

An Investigation into the Mathematical Preparedness of First Year Natural Sciences Students at the University of Guyana, Turkeyen Campus.

Antalov Jagnandan¹, Shawn Jagnandan²

¹Department of Mathematics, Physics and Statistics, University of Guyana, Georgetown, Guyana

²Department of Mathematics, Physics and Statistics, University of Guyana, Georgetown, Guyana

Abstract:

In order to be prepared for science-based degrees at universities, it is the view of many that the groundwork in mathematics that one receives at secondary school is fundamental. This research employed the analysis of data collected through questionnaires, interviews, online student record management system reports and anecdotal records from first year students, lecturers and administrators from the Faculty of Natural Sciences at the University of Guyana, Turkeyen Campus as well as secondary school teachers across the ten administrative regions of Guyana. It uncovered the mathematical preparation of first year Natural Sciences students at the University of Guyana, Turkeyen Campus. The performance of students over the last decade has been poor and a significant theory, by many, as to the major contributing factor for this is their mathematical preparation coming into the university. The results from this study have established this to be true and shows many similarities to those found in the literature. The objective of this study is to use these results as a high explanatory utility to help us recover from this epidemic that has been plaguing thousands of our students by bringing the mathematical preparation of students entering universities from secondary school under scrutiny.

Key Words: Mathematics Course; First-Year Student, Mathematical Preparedness; Performance; Secondary School, Challenges, Mathematical Gap, Focus Group.

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I. Introduction

Mathematics is an indispensable subject because it aids in logical thinking and helps develop our reasoning skills. Mathematics achievement by students, or lack of it, has consequences not only towards the individual but mainly towards national development [1]. Mathematics is required by most programs at universities; thus, students should enter universities with a good mathematical background. The seriousness of this is seen from the fact that students who enter universities with a poor mathematical foundation experience difficulty in progressing in their majors [2]. With the discovery of oil in Guyana, mathematics will play a very critical role since mathematics is required by many professionals in the industry.

First year students represent about one-third of the student population at universities [3]. Many of these students are ignorant of the university's academic expectation of them and are unprepared for what they encounter [4]. Many universities concede that there should be a transition where secondary school prepares these students for first year mathematics at the university [5]. According to Nicholas *et al.* [6], students are entering science degree programmes at universities without the required mathematical background. Ramsden [7] supports the fact that there is an idiosyncratic breach between secondary and university mathematics by indicating that student's learning tactics and content at university are predisposed by what took place at the secondary school. Areas where the breaches are occurring for the students coming into university from secondary school, according to Hoyles, *et al.* [8], are in their thinking, competence and perseverance. The mathematical taught at secondary schools are thought of by academics to be inadequate.

According to Darlington *et al.* [5], many universities are now conceding that there is no exact fit but rather a mathematical gap between secondary school and university. This gap results in poor mathematical thinking and weak calculation competence among students [8]. In Atuahene *et al.* [9] 2016 study, there was support for this idea where their studies showed that the more rigorous the mathematics curriculum in secondary schools the more positive outcomes are achieved by student in university mathematics courses. The greater the mathematical content taken in at secondary school, the more prepared students will be in their first-year mathematics courses at university and often outperforms their peers [6].

The high failure rates as well as low grades in mathematics first year courses of Algebra (MTH 1101) and Calculus 1 (MTH 1202) at University of Guyana (UG), Turkeyen Campus in the Faculty of Natural

Sciences, are causes to sound an alarm to the administrators at UG and to the nation of Guyana. It seems as though this problem has stemmed from student's lack of mathematical preparedness for these courses. This study investigated the mathematical preparedness of students, identified their mathematical preparation issues and concerns and considered whether the skills acquired by them from secondary school are sufficient.

II. Material and Methods

The present study gathered data by the use of a questionnaire, marksheets from the last eight academic years for the courses Algebra (MTH 1101) and Calculus 1 (MTH 1202), interviews, anecdotal notes from students and lecturers and an online survey done by UG on the Students Record Management System (SRMS). These instruments were used to provoke the student's point of view as well as those of the lecturers/tutors and answer questions pertaining to student's mathematical preparedness. A mixed method research design was used for this study to collect quantitative and qualitative data. There is a need to have both qualitative and quantitative methods co-occur in methodology because if one is not there then many answers to questions would remain incomplete. This study applied a practical and result-orientated method of inquiry which helps to eradicate uncertainties [10].

This study's target population was first year university students attending University of Guyana, Turkeyen Campus who were required to take Mathematics from the Faculty of Natural Sciences in the academic year 2019/2020. The population included students who graduated June 2019 from secondary schools in Guyana and registered for their first semester in September 2019 at UG. The sample for this study was selected as a result of purposive sampling. The selection criteria were as follows: the student graduated from a traditional secondary school in Guyana; the student took mathematics up to the CSEC level at secondary school. Participation by students was voluntary.

Data analysis

A questionnaire, the Mathematics Preparedness Questionnaire, on students' experiences in mathematics to capture the level of preparedness in mathematics courses was given. A total of 557 responses from students were received in total from the 2 courses. Also, the online survey done by UG on the Students Record Management System (SRMS) where students assess their lecturers was used to collect data. In 2019, 50 students responded while in 2018, 103 students responded. The qualitative methods included interviews and focus group discussions with the Heads of Departments (HOD) of the three others departments (Biology, Chemistry and Computer Science), who together with the Department of Mathematics, Physics & Statistics make up the Faculty of Natural Sciences. Also, three senior lecturers within the faculty, forty secondary school teachers with more than three years of experience in teaching mathematics and the four current UG lecturers of Algebra and Calculus with over three years' experience in lecturing these courses. In addition, the lecturer's anecdotal notes of observations for the academic year 2019/2020 was used to gather qualitative data. The data was then organized using tables and interpreted using basic statistical tools from excel such as bar graphs and pie charts.

