Student Performance in Mathematics in the Pacific Senior Secondary Certificate (PSSC) and the Samoa Secondary Leaving Certificate (SSLC) Examinations from 2006 to 2019: A Critique Analysis

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Abstract

This paper discusses the student performance in Year 13 mathematics in Sāmoa over the 14 year period from 2006 to 2019. It is based on archival data of the official results of the Pacific Secondary School Certificate (PSSC) 2006 - 2012 and the Sāmoa Secondary Leaving Certificate (SSLC) 2013 - 2019 national examinations. The analysis finds that the assessment methodology in mathematics by where all students in all disciplines are assessed by the same topics even though some of the topics are more difficult or irrelevant to their field of studies. The paper argues that to fix the low student performance in mathematics the assessment methodology should be changed. The teaching and assessment of college mathematics especially Year 12 and Year 13 should be streamlined into major maths and basic maths rather than the general-mathematics-for-all approach. The streamlined to place good students in mathematics to take major maths while the below average students to take the basic maths. This would clearly show the real ability and performance of students in mathematics and provide a better way to monitor and assess the students overall performance and rating in the maths national examinations.

Keywords: mathematics, trend, assessment

Introduction

The research paper assessed and analysed the Pacific Senior Secondary Certificate (PSSC) and Sāmoa Secondary Leaving Certificate (SSLC) mathematics examination results from 2006 to 2019. The year 13 national examination called PSSC was usually set by The South Pacific Board for Educational Assessment (SPBEA) in Fiji until 2013. From 2013 to now the examination is locally set by Samoa and called the SSLC. This paper discussed and shared the progressions, obstacles and challenges encountered in the last 14 years with the PSSC and SSLC national examination results. Mathematics is useful and indispensable in life, yet it is the least preferred subject due to the mathematical formulas, methods of calculations, deductions, set of theories, and applications are not easy. The maths in PSSC and SSLC national examinations has low pass rates. This study analysis rejects the ability of students to grasp the course content or the technique and methodology of teaching the lessons as the major problem. However, the study found that the assessment system of mathematics subject was and is the main issue.

In Samoa, the year 12 and year 13 students are studying the entire maths course which is unfair and hard for the weak students in mathematics. It should be better to divide the maths course subject into major maths and basic maths. The major maths to have topics like concepts in numbers, algebra, geometry, trigonometry, probability and statistics and calculus, while the basic maths to have decimals, fractions, graphs, integers and rational fractions, measurements, number series, percent, simple algebra, powers, exponents and roots. The students taking science subjects of biology, chemistry and physics do

major maths, while others in arts, commerce and general courses to do the basic maths or general maths. Then the SSLC should set two national examinations papers for major maths and basic maths. Only then, a clear average rating marks for SSLC mathematics exam would be shown for how well or poor the students are performing. Currently all students in year 12 and 13 are studying only one mathematics course and sitting one mathematics national exam paper. In doing so, the weak students in maths who are struggling are pushing the average marks of mathematics down. So in the last 14 years the results of PSSC and SSLC examinations are not good - showing more poor performance of the students. Since the college students are streamlined into four major disciplines of arts, commerce, general and science in the mid-1990s, so the maths course should have been divided into major maths and basic maths.

Without doing so, the mathematical assessment continue to have negative effects on students' performance. This issue needs to be addressed before looking at other factors affecting the students' performance like the syllabus contents, delivery of lessons, parents' support, and student study environment. For ease of reference, the paper set the backdrop of importance of maths in the day-to-day and work, the method of data collection, the research findings and discussion and conclusion.

Mathematics Significant and Relevant to Life

Humans are the most intelligent beings where mathematics helps them to understand the world and provide an effective way of building their mental discipline. Math encourages the logical reasoning, critical thinking, creative thinking, abstract thinking, problem-solving ability, and effective communication skills (LaMar et al., 2020). Mathematics is a powerful tool for global understanding and communication that organizes the humanity and prevents chaos. Mathematics plays a vital role in all aspects of life, whether in everyday matters such as time tracking, driving, cooking, or jobs like accounting, finance, banking, engineering, and software (Boaler et al., 2018). These functions require a strong mathematical background, and scientific experiments by scientists need mathematical techniques (Arthur et al, 2018). They are a language to describe scientists' work and achievements. As for mathematical inventions, they are numerous throughout the ages. Some of them were tangible, such as counting and measuring devices. Some of them are not as tangible as methods of thinking and solving. The symbols that express numbers are also one of the most important mathematical inventions (Boaler and Selling, 2017).

Mathematics helps in analytical thinking. While solving math problems, data are collected, disassembled and then interconnected to solve them. Mathematics helps to develop the ability to think, helps explain how things work, helps to develop wisdom, increases the speed of intuitive, helps to make the child smarter, important in a constantly evolving world and provides exploration and inventions opportunity to the humanity (Altay et al, 2017). Mathematics is the pillar of organized life for the present day. Without numbers and mathematical evidence, we cannot resolve many issues in our daily lives. There are times, measurements, rates, wages, tenders, discounts, claims, supplies, jobs, stocks, contracts, taxes, money exchange and consumption. In the absence of sorting and arranging these things through mathematical calculation the society will interface with confusion and chaos (Selbach-Allen et al., 2020).

The mathematics has become the companion and support of humans since their existence on planet earth. First human wanted to answer the questions of "How many?" that person invented math (Barbagallo et al., 2018). Then algebra was invented to facilitate calculations, measurements, analysis, and engineering. The science of trigonometry emerged when humans wanted to locate high mountains and stars. The knowledge of mathematics developed when human felt the need to plan, count, subtract, multiply, calculate and understand the day to day life and activity (Mulwa, 2015). Mathematical rapprochement is necessary for any process, so anyone wants to reach the height of life, should not ignore and disregard the mathematics (He et al., 2021).

