance. An oblimin rotation provided the best defined factor structure. All items in this analysis had primary loadings over .5.

Table 2. Total variance explained

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings
	Total	**% of Variance**	**Cum %**	**Total**	**% of Variance**	**Cum %**	**Total**
1	3.123	26.028	26.028	3.123	26.028	26.028	3.011
2	2.158	17.986	44.014	2.158	17.986	44.014	2.21
3	2.089	17.405	61.419	2.089	17.405	61.419	2.259

7. Results and Interpretations

7.1. Null Hypothesis

Among Gaborone SSS students, level to which mathematics is gender typed as a male subject, their level of cultural values, their level of language as a barrier do not significantly predict their performance in 2016 mathematics Junior Secondary Certificate Examinations.

This hypothesis was tested by carrying hierarchical multiple regression of actual performance in 2016 junior secondary

certificate examination mathematics using their cultural values, language as a barrier and gender typing mathematics as a male subject.

Factorability was also examined by the measures of sampling adequacy (MSAs) for suitability of your data for structure detection. The Kaiser-Meyer-Olkin Measure of SamplingAdequacy is a statistic that indicates the proportion of variance in your variables that might be caused by underlying factors. High values (close to 1.0) generally indicate that a factor analysis may be useful with your data. If the value is less than 0.50, the results of the factor analysis probably won't be very useful. For this study, the result was .643 which indicates the suitability of data. On the other hand, Bartlett's test of sphericitytests the hypothesis that your correlation matrix is an identity matrix, which would indicate that your variables are unrelated and therefore unsuitable for structure detection. Small values (less than 0.05) of the significance level indicate that a factor analysis may be useful with your data. The results therefore, showed that the Bartlett's test of sphericity was significant.

7.2. Hierarchical Multiple Regression

Prior to conducing a hierarchical multiple regression, the relevant assumptions of this statistical analysis were tested. Firstly, a sample size of 300 was deemed adequate given three independent variables to be included in the analysis [14]. The assumption of singularity was also met as the independent variables (cultural value, gender stereotype and language barrier) were not a combination of other independent variables. An examination of correlations (see Table 3) revealed that no independent variables were highly correlated. However, as the collinearity statistics (i.e., Tolerance and VIF) were all within accepted limits. Tolerance values for the predictor variables were assessed, all the values ranged between (.979-, .994). These are closer to 1. The assumption of multicollinearity therefore, was deemed to have been met [15].

An examination of the Mahalanobis distance scores indicated no multivariate outliers. Residual and scatter plots indicated the assumptions of normality, linearity and homoscedasticity were all satisfied [16]. A three stage hierarchical multiple regression was conducted with Mathematics performance as the dependent variable and (cultural value, gender stereotype and language barrier) as predictor variables. The predictors as the predicted variables were measured in a continuous scale

Cultural value was entered at stage one of the regression to control for culture influence responding. The gender stereotype was entered at stage two and language barrier at stage 3. These variables were entered in this order as it seemed chronologically plausible given the fact that cultural value as the main individual factor influences the gender stereotype as well as the language of an individual.
Intercorrelations between the multiple regression variables were reported in Table 3 and the regression statistics are in Table 4.

The hierarchical multiple regression revealed that at Stage one, cultural values contributed significantly to the regression model, F (1,298) = 5.954, p=.015) and accounted for 2% of the variation in Mathematics performance. Introducing the gender stereotype explained an additional 0.6% of variation in performance and this slight change in $R^2$was not significant, F (2,297) = 3.972, p =.161. Adding language barrier to the regression model explained an additional 6.1% of the variation in performance and this change in $R^2$was significant, F (3,296) = 9.456, p = 001. When all three independent variables were included in stage three of the regression model, only cultural values and language barrier were significant predictors of Mathematics performance. The most important predictor of performance was language barrier which uniquely explained 6% of the variation in performance. Together the three independent variables accounted for 9% of the variance in performance.

Table 3. Pearson correlation of Mathematics performance and predictors

		Maths performance	**Cultural values**	**Gender stereotype**	**Language barrier**
Pearson Correlation	**Maths Performance**	1			
	cultural values	0.14**	1		
	gender stereotype	-0.098**	-0.127**	1	
	language barrier	0.258**	0.039	-0.075	1

Furthermore, the results showed that cultural value was a good predictor of mathematics performance as it was

statistically significant in all the three models. Model 1 (β= .035, p=.015), Model 2 (β=.033, p=.025) and model 3 (β=.031, p=.030). This is an indication that high and positive level of cultural values to mathematics is associated with high performance in Mathematics and the low cultural value is associated with low Mathematics performance.

Interestingly, the results show that language barrier was the best predictor of Mathematics performance. This is so because including it in the model added more percentage to the prediction level of cultural factors. It showed a significance prediction. Even though it was added to the model last, it showed a greater significance in prediction, Model 3 (β=.059, p= .001). This means that language significantly predicts performance. This indicates that having an advantage in the language used in learning and teaching mathematics positively relates to a positive performance. Someone with difficulties in Language of instruction predicts a poor performance in Mathematics.