III. Results

Table 1: Performance in the first-year mathematics courses in Faculty of Natural Sciences

Academic year	Total scripts	F grade		A-D grades		A grade	B grade	C grade	D grade	F & D grades combined
		#	%	#	%	%	%	%	%	%
2011/2012	641	241	37.60	400	62.40	11.39	8.58	14.98	27.45	65.05
2012/2013	598	225	37.63	373	62.37	23.41	9.36	18.06	11.54	49.17
2013/2014	650	218	33.54	432	66.46	24.92	12.00	16.92	12.62	46.16
2014/2015	614	179	29.15	435	70.85	24.59	11.57	19.38	15.31	44.46
2015/2016	652	204	31.29	448	68.71	22.24	8.44	18.87	19.16	50.45
2016/2017	613	238	38.83	375	61.17	22.84	8.32	17.45	12.56	51.39
2017/2018	592	287	48.48	305	51.52	10.97	9.46	18.08	13.01	61.49
2018/2019	882	423	47.96	459	52.04	6.58%	7.03	15.08	23.35	71.31
AVERAGE		38.06		61.94		18.37	9.34	17.35	16.88	54.94

Table1 shows the results from the mathematical courses MTH 1101 (Algebra) and MTH1202 (Calculus 1) done at University of Guyana, Turkeyen Campus between September 2011 to August 2019. From the table above, based on the row "AVERAGE", the passing percentage across the eight years is 61.94 %. This passing percentage is below 70%.

Table 2: Results from Students Record Management System for Algebra

ALGEBRA SRMS EVALUATION				
QUESTION	2018/2019		2019/2020	
	MEAN SCORE/7	%	MEAN SCORE/7	%
I was able to cope with the volume of work for the course	5.53	79.0	4.46	63.7
The standard of work met my expectations	5.69	81.3	5.18	74.0
I felt engaged and intellectually stimulated during the classes	5.71	81.6	4.82	68.9
The lecturer found ways to help students understand the content	6.95	99.3	4.9	70.0
The lecturer offered adequate guidance to students	6.03	86.1	5.14	73.4
I felt that the lecturer was interested in the students and their learning	6.06	86.6	5.38	76.9
The tests and assignments were generally well prepared	6.11	87.3	6.06	86.6
The skills and knowledge tested were consistent with what was expected	6.1	87.1	6.08	86.9
I felt my work was graded fairly during the course	6.18	88.3	6.61	94.4
The content indicated in the course outline was covered in the course	6.22	88.9	6.38	91.1

Table 2 shows the results from SRMS for Algebra at University of Guyana, Turkeyen Campus for the academic years 2018/2019 and 2019/2020. From this table, the following were observed: the lowest score came from the question if they were able to cope with the volume of work; no major issue with their tests and marking; no major issue with the content of the course and no major issue with the lecturer helping. Therefore, one can safely conclude that the major reason they were expecting low grade did not really have much to do with the tests, the marking, the lecturer, nor the course itself but rather that they were not prepared for these courses.

Students’ responses to the Mathematics Preparedness Questionnaire

Figure1: Students who came to UG directly from secondary schools.

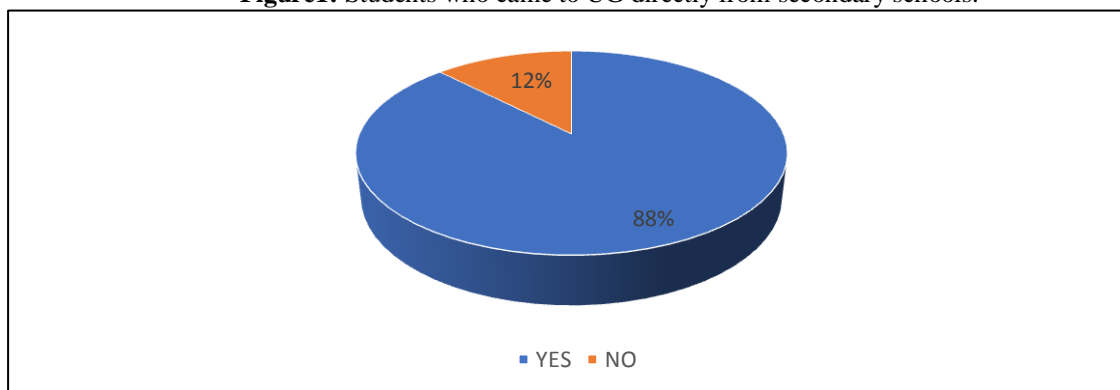


Figure 1 depicts the results of the respondents who came to UG directly from secondary schools.

Figure 2: Number of years students spent between finishing secondary school and entrance to UG

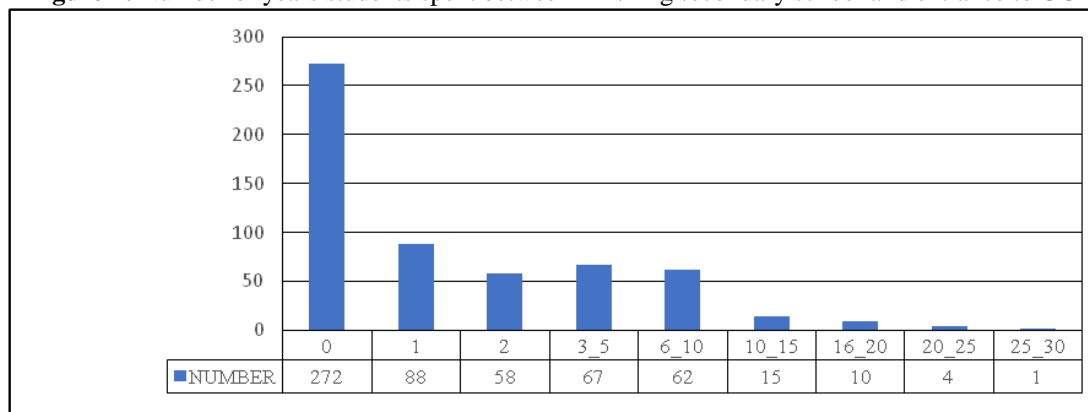


Figure 2 depicts the number of respondents and the years they spent after secondary schools before coming to UG.

Figure 3: Number of times the students are taking the courses.