Mathematics is deeply related to the natural phenomenon, the way to solve many secrets of nature. Mathematics is necessary to understand the other branches of knowledge. All depend on mathematics in one way or another. Without mathematics the science and art would not be understood well, as it is the key to other disciplinary studies (Selbach-Allen et al., 2020; He et al., 2021). The discipline and mastery of any science or art are very much related to the size of mathematics. The most valuable thing in math is using it in everyday life. No one can play any entertainment game without using numbers or practice any sport without using numbers or work without using numbers or enter the store without using the numbers or organizing players without using numbers Arthur et al., 2018; Altay et al., 2017). The importance of mathematics is that it is a method based on research and analysis, to reach the desired results, and is used for calculation and presentation of data; not only the use of this science in a particular field but the use of all areas of life and different sciences (Boaler and Selling, 2017).

Why Students Find Mathematics Difficult?

Gallup in 2005, conducted surveys asked the students to specify the subject name that they find the most difficult. Unsurprisingly, maths is the subject that students find the most difficult. Why students find maths as a nightmare? Math is a very abstract subject (Cevikbas and Kaiser, 2021). For students, learning usually happens best when they can relate it to real life. In the early years of school the students are required to learn the fixed and standardized formal procedures and rules of mathematical methods like add, subtract, divide and multiply numbers (Forslund et al., 2021).

This is where students stray from mathematical mind-sets. As math becomes more advanced and challenging, that can be difficult to do. As a result, many students find themselves needing to work harder and practice longer to understand more abstract math concepts. Dyscalculia is a learning difficulty that causes students to struggle with formulas, shapes, and number-related concepts (Sekao and Engelbrecht, 2021). This makes it difficult for them to understand and process math problems. These students usually fall far behind their peers in math and have trouble with number-related problems that do not improve with ongoing practice. Students with math anxiety do not simply dislike math (Boaler et al., 2016).

For them, math causes debilitating feelings of fear and failure that hurt their ability to perform. The pressure and lack of confidence make these students feel when faced with math causes their brain to freeze and forget the things they do know. Math challenges are not always a result of a learning difficulty (Boaler, 2008).

For many students who struggle with math, it is because they do not have the proper foundation needed for success (Nurnberger-Haag et al., 2021). Math is a cumulative subject where everything builds on what came before. The students need to know the basics before they move onto new topics. If the students start to fall behind in one area, it can be very difficult to make sense of advanced concepts without understanding the foundational knowledge (Makhubele, 2021). Math is not something that students automatically understand it. It takes time and practice to understand math. Since many students do not enjoy math, getting them sitting down and practice can be a struggle. Without practice, students struggle to understand because they do not know how to handle and comprehend the basic math (Watanabe, 2021).

For many students, math is a subject where they simply memorize concepts and formulas without really understanding them (Akhter and Akhter, 2018). This may work for a while, but as they progress and encounter more difficult problems, many find that they do not know how to solve them because they do not have the problem-solving skills they need to tackle these new problems (Sekao and Engelbrecht, 2021).

This leads them to losing interest, confidence and falling behind from math. When students expect math to be difficult, they quickly give up when they do not understand something (Watanabe, 2021). A negative mind-set quickly turn into a cycle of low confidence, less motivation, and poor performance (Sekao and Engelbrecht, 2021).

Mastering Maths Requires Efforts

Our brains develop important neural pathways for processing information and mathematics plays an important role in brain development and analytical skills (Li and Schoenfeld, 2019). Understanding mathematics and arrive at the logical solutions will able to prepare the mind to deal and handle the real problems. In capturing critical and analytical skills will help the person to live well in this chaotic society, so mastering math is crucial for living. Mastering mathematics required math teachers to understand and know different applications and strategies to motivate and drive students into establishing and having mathematical mind-set (Boaler et al., 2016).

The brain develops important neural pathways for processing information so it is no surprise that mathematics plays an important role in brain development and analytical skills. When students are able to understand mathematics and arrive at the logical solutions, they will be able to prepare their minds deal and handle real problems. The neuroscientific evidence shows that the human brains have enormous capacity to grow and change at any stage of life (Boaler et al., 2016). Sarah Flannery, who won Europe's Young Scientist of the Year Award in 1999 for inventing a new mathematical algorithm, talks about the way she developed her mathematical thinking from working on puzzles at home with her dad. These puzzles were more important to her than all of her years of math class (Boaler, 2008).

Math to see it as a broad landscape of unexplored puzzles in which students can wander around asking questions and thinking about the relationships (Boaler, 2008; Foster, 2022). This will develop their inquisitiveness to learn and know more about mathematics. When students see mathematics as a set of

ideas and relationships and think about these ideas, they have a mathematical mind-set. The best and most important way is to encourage students to play with numbers and shapes, thinking about what patterns and ideas they can see (Mainali, 2021). They approach math with the desire to understand it and to think about it, and with the confidence that they can make sense of it. Successful math users approach math with a mathematical mind-set, knowing that math is a subject of growth and that their role is to learn and think about new ideas. The mathematical mind-set needs to be instilled into students from their first experiences of math to motivate and draw their attention into liking and exploring mathematics (Sachdeva and Eggen, 2021).

Schools are responsible for the graduation of creative students capable of development in all aspects of life. There should be a strong relationship between studying mathematics and increasing creative thinking where teachers give the students opportunity to think creatively in classroom (Mulwa, 2015). Providing an effective environment for thinking in classroom like order of students, type of questions, clarity of the lesson, effective feedback, relationship of teacher and student, good exchange of communication and information will establish a good learning environment for mathematics (Mainali, 2021; Foster, 2022). Such setting will pull and create discussion in the classroom and give the opportunity to students to share their ideas, experiences, skills and knowledge with each other (Boaler et al., 2018).