Table 4. Summary of Hierarchical Regression Analysis for Variables predicting Mathematics Performance

Variable	β	t	sr^2	R	R^2	ΔR^2
Model 1				.140	.020	.020
Cultural value	.035	2.440*				
Model 2				.161	.026	.006
Cultural value	.033	2.245*				
Gender stereotype	-.018	-1.404				
Model 3				.296	.087	.061
Cultural value	.031	2.181*				
Gender stereotype	-.014	-1.130				
Language barrier	.059	4.463*				

*Note. N = 94; *p< .05,

Gender stereotype was not significant in the two models. Therefore, it was less important in the prediction of Mathematics performance: Model 2 (β=-.018) and model 3 (β=-.014). This means among Gaborone Senior Secondary School students, the effect of gender and its roles in Mathematics performance is not statistically significant. The differences that might occur for gender are just due to chance.

8. Conclusion

The study was conducted using a quantitative approach having adopted a questionnaire as a mode of data collection. Based on the data obtained from the participants, it was concluded that cultural factors have been seen to predict Mathematics performance. Even though that was the case, gender did not differ significantly. Both boys and girls indicated that gender issues might not be of a great problem in influencing mathematics performance. We saw language barrier significantly predicting mathematics performance more than cultural values and gender stereotype. The use of English as a mode of teaching and instruction is found to have a great impact in the performance of students. Language is a cultural factor which has been embedded in individual's lives. On another note, this study concludes that cultural values impact Mathematics performance.

9. Discussions, Implications and Recommendations

No matter how mathematics performance is influenced by a lot of factors, cultural influence should not be left behind. The discussions are based on the findings of this study which looked at cultural factors and performance in mathematics. In our society that groom children under a patriarchal believes, there tends to be certain influences that happen to children and affecting them academically. Even though this study showed no mean differences in terms of gender, mathematics performance was not affected by gender stereotypes.

The perception that there is a gender difference in the achievement of Mathematics is prevalent among many scholars.Mathematics is considered as a male dominated in various countries[17].However, in this study that was not the case. For this study, gender stereotypes did not significantly influence performance. This might be due to great initiatives of gender equity in our education system which has made it in light to embrace Mathematics as a subject for all not just boys.

According to [18] equity cannot be achieved through making a subject compulsory, because many students may just attend classes simply to satisfy the regulation. Such students are never members of the class in a true sense. At the end, more psychological damage is done than would have been the case if the subject were not made compulsory. Equitable access to

mathematics education calls for the provision of adequate resources and a conducive psychological environment that enables all students toenroll in and learn the subject willingly. The conducive psychological environment is created by a skillful manipulation of the complex interactions of psychological, personal andenvironmental variables in order to motivate learners' interest and to satisfy their desire to enroll in and willingly attend classes in the subject [18].This psychological manipulation may include the change of culturally bound mind to a more open mind on issues subjects.

This study suggests that one's attempt to perform well depends on their level of understanding the language being used. Upon how much 'power' one has over an attribute teaching of mathematics strictly in English should be the emphasis to enable the mathematics teachers explain in the mother tongue whenever they are teaching. Students indicated language barrier to be influencing their performance. This result corroborates with that of other studies. For example, according to [19], children take years to master their native language. Botswana is multi-national society with over twenty-five spoken languages. Setswana is regarded as a national language and English taken as an official language and students are expected to learn Setswana until they finish secondary school while English is a medium of instruction from primary up to university level. These languages are used for testing students' mastery of subject content and used in the examinations. The student might understand the concepts in their mother but fails to express it in the language of examinations. At the end, the student might perform poorly just because of lack of understanding the instruction but not necessarily meaning that the students did not master anything. That is why students who go to private schools perform greatly because to them, English is just an easy language to comprehend. But then it goes to the issue of how people or families value education.

On the issue of cultural values, issues of cultural roles always pop in. While at home, girls feel they are given so much work to do while boys simply loiter about a fact which denies girls opportunity for serious academic pursuit [20].Cultural values were found to affect Mathematics performance. Now, this prompts the issue of gender roles where a woman's place has been groomed to be in the kitchen. This is a value that can affect students' performance. Not surprisingly, the results of this study related to that by [20, 21]. They stated that this is an attribute of illiterate parents who are yet to appreciate the significance of the girl-child education or have either ignored or do not practice. This finding is echoed by the cultural perception that the woman's rightful place is at the kitchen. This perception has led to overburdening girls with domestic chores leaving them with little study time. The study established that cultural factors indeed influenced girl student's academic achievement. Domestic chores and practices by parents of marrying off daughters were other cultural factors that negatively affected the girl child's academic performance. Even though that's the case, a positive cultural value should enhance both boy and girl students' academic performance.

10. Recommendations

With the findings stated, it is therefore recommended that in issues of cultural values and in cases where there are stereotypes concerning certain subjects like mathematics, the Ministry of Education as well as teachers should empower and encourage students that all the subjects belong to everyone. Hence this will motivate those whose values are stereotypical to mathematics to perform better in it.

More research is needed in finding the disparities of the variables discussed in this study in terms of geographic location. This study was conducted in an urban location, hence limiting the generalizability to the whole country.

It was evident that though there was a significant prediction of mathematics performance from cultural factors, it was at low levels. This could have been due to the fact that the study was conducted in an urban location, so further research is also recommended in rural places.

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