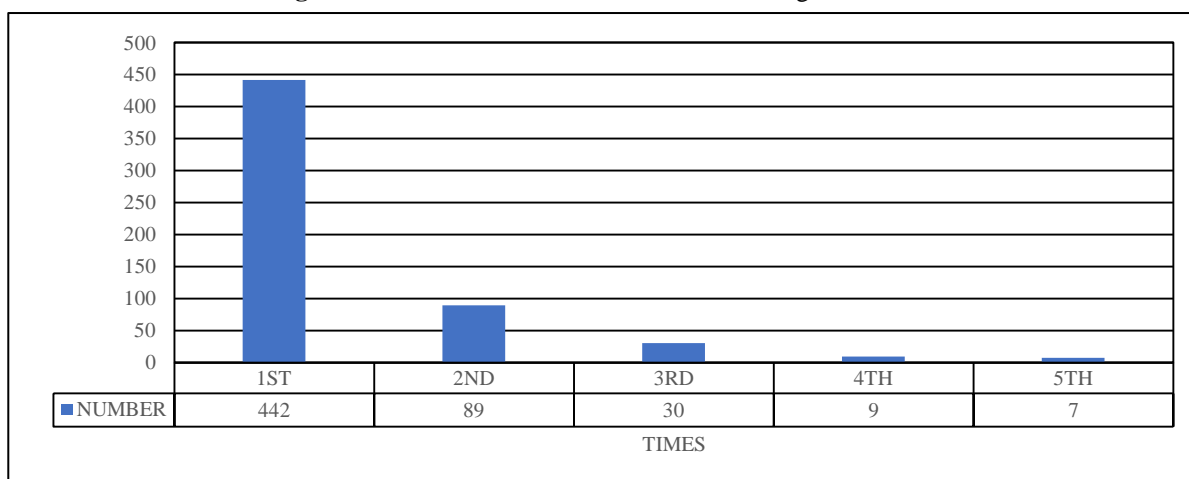


Figure 3 shows the number of respondents and the number of times they are doing the courses.

Figure 4: Lecturing of mathematics at UG resembles that at the secondary school level

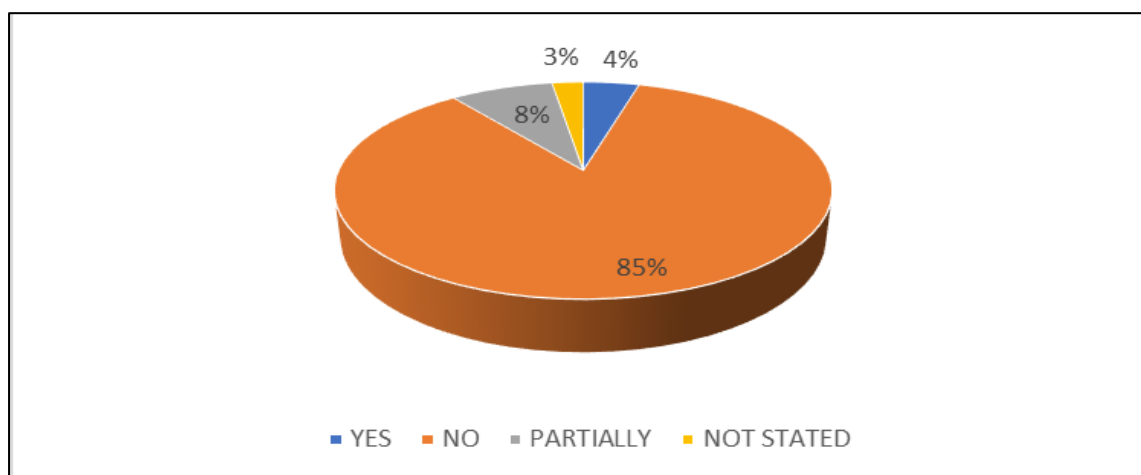


Figure 4 shows the percentages of respondents who think lecturing of mathematics at UG resembles that at the secondary school level.

Figure 5: Mathematical qualifications of the students coming into these courses

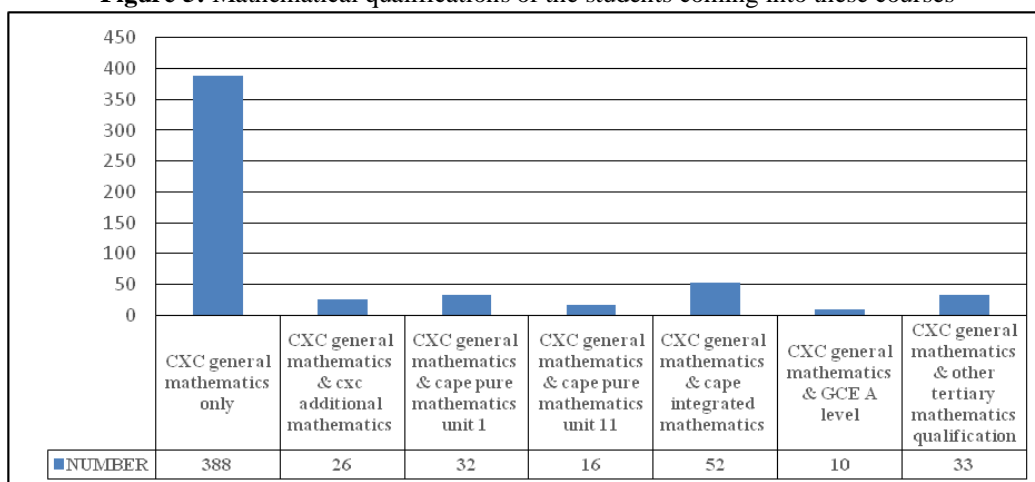


Fig.5. illustrates the mathematical qualifications of the students coming into these first-year mathematics courses.

Figure 6: Challenges encountered regarding the learning of mathematics on these courses