Methodology

A longitudinal study of correctional research involved looking at the Pacific Senior Secondary Certificate (PSSC) and Sāmoa Secondary Leaving Certificate (SSLC) mathematics examination results from 2006 to 2019. The longitudinal quantitative data analysis simply means analysing data that is numbers-based – or data that can be easily "converted" into numbers without losing any meaning (Danioni et al., 2021). The quantitative analysis is generally used for three purposes. It is used to measure differences between groups, to assess relationships between variables and to test hypotheses in a scientifically rigorous way (Albers, 2017). The quantitative data analysis used these three purposes through analysing numbers where all involved statistics. The statistical analysis form the quantitative analysis and can vary from basic calculations like averages and medians to more sophisticated analyses like correlations and regressions (Abuhamda et al., 2021).

The statistical analysis has two main branches of statistical methods that are descriptive statistics and inferential statistics (Abuhamda et al., 2021). In research descriptive statistics can be used or both descriptive and inferential can be used depending on trying to find and identify the subject at hand (Knottnerus and Tugwell, 2018). In this research both the descriptive and inferential statistics were utilized where the data set of sample inferences about the year 13 students' population. The inferential was utilized to make prediction and establish explanation about how well the year 13 students performed in the PSSC and SSLC mathematics national examinations from 2006 to 2019. The inferential statistics connect the dots and provide explanation and predication on the mathematics examination results for year 13 students based on the observation sample data. The inferential statistics used in this analysis to test the hypotheses that predict the differences in the year 13 examination results.

Sampling

The quantitative research focuses on gathering numerical data and generalizing it across groups of people or to explain a particular phenomenon. It focuses on numeric and unchanging data and detailed, convergent reasoning rather than divergent reasoning. The quantitative research method of numerical analysis data was used by collecting and analysing the official archival data of examination results from Pacific Secondary School Certificate (PSSC) 2006 – 2012 and the Sāmoa Secondary Leaving Certificate (SSLC) 2013 – 2019. It is the same national examination where it used to be called PSSC till 2012 when its name changed to SSLC.

Data Collection

An average of 70 percent of the Year 13 student population or around 1200 students who sit for the national examination each year studied mathematics. The purposive sampling was used where all year 13 students who sit 2006 to 2019 national examination were used. The intention and the purpose of the study is to identify how well the year 13 students are doing in the mathematics national examination compare to other subjects. The setting of year 13 examination, sitting for the examination, collecting examination papers, marking them and entering into the computer then this pre-existing data from the Ministry of Education, Sports and Culture was extracted and analysed. The overarching issue to classify the features, count them, and construct statistical models in an attempt to explain what has been collected and observed.

Data Analysis

The examination results from PSSC 2006 – 2012 and SSLC from 2013 – 2019 from accounting, history, geography, economic, biology, chemistry, physic, English and mathematics were analysed and average passing rates put into table and put into graph to see how well year 13 students performed each year in each subject from 2006 to 2019. The failure average rates was also analysed and put into table and put into graph to see how year 13 students performed each year in each subject from 2006 to 2019. Each subject was graphed to see how many students passed or failed from 2006 to 2019. Total number of math students enrolled into each discipline namely commerce, arts, science and general was analysed and put into table from 2006 to 2019, then their enrolment was graphed to see it clearly.

The maths passing rate of students in each discipline was analysed and put into table from 2006 to 2019 then graphed to show how many passed. While at the same time the failure rate of students in each discipline was analysed and put into table from 2006 to 2019 then graphed to show how many failed. A graph developed for each discipline from 2006 to 2019 showed how many students in that discipline passed or failed mathematics examinations.

Findings

The findings analysed and explained the PSSC 2006 – 2012 and SSLC from 2013 – 2019 examination results in accounting, history, geography, economic, biology, chemistry, physic, mathematics and English. It

further looked at how good or bad students in each discipline of commerce, science, arts and general have performed in mathematics national examinations from 2006 to 2019 then focused primarily at math subject of how many year 13 students passed and failed their examinations.

Figure 1:PSSC and SSLC Passing Rate from 2006 to 2019

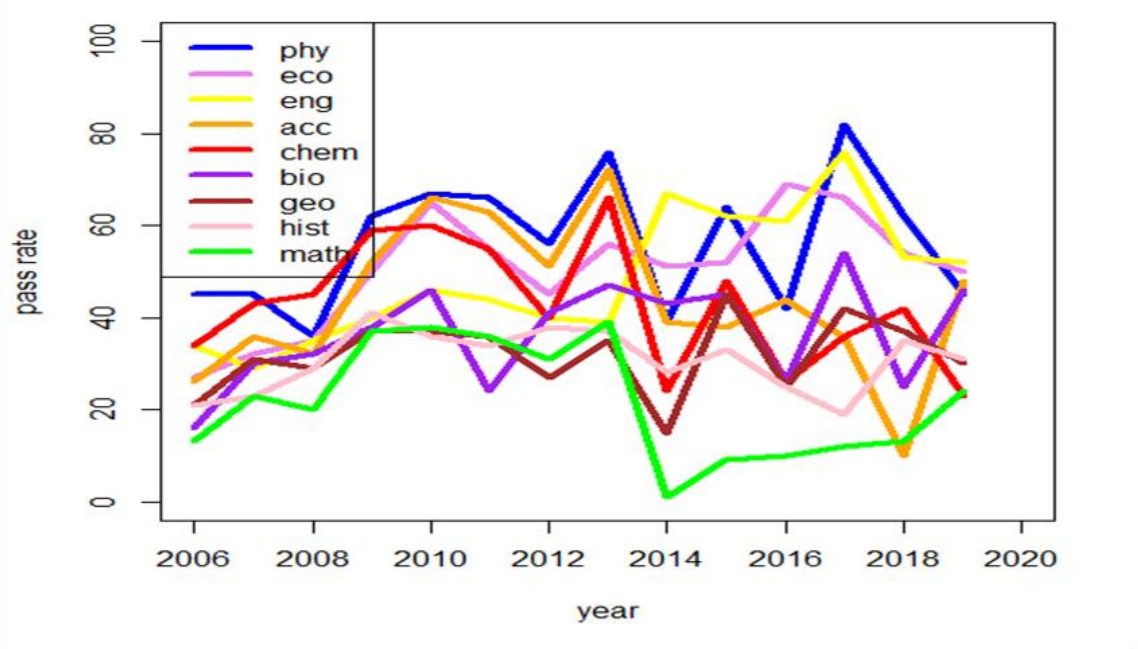


Table 1: PSSC Passing Rate from 2006 – 2019 and SSLC Passing Rate from 2013 - 2019

