Original Research Article

STEM Education in The University of Bamenda: A Possible Panacea to Dyscalculia

ABSTRACT

The study set out to determine if STEM Education in The University of Bamenda could be a possible panacea to the dyscalculia of students. The study design was partly a longitudinal developmental design, and partly a quasi-experimental research design. The population of the study was made up of all the 13 students admitted into the STEM education programme of the University of Bamenda in the 2019/2020 academic year and 15 other students from the faculty of education. Data was collected using a self-designed questionnaire. The questionnaire was vetted using three experts in the field of mathematics education. A pilot test with ten students from different departments in the Faculty of Education in UBa, yielded a Cronbach alpha reliability of 0.83. Means were used to answer the research questions while the one sample t-test and the independent samples t-test were used to test the hypotheses at the 0.05 level of significance. The findings of the study revealed that the STEM Education programme in the University of Bamenda significantly reduces the dyscalculia of STEM students. Furthermore, the dyscalculia of male STEM students decreases significantly compared to that of their female counterparts after their STEM Education studies in the University of Bamenda. It was recommended that practicing teachers, especially those at the Basic Education level and arts teachers, should be encouraged to apply and go through the STEM education programme in UBa as this study has revealed that the programme has great potentials in reducing their dyscalculia. It was also recommended that some cores courses in the STEM programme should me made compulsory to all Faculty of Education (FED) students as this study also revealed that the other programmes in FED did not reduce the dyscalculia of students like the STEM programme did.

Keywords: STEM education, dyscalculia, panacea, The University of Bamenda, Faculty of Education.

1. INTRODUCTION

The University of Bamenda (UBa) is one of two Anglo-Saxon state Universities in Cameroon. Created in 2010 by Decree No. 2010/372 of 14th December 2010, UBa is located in the North West Region of Cameroon. Created as a means of decongesting the University of Buea, one of the missions of The University of Bamenda is to arm learners with universally approved knowledge in technology sciences and the arts. Thus, the university focuses on instilling in its learners 21st century skills of critical and constructive thinking, creativity, communication, collaboration, digital literacy, among others; skills that will enable learners to be enterprising in order to meet up with the challenges of this century. This suggests that the

various faculties and schools must have this mission statement reflected in all the programs offered in their different departments.

UBa has six faculties and six schools among which are the Faculty of Education (FED), Higher Teachers Training College (HTTC), Higher Technical Teachers Training College (HTTTC) and even the Faculty of Science, which all act as reservoirs for technical, science and mathematics teachers of secondary schools all over the country. Although HTTC has been training mathematics teachers for so many decades, experience, supported by GCE results in Cameroon suggest that many students still dread mathematics. They display much phobia towards anything digital. While the Faculty of Education is one of the youngest faculties in UBa, there is hope that its teacher education program will revert the dyscalculia common among primary and secondary school pupils/students; a situation worsened by the current socio-political situation plaguing the North West and South West Regions of Cameroon.

Acquisition of mathematical skills is one of the basic skills required for independent living in a proficient society. The possession of these skills turn to affect educational opportunities, employment opportunities and consequently socio-economic status. The term Dyscalculia is derived from the Greek word ‘dys’ meaning ‘difficulty’ and the Latin word ‘calculia’ meaning ‘calculus’ (a small stone or pebble used for calculation). Basically, the word dyscalculia refers to a difficulty with numbers which could be as a result of a developmental or cognitive condition. The difficulty could also be acquired as a result of brain injury [1].

Dyscalculia is a specific type of learning difficulty that has also been referred to as ‘number blindness’. It is similar to the word dyslexia, generally described as ‘word blindness’. A range of descriptive terms used to describe dyscalculia include: developmental dyscalculia, psychological difficulties in Mathematics, mathematical disability, number fact disorder and arithmetic learning disability [2].