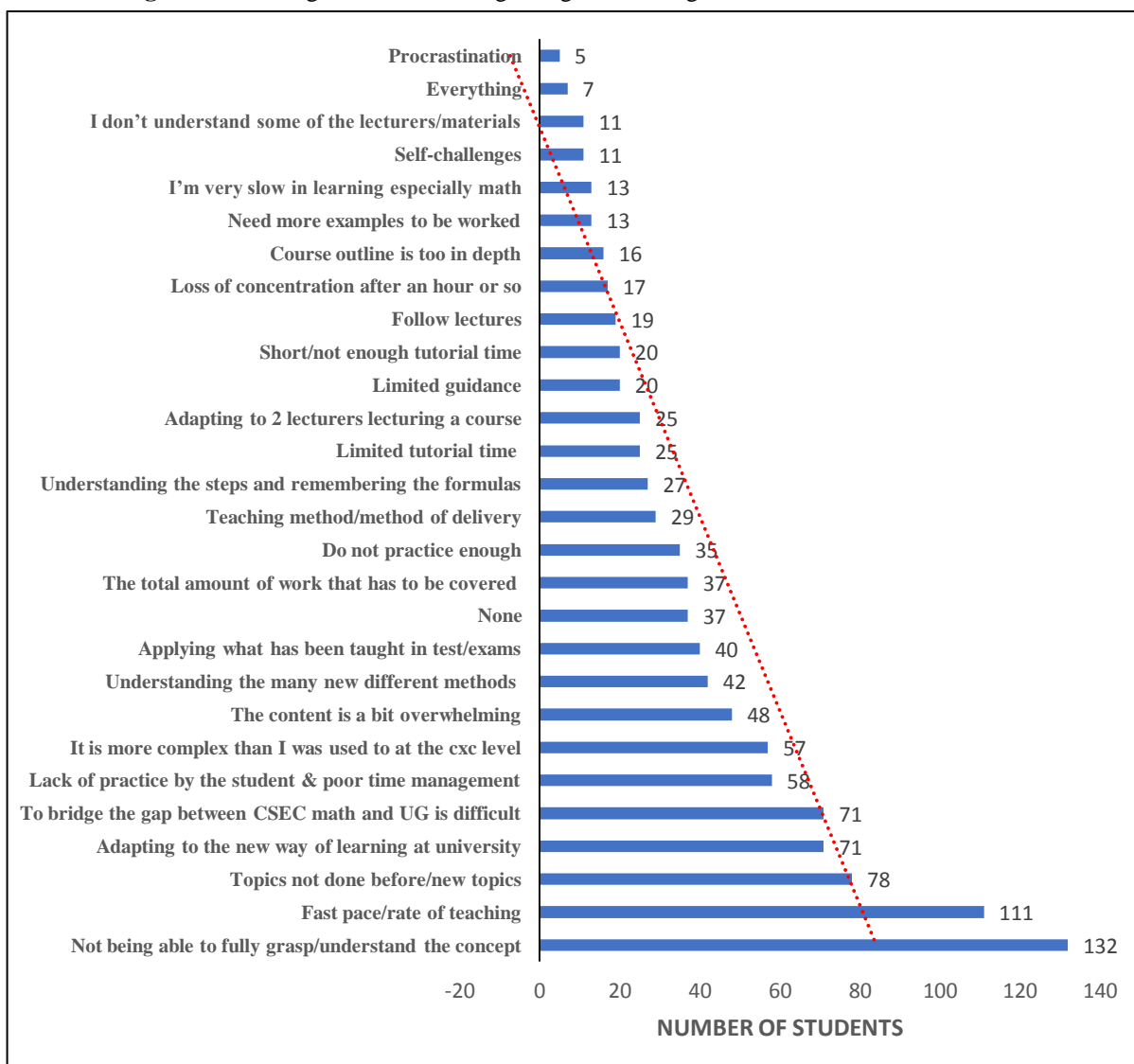


Figure 6 depicts the challenges encountered regarding the learning of mathematics in the courses MTH 1101 (Algebra) and MTH1202 (Calculus 1) done at University of Guyana, Turkeyen Campus.

Figure 7: Teaching of mathematics at secondary school helps to develop strong problem solving, analytical and critical thinking skills needed for these first-year mathematics courses

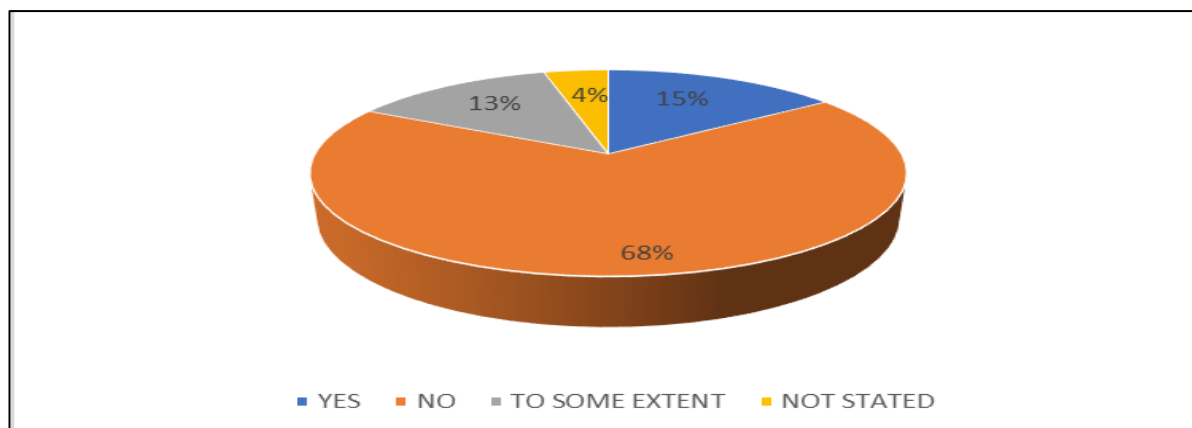


Figure 7 depicts the percentages of the responses to the question of whether students think the teaching of mathematics at secondary levels helps students to develop strong problem solving, analytical and critical thinking skills needed for these first-year mathematics courses.

Figure 8: CSEC Mathematics Grades of the students coming into these courses

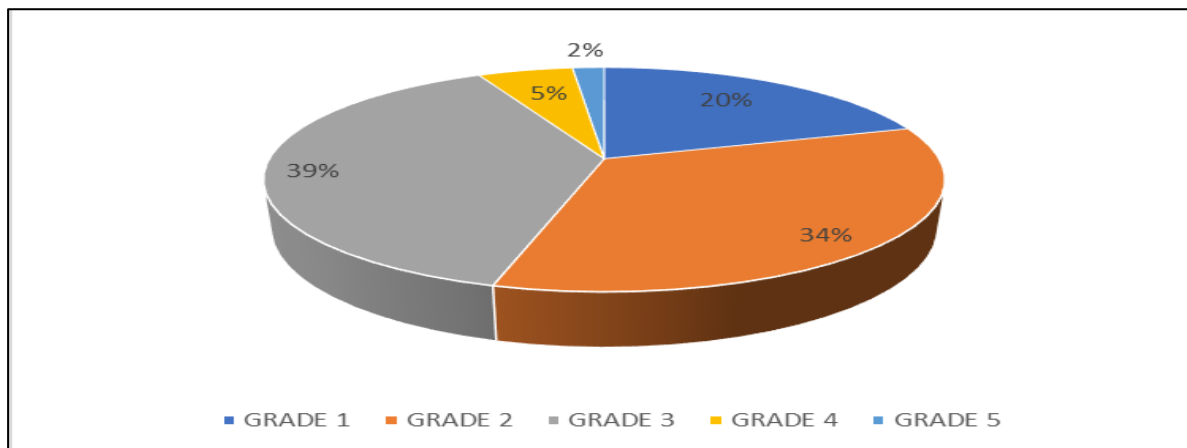


Figure 8 depicts the percentages of the CSEC Mathematics Grades of the students coming into these first-year mathematics courses.