	PSSC (2006 - 2012) & SSLC (2013 - 2019) pass rate (%)													
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
physics	45	45	36	62	67	66	56	76	39	64	42	82	62	45
economics	27	32	35	50	65	55	45	56	51	52	69	66	54	50
english	34	29	35	40	46	44	40	39	67	62	61	76	53	52
accounting	26	36	32	52	66	63	51	72	39	38	44	36	10	48
chemistry	34	43	45	59	60	55	40	66	24	48	26	36	42	23
biology	16	30	32	38	46	24	41	47	43	45	26	54	25	46
geography	21	31	29	37	37	36	27	35	15	45	25	42	37	30
history	21	23	29	41	36	34	38	37	28	33	25	19	35	31
mathematics	13	23	20	37	38	36	31	39	1	9	10	12	13	24

The figure 1 and table 1 indicates year 13 students do not perform well in mathematics national examinations as it shows from 2006 to 2019 where the math ranked the lowest in the graph and table compare to the other eight subjects. The passing rate of mathematics national examinations in the last 14 years ranged from 1 to 39 percent. In 2013 mathematics passing rate hit 39 percent and in 2014 it hit the lowest passing rate of 1 percent.

The history and geography are other two subjects that year 13 students not doing well in them with the passing rate of 19 to 41 percent and 15 to 45 percent respectively in the last 14 years. The physics with 36 to 82 percent passing rate, economics with 27 to 69 percent passing rate, while English with 29 to 76 passing rate. The year 13 students are doing pretty well in the national examinations in these subjects.

The accounting with 10 to 72 percent passing rate, biology with 16 to 54 percent passing rate, while chemistry 24 to 60 percent passing rate. The year 13 students are fairly doing well in these subjects in the national examinations in the last 13 years.

The graph, however, slashes down in 2014 especially mathematics national examination where year 13 students poorly performed to hit the passing mark of 1 percent. All the other examination subjects not well either with the exception of English and Economics with their passing rate of 51 and 67 percent. From 2014 to 2019 maths national examinations passing rate remain low at 10 to 25 percent passing rate which categorically in the failure mark. From 2014 to 2019, physics 39 to 82 percent pass rate, Economics 50 to 69 percent and English 52 to 76 percent meaning the year 13 students doing exceptionally well.

While History 19 to 35 percent passing rate, geography 15 to 45 percent passing rate, biology 25 to 46 percent passing rate, chemistry 23 to 48 percent passing rate and accounting 10 to 48 percent passing rate. The year 13 students did not do well in the national examinations in these subject areas in the last five years.

