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Factors that contribute to low performance in numeracy in primary schools

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Abstract: ***This paper presents discussion based on a research conducted on students' low performance in numeracy in grade eight national examinations. Examination results in recent years showed that students generally perform lower in numeracy than in literacy and combined subjects. As stated by Eliakim, (2015) performance in mathematics has considerable room for improvement. The study explored the challenges faced by teachers and students in teaching and learning numeracy lessons in class. The introduction of Tuition Fee Free Education (TFFE) in 2012 could be one of the contributing factors for lower performance in numeracy because of the increased in primary students' enrolment. The increase in enrolment has resulted in overcrowding, shortage of learning materials and increased work stress on teachers. As stated by Earthman (2002) addressing the individual needs of students can be a challenge in bigger classes. Papua New Guinea primary school teachers face similar challenges and therefore such practice can affect the teaching of mathematics at the primary level of education. The mixed method was used in this research to explore how students are supported in their learning of mathematics in the primary level of their education. Questionnaires, interviews, lesson observation and focus group discussion were used to collect data. The purposive sampling was used to select the research site and the participants. This study found that there was an acute shortage of resource books for teachers and students as a result of high enrolment and distribution problems faced by the Curriculum and Development Division (CDD) Rena (2010).***

Key words: *Overcrowding, numeracy performance, resource books, examination results, students' population, teaching strategies*

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INTRODUCTION

The research was conducted in an urban school. The school was established during the colonial times in 1940s. The school is located within the town boundary and is a level eight primary school having twenty-four (24) teaching staff, two deputy principals and a principal. The school enrols lower primary grades of 3 to 5 and upper primary grades of 6 to 8. Each grade has four classes totalling to 24 classes altogether having the students' population of 59 to 80 in a class. The total number of students in the study site was 1800. The elementary grades from elementary preparatory (EP) were accommodated within the primary campus. However, the elementary has its own administration that report to the primary administration. There were four grade eight classes with the enrolment shown in the table below

.

Table. 1: Grade 8 class enrolment for year 2018

Class	Males	Females	Total
8A	24	35	**59**
8B	32	36	**68**
8C	26	35	**61**
8D	32	33	**65**
Total	**114**	**139**	**253**

The school has 24 classrooms and ten office blocks. The administration office was located at the centre of the school making it more accessible by teachers, board members, parents and students. While the administration block seemed well furnished, most of the classrooms have rusted iron roof that need replacement. A double storey building was inspected and condemned by the building board in 2016 due to the rotten stairs and timbers that pose danger to the students and teachers. The school does not have a library building to keep books for students' learning. All learning materials and reading books were kept in the office blocks between the classroom buildings. The books are distributed to students to use and returned after lessons. Each class has a storage area in the teachers' corners to keep resource books for class use.

The school's catchment population is made up of children of public servants and the children who come from the nearby settlements. Forty per-cent (40%) were the children of public servants who work in town. Sixty per-cent (60%) of the students come from the six settlement suburbs that are located in the fringes of the town.

Identifying the issue

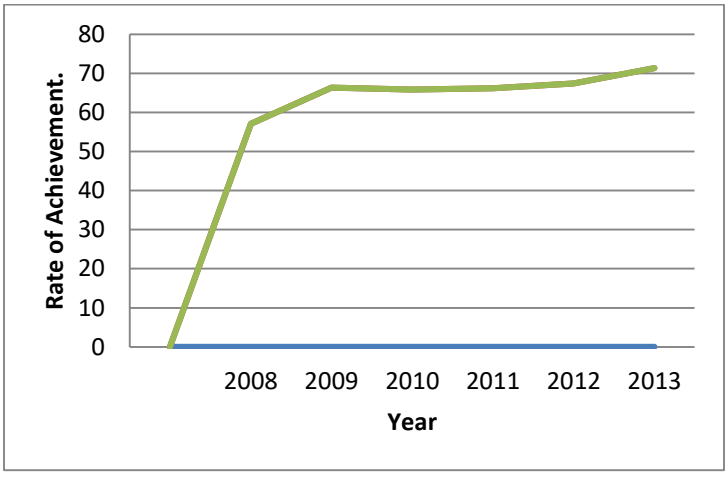
There have been discussions by parents, education authorities and interested education stakeholders on the general students' low performance in numeracy compared to language and literacy and combined subjects in the National Grade Eight Examination in recent years. The national pass mark that is set as the bench mark for grade eight students to achieve at is 80 out of 120 in all the subjects. They are expected to achieve at this level in order to advance to grade nine in secondary level (Kilala & Magury, 2017). However, many grade eight students were not able to achieve at this level as shown in figure 1. When this happens the provinces lower their cut off mark depending on the availability of spaces in their provincial high schools to allow required number of students to advance into grade nine (Devette & Magury, 2013). This may mean that most grade eight students selected to grade nine may not fully understood subject contents well at the end of primary education. Therefore, when they are selected to secondary level education, they may find it hard to cope with grade nine subject lessons. This may cause students to cheat in assessment tasks, quizzes and examinations in order to gain good marks or some may begin to drop-out of school because the lesson contents in grade nine may be quite difficult for them. This study is focused on exploring why grade 8 students generally perform lower academically in numeracy than other school subjects in primary schools.

Primary students' performance in mathematics

Numeracy achievement in primary schools is becoming a concern for many schools in PNG. This is because of the students' general low performance in numeracy in grade eight national examinations in recent years. According to a research by the national research institute (NRI), it was found that the quality of learning in basic education was fairly lower than what was expected (Devette & Magury). This is particularly the case for academic performance in numeracy as shown in Figure 1. As discussed earlier, in recent years the selection authorities had to select most students that scored below 80 in order to allow for more students to advance to grade 9 for secondary level education. This practice has been viewed by some educators and education stakeholders as possible hindrance to students' learning of subjects at the next level of education especially in mathematics. This is because they may have knowledge gaps in content which bridges secondary school subjects' learning. This may have an impact on the number of students who choose to study in mathematics and science fields.