Furthermore, dyscalculia can be categorized into: Developmental Dyscalculia which arises as a result of some deficiency or disorder in cognitive processes such as attention, perception, memory, spatial visualization, information processing, and Difficulties in learning acquired mathematics (acquired dyscalculia) which arises as a result of damage to one or both halves of the brain [3]. Again, six sub-patterns of math learning difficulties that are predominant in children and adults include: Verbal Developmental Dyscalculia in learning mathematics, in which the ability to recall terms, relations, and symbols is perturbed; Lexical Developmental Dyscalculia, in which the ability to read mathematical signs is perturbed; Graphical Developmental Dyscalculia, in which the learner finds difficulties in writing numbers and symbols; Operational Developmental Dyscalculia, in which the learner finds difficulties in performing mathematical operations such as addition, subtraction, multiplication, and division; Practognosic Developmental Dyscalculia, in which children who suffer from this disorder find it very difficult to place things according to a specific arrangement based on their size or amount, and therefore it is difficult for them to determine whether one of the groups contains a number of elements greater than or less or equal to the number of items in the other group; Ideognotical Developmental Dyscalculia, which refers to the inability of learners to understand mathematical ideas and relationships with mental calculation. Although these children are able to read and write numbers, they are unable to understand what they write or read [4].

Again, other authors suggest dyscalculia can be classified into primary and secondary [5]; "Primary dyscalculia is a heterogeneous disorder resulting from individual deficits in numerical or arithmetic functioning at behavioural, cognitive/neuropsychological and neuronal levels. The term secondary dyscalculia should be used if numerical/arithmetic

dysfunctions are entirely caused by non-numerical impairments such as attention disorders" (p2).

Reacting to the various types of dyscalculia, one of the things that need to be done to revert dyscalculia is to give specific instructions related to the basics in mathematics such as making mathematical representations, making comparisons and reinforcing basic mathematical facts to learners [6]. The aformentioned various types of dyscalculia were identified among the third batch of students admitted into the STEM programme in the University of Bamenda, hosted by the faculty of Education.

Science, Technology, Engineering and Mathematics (STEM) Educations is one of the special programmes offered in the Faculty of Education of The University of Bamenda. STEM education is a relatively new teacher education training programme, which was first introduced in Cameroon in UBa. Among the thirteen students admitted into the STEM programme in the 2019/2020 academic year, only two had science backgrounds. The researcher wondered how non science students who even showed signs of having dyscalculia could cope in a programme which integrates science, technology, engineering and mathematics. Thus it was necessary to do a proper follow-up of these students so as to provide accurate quantitative and qualitative data to authorities in relation to how the students were coping; data that could help them to review the admission requirements if need be.

2. METHODOLOGY

The study adopted a longitudinal developmental research design. This design was adopted because the researcher intended to study how the dyscalculia displayed by the students admitted into the STEM education programme was affected as they progressed in their studies. The study also exploited the quasi experimental research design. The use of an intact class and the control of some variables also necessitated the use of this design. The population of the study was made up of all the 13 students admitted into the STEM education programme of the University of Bamenda in the 2019/2020 academic year. Purposively, the researcher worked with all the students due to the fact that they were few and also because the researcher lectures in that department. To provide control to the study, 15 other students admitted in the same academic year were randomly selected from other departments in the Faculty of Education.

Data was collected using a self-designed questionnaire. The 10-itemised questionnaire employed the 4-point Likert scale of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) (See Appendix). Each student was required to indicate their degree of agreement or disagreement with each statement on the questionnaire. The questionnaire was vetted using three experts in the field of mathematics education. After a pilot test with ten students from different departments in the Faculty of Education in UBa, the Cronbach Alpha reliability of the instrument was found to be 0.83. The instrument was administered to the STEM students and the control group during the third week of October in 2019. SA was scored 4 points, A was scored 3 points, D was scored 2 points and SD was scored 1 point. Thus a student could obtain a maximum score of 40 (10 items x 4) and a minimum score of 10 (10 items x 1). Any score greater than or equal to the midpoint of 25 (2.5 on the 4-point Likert scale x 10 items) was an indication that the student had high dyscalculia; the greater the score, the higher the dyscalculia. On the other hand, any score lower than the midpoint of 25 was an indication that the student had low dyscalculia; the lower the value, the lower the dyscalculia. A value of 10 was an indication of no dyscalculia. The data collected revealed that on an average, both groups had dyscalculia.