Figure 2:PSSC and SSLC failure rate in 2006 to 2019

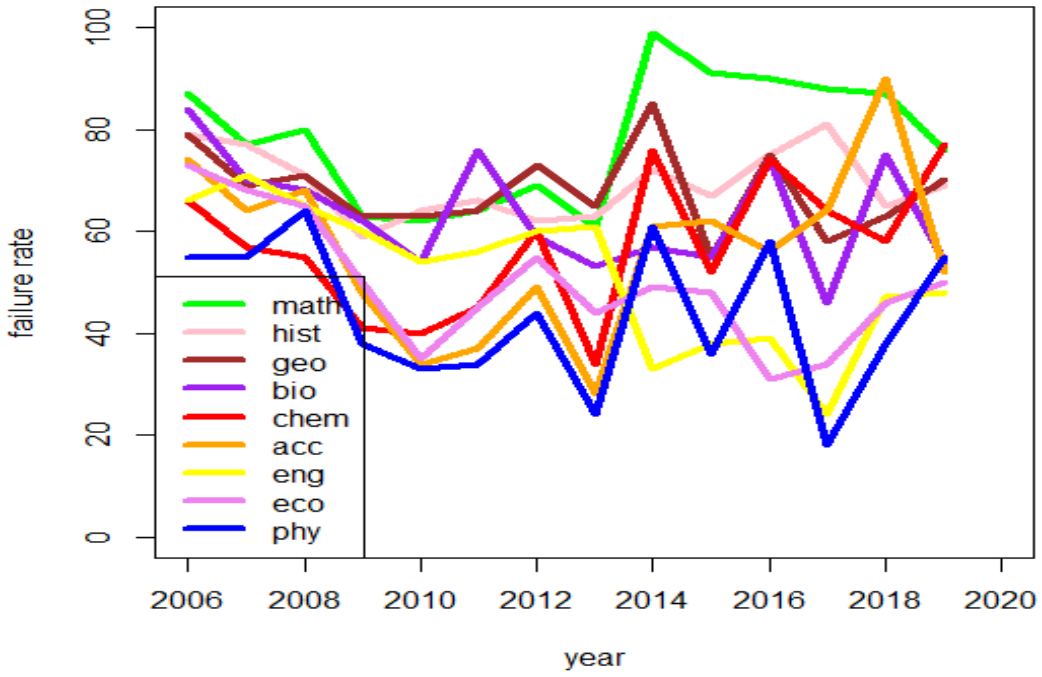


Table 2: PSSC 2006 – 2012 and SSLC 2013 – 2019 Failure Rate

	PSSC (2006 - 2012) & SSLC (2013 - 2019) failure rate (%)													
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
mathematics	87	77	80	63	62	64	69	61	99	91	90	88	87	76
history	79	77	71	59	64	66	62	63	72	67	75	81	65	69
geography	79	69	71	63	63	64	73	65	85	55	75	58	63	70
biology	84	70	68	62	54	76	59	53	57	55	74	46	75	54
chemistry	66	57	55	41	40	45	60	34	76	52	74	64	58	77
accounting	74	64	68	48	34	37	49	28	61	62	56	64	90	52
english	66	71	65	60	54	56	60	61	33	38	39	24	47	48
economics	73	68	65	50	35	45	55	44	49	48	31	34	46	50
physics	55	55	64	38	33	34	44	24	61	36	58	18	38	55

The figure 2 and table 2 clearly show that mathematics national examinations from 2006 to 2019 by year 13 students has the highest failure rate of 61 to 99 percent in the last 14 years. History and Geography have the second highest failure rate with 59 to 81 percent and 55 to 85 percent failure in the national examinations in the last 14 years. Next is Biology with 46 to 84 and Chemistry with 34 to 77 percent failure rate in the national examinations from 2006 to 2019. Follow by Economics with 31 to 73 percent failure rate.

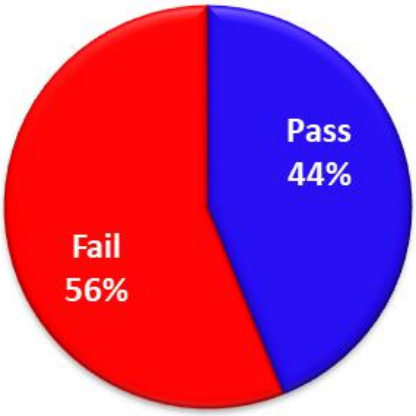
The graph and table illustrate clearly that Accounting, English and Physics national examinations have lower rate of failures from 2006 to 2019. The Accounting with 28 to 74, English with 24 to 71 and Physics with 18 to 64 percent failure rate. This means the year 13 students did fairly well in the national examination in these subject areas. The graph shows that between 2006 and 2008 the nine courses have high rate failures ranged from 55 to 87 percent.

From 2009 to 2013 the rate of failures of all the nine courses increased and ranged from 24 to 76 percent. Within this period, Biology, in 2011, went up to 76 percent, while in 2012 Geography reached 73 percent while the failure rates for the other seven courses ranged from 24 to 65.

The failure rates of mathematics from 2006 to 2019 in the year 13-Maths national examinations are very high as shown in figure 2 graph and table 2 which ranged from 61 in 2013 to its worst failure rate in the 14-year period under review of 99 percent in 2014.

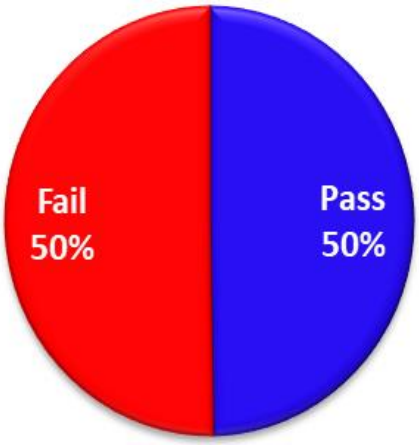
From 2015 to 2019 all the nine courses did not do much to reduce their failures rate, all were still high. Maths 76 to 91 percent, Accounting 52 to 90 percent, history 65 to 81 percent, Chemistry 52 to 77 percent, Geography 55 to 75 percent, Biology 54 to 75 percent, Physics 18 to 58 percent, Economics 31 to 50 percent and English 24 to 48 percent.

Figure 3: Proportion of Students- Fail and Pass in Accounting 2006 to 20019



From 2006 to 2019, 5584 year 13 students sat for the Accounting national examinations and 3131 students failed the 14 examinations while 2353 students passed. The difference of 678 more students failed the course than passed it. Figure 3 shows that 44 percent of students passed and 56 percent failed in the Accounting national examination from 2006 to 2019.

Figure 4: Proportion of Students - Fail and Pass in Economics 2006 to 2019

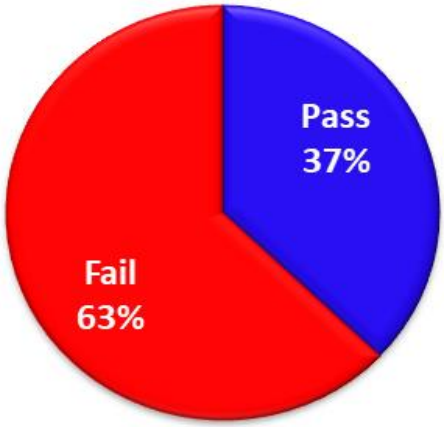


From 2006 to 2019, 6466 year 13 students sat for the Economics national examinations and 3249 students failed the 14 examinations while 3217 students passed the 14 exams. The difference of 32 more students failed the course than passed it. Figure 4 shows that 50 percent of all students passed and 50 percent failed in the Economics national examination from 2006 to 2019.

Figure 5: Proportion of Student - Fail and Pass in History 2006 to 2019

From 2006 to 2019, 5847 year 13 students sat for the History national examinations and 4037 students failed the 14 examinations while 1810 students passed the 14 exams. The difference of 2227 more students failed the course than passed it. Figure 5 illustrates that 31 percent of students passed and 69 percent failed in the History national examination from 2006 to 2019.