Results of focus group responses to their interviews

Heads of Departments (HODs) -Computer Science, Chemistry and Biology

The HODs believe that the preparation of first year Natural Science students at Turkeyen Campus, entering the University of Guyana directly from secondary school are between 40% and 60%.

Senior lecturers within the Faculty of Natural Sciences

The senior lecturers believe that the preparation of first year Natural Science students at Turkeyen Campus, entering the University of Guyana directly from secondary school are between 40% and 60%.

Teachers at Secondary Schools across Guyana who are teaching Mathematics and have done first year mathematics courses in Natural Sciences

Of 40 teachers spoken to, over the ten administrative regions of Guyana, 60% of them believe that first year Natural Science students at Turkeyen Campus, entering the University of Guyana directly from CSEC are between 20% and 40% prepared to deal with the content of the mathematics courses while the remaining 40% believe that the first year Natural Science students are between 20% and 40% prepared to deal with the content of our mathematics courses.

Lecturers of Algebra and Calculus over the last five years at UG

All the lecturers believe that the first year Natural Sciences students at Turkeyen Campus, entering the University of Guyana directly from secondary schools, are between 20% and 40% prepared to deal with the content of the mathematics courses.

Results from Anecdotal records taken during lectures

During lectures spur-of-the-moment comments made by students concerning their conceptual understanding, their challenges and their preparation for these courses were recorded. I have grouped them into three categories: conceptual understanding, challenges and preparation

Conceptual understanding

Student #1: "This stuff mo hard than I accustom to."

Student #2: "Sir I don't understand this thing."

Student #3: "I'm very slow in learning maths."

Student #4: "I struggling to cope with this work."

Student #5: "Help me Sir. These things new to me"

Challenges

Student #1: "I can't tek this maths for more than an hour."

Student #2: "Sir I don't get the chance to practice."

Student #3: "I struggling with the many new different methods in this math course."

Student #4: "this method of lecturing is strange to me."

Student #5: "I need to get in front, this class is too big"

Preparation

Student #1: "I got to get some outside help."

Student #2: "Sir I get nervous and fearful and end up panic during exam."

Student #3: "I aint come UG fu dis stress."

Student #4: "Sir, these topics giving me licks: graphing, simultaneous and quadratic equations."

Student #5: "Sir, when you go in depth, I does lost"

IV. Discussion

A question of strong dispute concerns how mathematically prepared are our first-year students entering universities [11]. Furthermore, concerns surround these students increasing in numbers but the decreasing in competence in mathematics at universities [12]. Lithner [11] further support this position by stating that real concern lies in the fact that students are coming into universities annually with numbers increasing each year but there are clear signals of diminishing mathematics preparation levels. The problem of transition due to mathematical preparation from secondary to tertiary education can be viewed as the major contributing factor that is evolving into a stumbling block in mathematics [13].

Even though mathematics preparation done in secondary schools is given special attention in the syllabus, the preparation of incoming university students does not resonate this fact [14]. Responsible for this is the changes that takes place from teaching to lecturing, the level of foundational conceptual understanding of students coming into universities, the procedural knowledge and mathematical thinking required by these university courses [14]. Literature seems to suggest that reforms can lead to substantial improvements [11]. However, at the university level it is the preparation of the students and their autonomous attitude towards learning mathematics that will result in significant improvements [13].

Data Analysis of performance

A course that has a passing percentage of less than 70% over a period of seven years can be termed a high-failure rate course [2]. Thus, we can classify Algebra and Calculus 1 as high-failure rate courses. This percentage corresponds with previous studies which shows that over 30% students in first year mathematics courses have scored less than 50% annually [15].

In addition, even though 61.94% of students achieved Grades A-D (passed), 34.23% would have gotten a C grade and D grades. Furthermore, 54.94% of students (more than half the students) got either an F or a D grade. According to Shakerdge [16], based on reports from mathematics associations, 50 % of students don't pass first year mathematics at universities with a grade C or greater. This would have resulted in their Grade Point Average (GPA) being negatively affected and can even result in them having to spend a longer time in the programme since students need to have a GPA above 2.0 in order to graduate.

Correspondingly, it is indicating to us that more than half the class lacks the conceptual understanding of the concepts which are foundation elements to the Faculty of Natural Sciences and their programmes. This is of critical importance since Algebra and Calculus 1 are very important for Computer Science, Networking, Chemistry, Physics, Biology and Mathematics studies [2]. These programmes of study require the mathematics skills gained from the courses Algebra and Calculus. Similarly, it also affects career paths since some students usually come into Natural Sciences with the intent of going over into Health Sciences to do Medicine. However, they must attain a GPA in their first year above 3.4 to be considered. Unfortunately, very few students make it, mainly because of poor grades in Algebra and Calculus. Thus, students are forced to resort to a field of study they did not originally want to do.

Analysis of students' responses using the Students Record Management System (SRMS)

In 2018/2019 students rated the lecturer's performance as 86.9 % which is rated by the system as excellent. The students overall rating of the lecturers was excellent which suggests that this is not a factor affecting their performance. In 2019/2020 students rated the lecturer's performance as 79.8% (excellent). The students overall rating of the lecturers was excellent again suggesting that this is not a factor affecting their performance. Since the lecturing or performance of the lecturer is not a factor affecting student performance then this is an indication that the students are the ones experiencing challenges due to this transition. Literature supports this position where according to Liston *et al.* [5], first year university students find moving from secondary school mathematics to university mathematics a major barrier. In addition, Kantanis [17] describes this transition as a difficult time for the students.

The grades expected by the students in 2018/2019 were as follows: A – 0 %, B – 5 %, C – 19 %, D – 25 % and F – 51 %. The percentage of students expecting to fail was 51% (one in every two students). In addition, 5% are expecting an A or B while 44% are expecting C or D. In 2019/2020 the grades expected by the students were as follows: A – 2%, B – 10%, C – 30%, D – 34%. F – 24%. The percentage of students expecting

to fail was 24% (1 in every 4 students). In addition, 12% are expecting an A or B while 64% are expecting C or D.