As teaching went on, the researcher closely monitored both groups. Each year, opportunities were created were mathematical issues were discussed in both groups on different occasions. The researcher noted the responses provided by various students from both groups. After three years of studies, the researcher again administered the instrument to the two groups in order to see how their programmes had affected their dyscalculia. Means were used to answer the research questions while the one sample t-test and the independent samples t-test were used to test the hypotheses at the 0.05 level of significance.

2.1 Research Questions

- How did the STEM Education programme in the University of Bamenda affect the dyscalculia of STEM students?

- How was the dyscalculia of male and female students affected by the STEM Education programme in the University of Bamenda?

2.2 Hypotheses

Ho1: The STEM Education programme in the University of Bamenda does not significantly affect the dyscalculia of STEM students.

Ho2: The dyscalculia of male and female STEM students is not significantly affected by the STEM Education programme in the University of Bamenda.

3. RESULTS AND DISCUSSION

Effects of the STEM Education programme in the University of Bamenda on the dyscalculia of STEM students

Table 1. One-Sample Statistics showing Dyscalculia Scores of STEM Students

	N	Mean	Std. Deviation	Std. Error Mean
Dyscalculia Score for STEM Students Before Studies	13	29.23	5.085	1.410
Dyscalculia Score for STEM Students After Studies	12	14.08	2.466	.712
Dyscalculia Score for Control Group Students Before Studies	15	29.73	3.369	.870
Dyscalculia Score for Control Group Students After Studies	15	27.40	3.418	.883

Table 1 shows that the mean dyscalculia score for STEM students before the start of the STEM education programme was 29.23, suggesting that the 13 students who started the programme, on an average, had dyscalculia. At the end of the study programme the mean dyscalculia score was found to be 14.04, suggesting that the 12 students who completed the programme, did not have dyscalculia. On the other hand, the mean dyscalculia score for the

control group students before the start of their studies in the Faculty of Education (FED) was 29.73, while their mean dyscalculia score at the end of their studies was 27.40. These values suggest that this group of students still had dyscalculia even after studying for three years in FED.

Table 2. One-Sample t-test for Hypothesis One

	Test Value = 25					
	T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Dyscalculia Score for STEM Students Before Studies	3.000	12	.011	4.231	1.16	7.30
Dyscalculia Score for STEM Students After Studies	-15.332	11	.000	-10.917	-12.48	-9.35
Dyscalculia Score for Control Group Students Before Studies	5.441	14	.000	4.733	2.87	6.60
Dyscalculia Score for Control Group Students After Studies	2.719	14	.017	2.400	.51	4.29

A one sample t-test was performed to compare the mean dyscalculia score of STEM students before and after their studies in the STEM education programme, against the population mean. Before the start of the study programme, the mean dyscalculia value of 29.23 (See Table 1), was significantly higher than the population mean (test value) of 25 at the 5% level of significance; t(12) = 3.00, *P* = .01. This suggests that the level of dyscalculia among STEM students was significantly high before the start of their studies. Table 2 also reveals that at the end of the study programme, the mean dyscalculia value of 14.08 (See Table 1), was significantly lower than the population mean (test value) of 25 at the 5% level of significance; t(11) = -15.33, *P* = .00. This suggests that the level of dyscalculia among STEM students was significantly low after the end of their studies. Thus Ho_1 is rejected. For the control group, the table reveals that the level of dyscalculia was significantly high, both before and after their studies. The findings of this study therefore reveal that the STEM programme in the University of Bamenda has the potentials of significantly lowering the level of dyscalculia possessed by students before university studies. One can say with some certainty that the curriculum of this study programme is tailored towards helping students to acquire 21st century skills, whether with an arts or a science background. This implies that this curriculum could be exploited before the construction of similar curricula, or better still, some of the key courses could be made compulsory for all students in the faculty of education.

Effects of the STEM Education programme in the University of Bamenda on the dyscalculia of Male and Female students

Table 3. Statistics showing Dyscalculia Scores of Male and Female STEM Students

	Sex	N	Mean	Std. Deviation	Std. Error Mean
Dyscalculia Scores for Male and Female STEM Students Before Studies	Male	4	30.00	7.394	3.697
	Female	9	28.89	4.226	1.409
Dyscalculia Scores for Male and Female STEM Students After Studies	Male	3	11.00	1.000	.577
	Female	9	15.11	1.833	.611

Table 3 reveals that before the start of the study programme, Male STEM students had a higher dyscalculia score (30.00) compared to that of their female counterparts (28.89). It further shows that at the end of the study programme, Male STEM students had a lower dyscalculia score (11.00) compared to that of their female counterparts (15.11).