Figure 6: Proportion of Students- Fail and Pass in Biology 2006 to 2019



From 2006 to 2019, 5025 year 13 students sat for the biology national examinations and 3159 students failed the 14 examinations while 1866 students passed the 14 exams. The difference of 1293 more students failed the course than passed it. Figure 6 shows that 37 percent of students passed and 63 percent failed in the Biology national examination from 2006 to 2019.

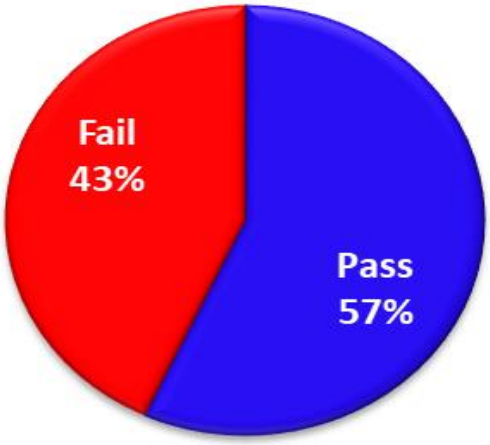
Figure 7: Proportion of Student - Fail and Pass in Chemistry 2006 to 2019

From 2006 to 2019, 3913 year 13 students sat for the Chemistry national examinations and 2272 students failed the 14 examinations while 1641 students passed the 14 exams. The difference of 631 more students failed the course than passed it. Figure 7 shows that 42 percent of students passed and 58 percent failed in the Chemistry national examination from 2006 to 2019.

Figure 8: Proportion of Students - Fail and Pass in English 2006 to 2019

From 2006 to 2019, 23598 year 13 students sat for the English national examinations and 12009 students failed the 13 examinations while 11589 students passed the 13 exams. The difference of 420 more students failed the course than passed it. Figure 8 illustrates that 49 percent of students passed and 51 percent failed in the English national examination from 2006 to 2019.

Figure 9: Proportion of Students - Fail and Pass in Physics 2006 to 2019



From 2006 to 2019, 2509 year 13 students sat for the physics national examinations and 1082 students failed the 14 examinations while 1427 students passed the 14 exams. The difference of 345 more students passed the course than failed it. Physics is the only course more year 13 students passed the national examinations than failed it in the last 14 years. Figure 9 shows the 57 percent of students passed and 43 percent failed in the Physics national examination from 2006 to 2019.

Figure 10: Proportion of Students - Fail and Pass in Mathematics 2006 to 2019

From 2006 to 2019, 16802 year 13 students sat for the Mathematics national examinations and 13116 students failed in the 14 examinations while 3686 students passed the 14 exams. The difference of 9430 more students failed the course than passed it. The figure 10 shows the 22 percent of students passed and 78 percent failed in the maths national examination from 2006 to 2019. The Mathematics is the only course most students failed in year 13 national examinations in the last 14 years than any other course.

Figure 11: Mathematics Students Pass Rate Per Discipline of Arts, Commerce, General and Science

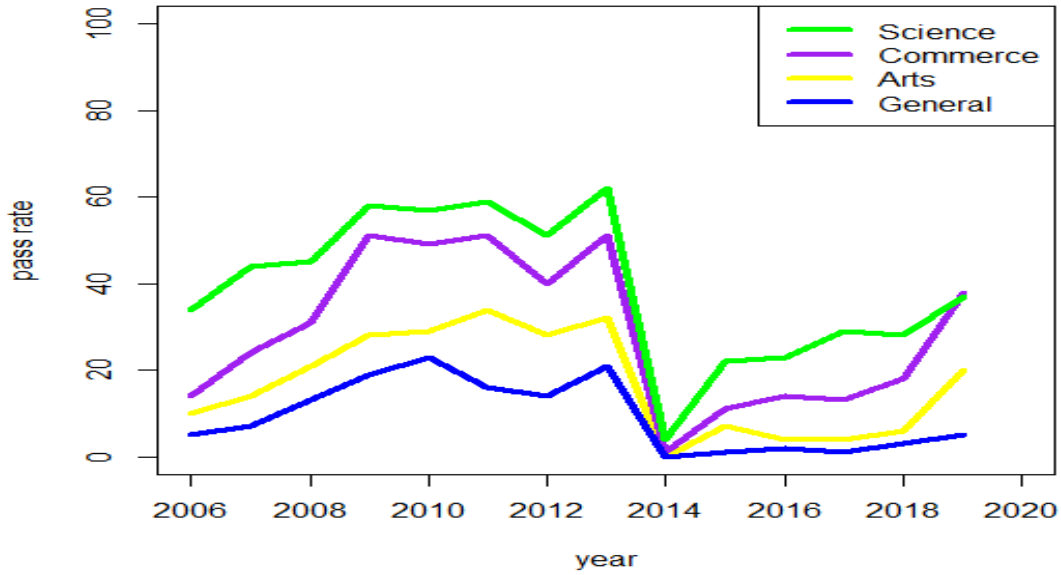


Table 3: Mathematics Students Pass Rate Per Discipline in Percentage

Discipline	PSSC/SSLC Pass Rate in Mathematics per Discipline (%)													
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Science	34	44	45	58	57	59	51	62	4	22	23	29	28	37
Commerce	14	24	31	51	49	51	40	51	1	11	14	13	18	38
Arts	10	14	21	28	29	34	28	32	0	7	4	4	6	20
General	5	7	13	19	23	16	14	21	0	1	2	1	3	5

Figure 11 and Table 3 indicates that in 2006, 34 percent of Science students who took Mathematics passed, 14 percent of Commerce students who took Mathematics passed, 10 percent of Arts students, and only 5 percent of General students passed the year 13 national maths examination. In 2007, 44 percent of Science students who took Mathematics passed, 24 percent of Commerce students, 14 percent of Arts students, and only 7 percent of General students who sat the year 13 national maths examination passed. In 2008, 45 percent of Science students passed, 31 percent of Commerce students, 21 percent of Arts students, and 13 percent of students in the General discipline who sat the year math national examination passed. In 2009, 58 percent of Science students who took Mathematics passed the examination, 51 percent of mathematics students in Commerce, 28 percent of mathematics students in Arts discipline, and only 19 percent of mathematics students in the General discipline passed the year 13 national maths examination. In 2010, 57 percent of mathematics students in the Science discipline passed, 49 percent in the Commerce discipline, 29 percent in the Arts discipline, and 23 percent in the General discipline passed the year 13 national maths examination.