Based on the student's estimation of grade, it shows that students are entering UG underprepared in mathematics because the depth or the content of mathematics taken in secondary school was inadequate. In other words, their mathematics experiences did not sufficiently prepare them for the Algebra at UG Turkeyen Campus. This analysis concurs with Hodara [18] whose study showed that students enter university underprepared in mathematics because either the depth or the content of math taken in high school was inadequate. Their study also showed that some students enter university underprepared in mathematics because they either did not master or forgot what they learnt in high school. Additionally, students are performing poorly at university because they are not prepared on entering. Universities need to recognize the gaps that exist in mathematics in the first year [19]. End of course evaluations are important in providing current and future students with the best possible academic experience. It is believed that through these student's open and honest responses about their experiences it will translate to the department which is the body responsible for how the course is executed [20].

Analysis of students' responses to the Mathematics Preparedness Questionnaire

From the results shown in Figure 1, it was observed that 80% of students are coming into UG and the Faculty of Natural Sciences directly from secondary school. This follows the trend that has been widely acclaimed that the proportion of students coming directly from secondary school into universities is currently 70% [21]. Based on performances in these courses and with the evidence of majority of students directly coming from secondary schools, one can question how mathematical prepared are these first year Natural Sciences students entering the University of Guyana, Turkeyen Campus.

Based on the years spent, as shown in the results from Figure 2, the majority of students spent zero years and this was followed by one year. This indicates that the majority of students came directly from secondary school. Based on the results, 360 out of 577 or 62% of the students came to UG within one year of graduating from secondary school. This is consistent with literature that reveals that approximately 67% of secondary school students choose to attend universities inside a single year after completing secondary school [22]. In addition, this can also direct us to say that these students entering UG would have received their mathematical preparation, experiences and skills from their secondary school. Thus, it is important that the secondary school mathematics get the students prepared [5]. However, this preparation is viewed as inadequate for the mathematics courses at universities [15]. Ramsden [7] has reported that the student's approaches at university level are influenced by what they would have received at secondary school. The lack of mathematical preparation has resulted in a conceptual gap that exists [8].

It can be observed, from the results from Figure 3, the majority of students are doing the course for the first time. Thus, this further implies that the only mathematical experiences and skills the students have are what they would have attained from secondary school. On the other side, 23% (135 out of 577) of students have had to repeat these courses. This has both economic, psychological and physiological consequences which will affect both the student and the education system. When a student repeats a course, it demoralizes the student [23].

Based on the results made known in Figure 4, 85% of the students said that the lecturing of mathematics at UG does not resemble that at the secondary school levels. In other words, four out of five students are saying that this did not take place at secondary school and we haven't been exposed to this. Ramsden [7] has reported that what takes place at universities are influenced by what took place at the secondary school. Furthermore, Dana-Kristin et al. [4] said that these students are unaware of what is academically anticipated of them and are not mathematically prepared for what they encounter.

Based on the results, as shown in Figure 5, of the mathematical qualifications of the students, the majority of students (388), which represents approximately three in every five students, just possess CXC Mathematics only. Thus, 67% of student's mathematical preparation would have been CXC Mathematics only from secondary school. In the CXC mathematics syllabus, it can be seen that one of its aim speaks of preparing secondary school students mathematically. Additionally, it says that the syllabus is structured so that students would be mathematically prepared after pursuing Mathematics in secondary school. Furthermore, it goes on to say that its design allows for any student to obtain the foundation necessary to meet the needs of studying Mathematics at an advanced level [26]. Thus, at least all students should be mathematically prepared for the mathematics courses at UG since all the students would have written CXC mathematics. However, the results of this study show this not to be true and hence brings into serious question the mathematical preparation of students coming into UG from our secondary schools. The issue of preparation of students coming into universities is also found in the United States where universities have reported more than 500,000 students are considered not prepared for first year university mathematics [27].

Based on the results revealed in Figure 6, out of the 577 respondents, eight out of the top ten concerns suggest that the students are questioning their mathematical preparedness for UG coming from secondary school with one of the concerns clearly stating that there is a gap between UG and secondary school and they are struggling to bridge that gap. The number one reason given by students is that they are not able to understand or fully grasp the concepts and that has to do with one's mathematical preparedness. Fast pace or rate of lecturing suggests that students are not mathematically prepared for the conditions under which university mathematics courses are done. Many students spoke about adapting to the university which is in synchronization with the fact that they are not mathematically prepared for the conditions under which university mathematics courses are done. Students spoke about the content and indicated they are not mathematically prepared for UG.

Previous studies have shown that students who enter universities with a poor mathematical preparation experience difficulty in progressing in their major [2]. According to Darlington et al. [5], first year university students doing mathematics service courses were lacking in three areas: the ability to confidently and reliably perform algebraic manipulations and simplifications; the logical supremacies required to solve multi-step problems and the understanding of the landscape of undergraduate mathematics courses. According to Dana-Kristin et al. [4], students enter universities with different levels of insights and outlooks regarding mathematics at universities and research has shown a misalliance between their what they believe and what truly exists. Furthermore, Dana-Kristin et al. [4] indicates that studies has shown that students enter universities unprepared mathematically and have challenges in ensuring they meet personal requirements as well as those of the lecturers. Students who graduate from secondary school want to have the guarantee that they are ready to meet the challenges of a university courses [24]. Since the only mathematical experiences and skills the students have are what they would have attained from secondary school there exists a incongruity between student's belief of their preparation and what lecturers believe it should be upon entering universities.

From the results shown in Figure 7, 68% percent of students said that they think the teaching of mathematics at secondary levels does not help them to develop strong problem solving, analytical and critical thinking skills needed for these courses. This is a contradiction to the purpose of the secondary school in terms of preparing the students for these mathematics courses. According to UNESCO IBE [25], the main purpose of the secondary school is to provide students with opportunities to acquire the skills and attitudes that would equip them for university and other tertiary institutions. Students arrive at postsecondary institutions from secondary schools with deficits in mathematics and this is due to inadequacy in content taught to the students or their non-mastery of the content. Furthermore, Dana-Kristin et al. [4] indicates that studies have shown that students entering universities have no idea of the expectation of the universities and are unprepared.

According to Caribbean Examination Council [28], an examination of what these grades should mean in terms preparation are as follows: Grade 1 represents a comprehensive grasp; Grade 2 signifies a good grasp; Grade 3 characterizes a fairly good grasp; Grade 4 embodies a moderate grasp; Grade 5 epitomizes a limited grasp and Grade 6 denotes a very limited grasp. From the results shown in Figure 8, 39% (approximately two in every five students) are coming in UG possessing a grade 3 which suggests just a fairly preparation. Even more shuttering is that additionally 5 % possess a grade 4 or have a moderate grasp and 2% have a grade 5 or are limited in their mathematical preparation. Thus, 46% of students are coming in these first-year mathematics courses with a fair or below mathematical preparation that is supposed to prepare them for the transition to the first-year mathematics courses at UG.