Table 4. Independent Samples t-test for Hypothesis Two

		t-test for Equality of Means						
		t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
Dyscalculia Scores for Male and Female STEM Students Before Studies	Equal variances assumed	.350	11	.733	1.111	3.174	-5.875	8.097
	Equal variances not assumed	.281	3.904	.793	1.111	3.956	-9.981	12.203
Dyscalculia Scores for Male and Female STEM Students After Studies	Equal variances assumed	-3.628	10	.005	-4.111	1.133	-6.636	-1.586
	Equal variances not assumed	-4.890	6.844	.002	-4.111	.841	-6.108	-2.114

Table 4 shows that the difference between the mean dyscalculia scores for male and female STEM students before the start of studies was 1.11. This difference was not significant [t(11) = .35, *P* = .73] at the 5% level of significance, although male students had a higher mean score. On the other hand, the difference between the mean dyscalculia scores for male and female STEM students after studies was significant [t(10) = -3.63, *P* = .01]. This suggests that Ho_2 was rejected. Thus male STEM students had a significantly lower mean dyscalculia

score than their female counterparts after their studies. Thus the STEM Education programme in the University of Bamenda has a more positive effect on the dyscalculia of male students than on that of female students.

4. CONCLUSION

The study whose aim was to determine if STEM Education in The University of Bamenda could be a possible panacea to dyscalculia established the following findings: The STEM Education programme in the University of Bamenda significantly reduces the dyscalculia of STEM students. The dyscalculia of male STEM students decreases significantly compared to that of their female counterparts after their STEM Education studies in the University of Bamenda. It is recommended that the authorities in UBa should also advertise the STEM Primary programme and should permit even arts students to apply for it. Practicing teachers, especially those at the Basic Education level and arts teachers, should be encouraged to apply and go through the STEM education programme in UBa as this study has revealed that the programme has great potentials in reducing their dyscalculia. It is also recommended that some cores courses in the STEM programme should me made compulsory to all FED students as this study also revealed that the other programmes in FED did not reduce the dyscalculia of students like the STEM programme did.

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APPENDIX

Questionnaire for Data Collection

Dear Respondent,

I humbly request that you kindly participate in this study dealing with dyscalculia. Your sincere responses will be of great value to this study. This is an academic exercise and your responses will be treated confidentially.

Thank you for your cooperation

Instructions: Below are statements relation to how you view mathematics. Please kindly provide a tick against each statement under Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD), depending on the degree to which you agree or disagree with each statement.

S/N	Statements	SA (4)	A (3)	D (2)	SD (1)
1	I have difficulties recognizing and remembering numbers				
2	I am not comfortable studying subjects which involve any mathematical calculations				
3	Sometimes I find it difficult to associate number symbol with the number value				
4	I have difficulty identifying patterns and placing things in their proper order				
5	I always need concrete or visual aids to help them calculate				
6	I have difficulties in understanding and remembering basic mathematical operations such as addition, subtraction, multiplication and division of real numbers				
7	I find it difficult to understand the principles behind word problems and other non-numerical mathematical calculations				
8	Have difficulties to estimate time.				
9	I struggle with mathematics homework, tasks and examinations				
10	It is difficult for me to understand the lessons involving visual-spatial like charts and graphs				

Raw Data Collected

Group	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Sex	1	1	1	1	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2
Dyscalculia Score Before Studies	37	35	27	21	29	35	31	31	27	32	23	30	22	28	32	30	33	27	29	31	30	23	28	32	25	31	30	37
Dyscalculia Score After Studies		12	11	10	14	16	14	17	12	16	15	18	14	23	29	28	30	27	27	30	26	20	26	29	25	27	29	35

* Group: 1 = STEM Students, 2 = Control Group Students
Sex: 1 = Male Students, 2 = Female Students