In 2011, 59 percent mathematics students in the Science discipline passed, 51 percent in the Commerce discipline, 34 percent in the Arts discipline, and 16 percent in the General discipline passed the

year 13 national maths examination. In 2012, 51 percent of mathematics students in the Science discipline passed, 40 percent in the Commerce discipline, 28 percent in the Arts discipline, and 14 percent in the General discipline passed the year 13 national maths examination. In 2013, 62 percent of mathematics students in the Science discipline passed, 51 percent in the Commerce discipline, 32 percent in the Arts discipline, and 21 percent in the General discipline passed the year 13 national maths examination. In 2014, only 4 percent of Science students who sat the mathematics examination passed, 1 percent of Commerce students who sat the math examination passed, and zero percent in the Arts discipline as well as the General discipline passed the year 13 national maths examination.

In 2015, 22 percent of mathematics students in the Science discipline, 11 percent in the Commerce discipline, 7 percent in the Arts discipline, and 1 percent in the General discipline passed the year 13 national maths examination. In 2016, 23 percent of mathematics students in the Science discipline, 14 percent in the Commerce discipline, 4 percent in the Arts discipline, and 2 percent in the General discipline passed the year 13 national maths examination. In 2017, 29 percent of mathematics students in the Science discipline, 13 percent in the Commerce discipline, 4 percent in the Arts discipline, and only 1 percent in the General discipline passed the year 13 national maths examination. In 2018, 28 percent of mathematics students in the Science discipline, 18 percent in the Commerce discipline, 6 percent in the Arts discipline, and only 3 percent in the General discipline passed the year 13 national maths examination. In 2019, 37 percent of mathematics students in the Science discipline, 38 percent in the Commerce discipline, 20 percent in the Arts discipline, and 5 percent in the General discipline passed the year 13 national maths examination.

Figure 11 shows that from 2009 to 2013 the year 13 mathematics pass rates in all the four disciplines were generally steady. However, in 2014, the pass rates in the four disciplines dropped dramatically to only 5 percent (16 students out of 1369) resulting in the worst pass rate in the year 13 Mathematics examination in the 14 years of this study.

Figure 12: Mathematics Students' failure rate per discipline of Arts, Commerce, General and Science

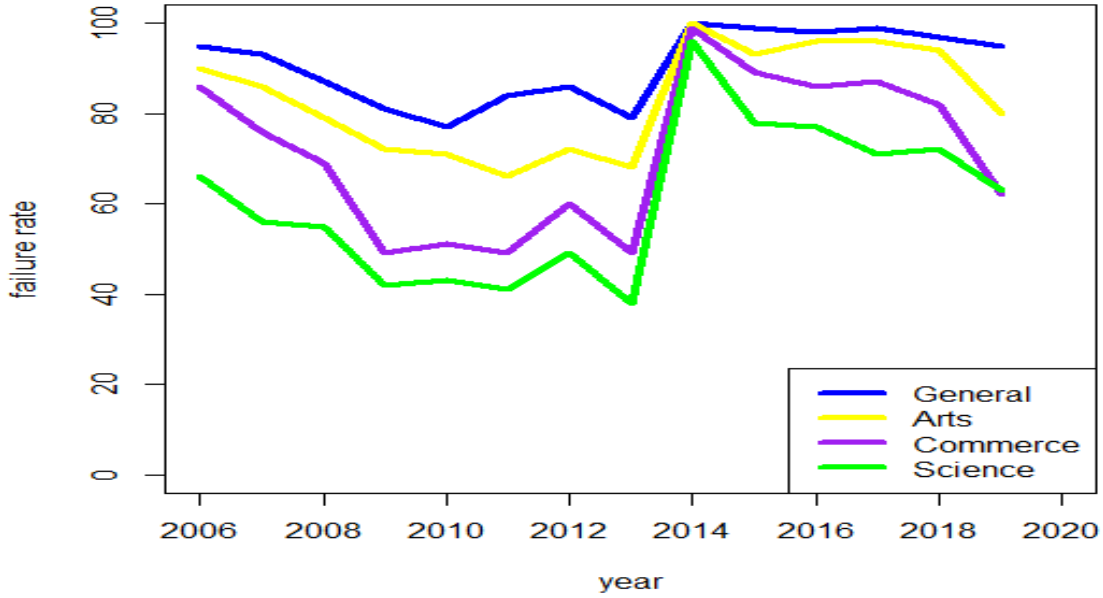


Table 4: Mathematics Students' failure rate per discipline in percentage

Discipline	PSSC/SSLC Failure Rate in Mathematics per Discipline (%)													
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
General	95	93	87	81	77	84	86	79	100	99	98	99	97	95
Arts	90	86	79	72	71	66	72	68	100	93	96	96	94	80
Commerce	86	76	69	49	51	49	60	49	99	89	86	87	82	62
Science	66	56	55	42	43	41	49	38	96	78	77	71	72	63

Figure 12 and Table 4 shows that in 2006, 95 percent of mathematics students in the General discipline, 90 percent in the Arts discipline, 86 percent in the Commerce discipline, and 66 percent in the Science discipline failed the year 13 national maths examination. In 2007, 93 percent of mathematics students in the General discipline, 86 percent in the Arts discipline, 76 percent in the Commerce discipline, and 56 percent in the Science discipline failed the year 13 national maths examination. In 2008, 87 percent of mathematics students in the General discipline, 79 percent in the Arts discipline, 69 percent in the Commerce discipline, and 55 percent in the Science discipline failed the year 13 national maths examination. In 2009, 81 percent of mathematics students in the General discipline, 72 percent in the Arts discipline, 49 percent in the Commerce discipline, and 42 percent in the Science discipline failed the year 13 national maths examination.