According to Darlington et al. [5], anxieties are upstretched over first year students arriving at universities with deficient mathematics preparation. According to Nicholas et al. [6], students are entering science degrees programmes at universities without the required mathematics background. According to Spencer-Ernandez et al. [29], over the decade spanning from 2008 to 2018, approximately 59% of the candidates who wrote the CSEC Mathematics achieved a failing grade. Further, the passing grade that students most frequently obtained was a Grade 3, which is the lowest grade in the pass band. This poses serious concerns for all stakeholders and questions the mathematical preparation that these students are receiving. This question of mathematical preparation has far-reaching implications for Guyana as well as the Caribbean and its peoples since as a people we would be unable to achieve optimal economic growth to fully harness the opportunities that have emerged [30].

Discussion of focus group responses to their interviews

Secondary school education is accepted as the route to facilitates access to university-level study [31]. Mathematical preparation at the secondary school level is the foundation needed to successful complete first year mathematics courses at universities. Heads believe this is currently lacking and that there exist increased gaps in students' knowledge, skills, abilities and interests [32]. Students who take mathematics courses at universities, find major difficulties in the transition from secondary schools. This difficulty is prevalent

irrespective if they are doing these courses as their major or as a service course [13]. This is also supported by lecturers of these courses who describes the shift as difficult for students [13].

Heads of Departments (HODs) -Computer Science, Chemistry and Biology

The reasons for choosing between 40% and 60%. are: many of the students struggle with concepts that based should have been covered in secondary school; there exists an opening and there is no bridge course to overcome the lack of fundamental knowledge in mathematics when students join university.

Senior lecturers within the Faculty of Natural Sciences

The reasons for choosing between 40% and 60%. are: the exposure level of the contents in high schools to the students is not that impressive and we are witnessing knock-on effects from a poor foundation at secondary school.

Teachers at Secondary Schools across Guyana who are teaching Mathematics and have done first year mathematics courses in Natural Sciences

The reasons for 60% choosing between 20% and 40% and 40% between 20% and 40% are: The secondary school syllabus does not fully provide the background knowledge for university mathematics courses; many teachers at secondary schools teach students "how to pass" rather than concept teaching; the gap between secondary school and UG is extremely wide; teachers at secondary schools teach only those topics in the syllabus that they are comfortable with; students are somewhat not accustomed to being independent and students are not prepared for the transition from "teacher methods" to "lecture methods".

Lecturers of Algebra and Calculus over the last five years at UG

The reasons for choosing between 20% and 40%. are: Reasons are: students are not exposed enough to reasoning problems and situations. CSEC teachers employ more of a drill and practice method to get pass grades; there exists an opening between secondary school and entering UG; at secondary schools, mathematics is taught to the students in a recitative manner. Students are not prepared for the reasoning and lack understanding and intuition which is necessary to cope with the mathematics program at UG and the skills acquired at high school are not sufficient for them to handle those two first year courses.

Discussion of Anecdotal records taken during lectures

From the conceptual understanding observations, one may conclude that these students are having trouble to understand the concepts taught. This observation can be linked to them not being mathematically prepared for the mathematical content as well as the methodology used in the course. Studies have shown a link between students' mathematical preparation and their approach further studies. This conception is crafted both by students and lecturers. Lecturers already have a prearranged outset of first year students' mathematical preparation [15]. This conception is based on the datum that students coming out from high school should possess a certain level of mathematical ability and knowledge. Areas where the breaches are occurring for the students coming into university from high school, according to Hoyles *et al.* [8], are in their thinking, competence and perseverance.

From the challenges category observation notes, one may conclude that these students are not prepared to cope with university life. This would seem to stem from them not being mathematically prepared for skills as well as the thinking required for these courses.

From the preparation notes, these students are not mathematically prepared to cope with these courses. These reactions are consistent with lack or insufficient preparation. Based on studies, more than 70% of students agree that they prefer the secondary school style and 66% say that they are not clear on what is expected of them. Many students also suggest that they lack mathematical preparation from their secondary schools [13].

V. Conclusion

In an era of the importance of mathematics, mathematical preparation is needed so that students are able to transition from secondary schools to universities. It is important that we focus on the mathematical preparation of our students so that we are able to guide them to mathematical success. There is a need for crucial pronouncements on this issue and this paper provides much clerical evidence for all stakeholders to develop multiple pathways to fully address this issue. It was revealed that more than 50% of the secondary school graduates are not mathematically prepared for the mathematics courses at UG. They are quick to identify gaps in their mathematical preparation of what they have and what is expected of them. This study points out that directly coming from secondary school can influence mathematical preparedness of first year Natural Sciences students entering the University of Guyana, Turkeyen Campus. In addition, it reveals that the methodology used by lecturers, the mathematical content required, the mathematical skill needed, the mathematical experiences they should have, the mathematical content they should be in possession of, are all

essential towards mathematical preparedness of first year Natural Sciences. Furthermore, the study clearly shows that the challenges to learning encountered by first year Natural Sciences students are as a result of their lack of mathematical preparedness for the courses. Finally, the study exposes the fact that if students are better prepared for the Algebra and Calculus 1 courses in Natural Sciences at University of Guyana, Turkeyen Campus their performance in their degree programme would be better.

References

- [1] J. Murray, "The Factors that Influence Mathematics Achievement at the Berbice Campus," *International Journal of Business and Social Science*, vol. 4, no. 10, pp. 150-164, 2013.
- [2] H. T. Eng, L. V. Li and N. H. B. Julaihi , "The Impact of 'High-Failure Rate' Mathematics Courses on UiTM SARAWAK Full-Time Diploma Students' Academic Performance," UiTM, Shah Alam, Malaysia, August 2008.
- [3] J. Engle, "Postsecondary Access and Success for First-Generation College Students," *AMERICAN ACADEMIC*, vol. 3, pp. 25-48, 2007.
- [4] M. Dana-Kristin and D. Ifenthaler, "Students' perceptions toward academic competencies: The case of German first-year students," *Issues in Educational Research*, vol. 28, no. 1, pp. 120-137, 2018.
- [5] E. Darlington and J. Bowyer, "Undergraduate Mathematics students' views of their pre-university mathematical preparation," *RESEARCH MATTERS*, no. Issue 24, pp. 2-11, AUTUMN 2017.
- [6] J. Nicholas, L. Poladian, J. Mack and R. Wilson, "Mathematics preparation for university: Entry, pathways and impact on performance in first year science and mathematics subjects," *International Journal of Innovation in Science and Mathematics Education*, vol. 23, no. 1, pp. 37-51, 2015.
- [7] P. Ramsden, "Learning to teach in higher education," *Studies in Higher Education*, vol. 18, no. 1, pp. 105-111, 05 Aug 2006.
- [8] C. Hoyles, K. Newman and R. Noss, "Changing patterns of transition from school to university mathematics," *Changing patterns of transition from school to university mathematics*, vol. 32, no. 6, pp. 829-845, 2001.
- [9] F. Atuahene and T. A. Russell, "Mathematics Readiness of First-Year," *JOURNAL of DEVELOPMENTAL EDUCATION*, vol. 39, no. 3, pp. 12-32, SPRING 2016.
- [10] A Study of Dominican Secondary Mathematics Teachers' Explanations of Factors Affecting Their Instructional Practices, MEd thesis submitted to the University of Alberta.
- [11] J. Lithner, "University Mathematics Students' Learning Difficulties," *Education Inquiry*, vol. 2, no. 2, pp. 289-303, 2011.
- [12] A. Smith, "Making mathematics count : the report of Professor Adrian Smith's inquiry into post-14 mathematics education," February 2004. [Online]. Available: <https://dera.ioe.ac.uk/4873/1/MathsInquiryFinalReport.pdf>. [Accessed 20th March 2021].
- [13] M. De Guzman, B. R. Hodgson, A. Robert and V. Villani, "Difficulties in the Passage from Secondary to Tertiary Education," *Proceedings of the International Congress of Mathematicians*, vol. III, pp. 747-762, 1998.
- [14] Y. Yoon Hong, S. Kerr, S. Klymchuk, J. McHardy, P. Murphy, S. Spencer, M. Thomas and P. Watson, "Teachers' Perspectives on the Transition from Secondary to Tertiary Mathematics Education," *MERGA*, vol., pp. 241-248, 2009.
- [15] M. Liston and J. O'Donoghue, "The transition from secondary school mathematics to university mathematics," in *the British Educational Research Association Annual Conference, Institute of Education, University of London*, London, 2007.
- [16] K. Shakerdge, "The Hechinger Report: High failure rates spur universities to overhaul math class," 6 May 2016. [Online]. Available: <https://hechingerreport.org/high-failure-rates-spur-universities-overhaul-math-class/>. [Accessed 5th March 2021].
- [17] T. Kantanis, "The role of social transition in students' adjustment to the first-year of university," *Journal of Institutional Research*, pp. 100 - 110, 2000.
- [18] M. Hodara, "Improving Students' College Math Readiness: A Review of the Evidence on Postsecondary Interventions and Reforms," Center for Analysis of Postsecondary Education and Employment (CAPSEE), Columbia University, New York, 2013.
- [19] Loughborough University, "Trying to make it all add up: preparing young people for the mathematical demands of university," 15th February 2015. [Online]. Available: <https://www.futurelearn.com/info/blog/mathematical-skills>. [Accessed 10th March 2021].
- [20] E. Honore, "The Signal: Why students should complete their end of course evaluations," 6 May 2019. [Online]. Available: <https://www.uhclthesignal.com/wordpress/2019/05/06/why-students-should-complete-their-end-of-course-evaluations/>. [Accessed 10th March 2021].
- [21] J. Marcus, "More high school grads than ever are going to college, but 1 in 5 will quit," 5th July 2018. [Online]. Available: <https://hechingerreport.org/more-high-school-grads-than-ever-are-going-to-college-but-1-in-5-will-quit/>. [Accessed 1st March 2021].
- [22] J. Bustamante, "Percentage of High School Graduates That Go to College," 7th September 2019. [Online]. Available: <https://educationdata.org/high-school-graduates-who-go-to-college>. [Accessed 1st March 2021].
- [23] A. B. Fong, K. Jaquet and N. Finkelstein, "Who repeats algebra I, and how does initial performance relate to improvement when the course is repeated?," U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory West., Washington, DC, November 2014.
- [24] N. McCormick and M. S. Lucas, "Exploring mathematics college readiness in the United States," . *Current Issues in Education*, vol. 14, no. 1, pp. 1-27, 2011.
- [25] UNESCO IBE, "International Bureau of Education of UNESCO," August 2006. [Online]. Available: http://www.ibe.unesco.org/fileadmin/user_upload/archive/Countries/WDE/2006/LATIN_AMERICA_and_the_CARIBBEAN/Guyana/Guyana.htm. [Accessed 25th February 2021].
- [26] CARIBBEAN EXAMINATIONS COUNCIL , "Caribbean Secondary Education Certificate Mathematics Syllabus," Caribbean Examinations Council, Jamaica, 2010.
- [27] S. Butrymowicz, "Most colleges enroll many students who aren't prepared for higher education," 30 January 2017. [Online]. Available: <https://hechingerreport.org/colleges-enroll-students-arent-prepared-higher-education/>. [Accessed 26th February 2021].
- [28] Caribbean Examination Council, "CXC," 9 October 2015. [Online]. Available: <https://www.cxc.org/ever-wondered-candidates-work-graded/>. [Accessed 26 February 2021].
- [29] J. Spencer-Ernandez and L. George, "Single Sex VS. Co-Educational High Schools: Performance of Caribbean Students Across School Types in Mathematics on the Caribbean Secondary Education Certificate," *Caribbean Educational Research Journal*, vol. 4, no. 2, pp. 96 - 121, September 2016.
- [30] P. Carnevale, N. Smith and M. Melton, "STEM State Level Analysis," 2018. [Online]. Available: <https://files.eric.ed.gov/fulltext/ED525307.pdf>. [Accessed 1st March 2021].

- [31] J. De Lisle, "SECONDARY SCHOOL ENTRANCE EXAMINATIONS IN THE CARIBBEAN: Legacy, Policy, and Evidence Within an Era of Seamless Education," *Caribbean Curriculum*, vol. 19, pp. 109-143, 2012.
- [32] V. Knight , "Universalising Secondary Education in the Caribbean: Contrasting Perspectives," *Caribbean Educational Research Journal*, vol. 4, no.1, pp. 97-114, 2016.

Antalov Jagnandan. "An Investigation into the Mathematical Preparedness of First Year Natural Sciences Students at the University of Guyana, Turkeyen Campus." *IOSR Journal of Research & Method in Education (IOSR-JRME)*, 11(4), (2021): pp. 40-51.