In 2010, 77 percent of mathematics students in the General discipline, 71 percent in the Arts discipline, 51 percent in the Commerce discipline, and 43 percent in the Science discipline failed the year 13 national maths examination. In 2011, 84 percent of mathematics students in the General discipline, 66 percent in the Arts discipline, 49 percent in the Commerce discipline, and 41 percent in the Science

discipline failed the year 13 national maths examination. In 2012, 86 percent of mathematics students in the General discipline, 72 percent in the Arts discipline, 60 percent in the Commerce discipline, and 49 percent in the Science discipline failed the year 13 national maths examination. In 2013, 79 percent of mathematics students in the General discipline, 68 percent in the Arts discipline, 49 percent in the Commerce discipline, and 38 percent in the Science discipline failed the year 13 national maths examination. In 2014, 100 percent mathematics students in the General discipline, 100 percent in the Arts discipline, 99 percent in the Commerce discipline, and 96 percent in the Science discipline failed the year 13 national maths examination.

In 2015, 99 percent of mathematics students in the General discipline, 93 percent in the Arts discipline, 89 percent in the Commerce discipline, and 78 percent in the Science discipline failed the year 13 national maths examination. In 2016, 98 percent of mathematics students in the General discipline, 96 percent in the Arts discipline, 86 percent in the Commerce discipline, and 77 percent in the Science discipline failed the year 13 national maths examination. In 2017, 99 percent of mathematics students in the General discipline, 96 percent in the Arts discipline, 87 percent in the Commerce discipline, and 71 percent in the Science discipline failed the year 13 national maths examination. In 2018, 97 percent of mathematics students in the General discipline, 94 percent in the Arts discipline, 82 percent in the Commerce discipline, and 72 percent in the Science discipline failed the year 13 national maths examination. In 2019, 95 percent of mathematics students in the General discipline, 80 percent in the Arts discipline, 62 percent in the Commerce discipline, and 63 percent in the Science discipline failed the year 13 national maths examination.

Generally, the mathematics course failure rate is high in all the disciplines in the last 14 years from 2006 to 2019 as shown in the table 4. On average, 83 percent of Arts students who took Mathematics failed, 71 percent of Commerce students, 91 percent of General students and 61 percent of Science students who sat the year 13 Mathematics national examination failed. Overall, the average failure rate in the mathematics examination in the last 14 years is around 78 percent.

Discussion

The failure rate of mathematics from 2006 to 2019 in the year 13 maths national examinations were very high as shown in Figure 2 and Table 2, which ranged from 62 to 99 percent in the last 14 years. Figure 1 and Table 1 explicitly illustrates that year 13 students do not perform well in mathematics national examinations as it shows from 2006 to 2019 where the math ranked the lowest in the graph and table compare to the other eight subjects. The passing rate of mathematics national examinations in the last 14 years ranged from 1 to 39 percent compare to physics with 45 to 82 percent indicates physics has better passing rate than maths. From 2006 to 2019, 16802 year 13 students sat for the mathematics national examinations and 13116 students failed the 14 national examinations while 3686 students passed the 14 exams. The difference of 9430 more students failed the course compare to the passing rate. The mathematics is the only course out of the nine courses where most students failed in year 13 national examinations in the last 14 years. In each year from 2006 to 2019 more numbers of year 13 students failed the maths national examination than passed it. Under the PSSC from 2006 to 2012, of these six years the

total number of 5885 year 13 students failed the mathematics national examinations and under the SSLC from 2013 to 2019, 7231 year 13 students failed the examinations.

In 2014 was the worst result in Samoa educational history for year 13 students in Mathematics, Geography, and Chemistry as most students failed than passed the national examination. From 2015 to 2019 all the nine courses did not do much to reduce their failures rate, all were still high as illustrated in Figure 2 and Table 2 of the research findings. However, maths still top all the subjects with the highest failure rate with 75 to 91 percent, accounting 52 to 90 percent, history 65 to 81 percent, chemistry 52 to 77 percent, geography 55 to 75 percent, biology 54 to 75 percent, physics 18 to 58 percent, economic 31 to 50 percent and English 24 to 48 percent.

In Samoa, the year 12 and year 13 students are studying the entire maths course which is unfair and unjust for the weak students in mathematics. The maths course should be divided into major maths and basic maths. The major maths to have topics like concepts in numbers, algebra, geometry, trigonometry, probability and statistics and calculus, while the basic maths to have decimals, fractions, graphs, integers, and rational fractions, measurements, number series, percent, powers exponents and roots and simple algebra and probability and statistics. The students who are good in maths taking physics, chemistry, commerce, economics and accounting to do major maths, while others who may not be good in maths taking arts courses are to do the basic maths. The SSLC should set two national examination papers for major maths and basic maths papers for year 13 students. In doing so, a clear average rating marks for SSLC mathematics exam will determine the actual performance of students in both the major and basic maths national examinations.

Conclusion

The mathematical assessment has long been plaguing the Samoan year 13 students' performance in the national examinations and will continue, unless the Ministry of Education, Culture and Sports streamlined the mathematics course into major maths and basic maths. Where the year 13 students who are in Science discipline, Arts discipline, Commerce discipline or General discipline could easily make their choice with help of the teacher to study major maths or basic maths. Only then a clear ranking mark in performance will show in the SSLC mathematics national examinations.

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