The Department of Education (DoE) provided the statistical report on the 2008 to 2013 grade eight results that confirms that the grade eight numeracy performances were below the national cut off mark. The report further indicated that the performance of students in numeracy was steadily progression over the years. This is shown in the line graph below.

Figure1: Line graph showing the students' numeracy achievement.



Source: Department of Education- 2008-2013 examination results

The graph shows the achievements of numeracy during a five-year period from 2008 to 2013 be 57.1, 66.3, 65.88, 66.38 and 71.3 respectively. The data indicated gradual improvement despite a drop of 0.42 in 2010. However, it is still below the set 80 cut off mark for secondary school selection.
Examination results in numeracy for the years 2014 to 2017 were not made available at the time of the study. However, it can be suggested that a steady improvement has been achieved but it has not yet reached the prescribed 80 cut off mark average.

Significance of the study

This research study is small so generalizations cannot be made from the research findings. However, it is significant because it explored why primary school students do not perform well in numeracy. For example, it found that classes in some primary school are large and therefore teachers cannot support individual student's learning in numeracy as well as they should. It also found that a lack of mathematics teaching and learning resources is experienced by the research site teachers. This research can be the basis for further research in the support of students' learning in mathematics.

SYNOPSIS

Numeracy performance of students in primary schools has been identified as below the expected level. The issue of low performance is attributed by the high number of students in a class that exceeded beyond the ratio of a teacher per students of 1: 35. The high enrolment challenged the teachers in addressing the learning needs of students resulting performing below the national cut off mark in the examinations. The bulk number of students selected to grade 9 are not well prepared on the learning outcomes in primary schools to transit smoothly into the new learning outcomes in grade 9. This would give a challenge in the students' learning in the secondary level of education when the lesson contents were not well learnt and understood in the primary level of education.

LITERATURE REVIEW

The structure of education in Papua New Guinea has been decentralized to sub-units to promote participation in decision making and to keep administrative workloads within reasonable limits, Bray (1985). They are elementary, primary, lower secondary, upper secondary and the tertiary. Each sector prepares the students with relevant knowledge, skills and attitudes to move to the next level of education. Each sector is to provide effective learning strategies which can enhance quality education which is emphasized in Papua New Guinea Vision 2050 document (Government of PNG, 2009). However, all sectors have their own challenges in addressing the learning needs of students. The primary sector, in which the study was based on, had its challenges especially in supporting students in learning basic mathematics at the primary level of education. Challenges encountered in the students' learning and mastery of mathematical skills can be influenced by lack of mathematics teaching and learning resources, increased in class sizes, strategies used to facilitate students' learning of mathematical knowledge and skills and the depth of mathematics content delivered at this level of school.

Resource books

Resource books play a fundamental role in school curriculum. Textbook has assumed the central position in mass education not only to support instruction but also to symbolize that instruction or in other words, the textbook defines the curriculum (Westbury, 1990, p.2). Textbooks are used as guides for teachers to assess the parameters of instructions and students' achievements. Students heavily rely on texts that constitute the basis of school knowledge, particularly in the Third World countries where there is chronic shortage of qualified teachers Altbach & Kelly (1988, p. 3).

A resource shortage has become a common challenge for many schools in Papua New Guinea. There was enough evidence in the study site to make assumption that similar issue of resource shortages may be experienced by many primary schools established in the districts and the remotest parts of the country. It has been reported by the school authorities and teachers that availability of mathematics resources to support students' learning is minimal or nil in some schools (Eliakim, 2015). In the absence of the resource books, teaching and learning becomes a tedious job for teachers and students. Teachers may not be guided well in their lessons preparations and delivery which may have adverse effect on the students' academic performance. This is supported by Roberts, 1984, who stated, 'The availability of learning resources in schools is very important because they play a major role in supporting students' in their school subjects in primary education.

Mathematics textbooks are vital support resources to support students' learning of mathematics. As stated by (Lockheed & Verspoor, 1991), the impact of the presence or absence of textbooks can be easily assessed from the results of students' achievement in their subject areas. The absence of mathematics textbooks in the classrooms as found in this research may be one of the reasons for students' general low performance in the grade 8 national examination as

shown in figure 1 in the examination results in the last three years. A research by Rena, R, 2011 on the challenges for quality primary education in Papua New Guinea, has found that there are inadequate text books for teachers' use due to distribution problems that schools were not able to receive the resources.

Enrolment

The introduction of Tuition Fee Free Education (TFFE) in 2012 has increased the enrolment of students in primary schools throughout the country. When more students were enrolled, more resources were to cater for the increase in student population. The increase in students' population does not only affect the resources, but also increase the work effort from teachers to address the high number of students' population. Overcrowding, especially in towns and city schools having 50 to 100 students in a class is a worldwide issue (Ijaya, 2000). Papua New Guinea is facing similar trend in in students' enrolment where more students are accommodated in the rooms that can cater for less students. Studies by Earthman (2002), Yaman, and Uygulamanda, (2009) and Burnet (1995) found out that overcrowded classroom conditions hinder teachers' attention to individual students and slows down the progress of students. Addressing the individual learning needs of students would be a challenge in bigger classes. Teachers tend to cover only basic topic lessons according to the allocation of time for the learning area Earthman (2002, p.11). When the above challenges are not addressed, students' numeracy performance may be affected as a result.

Negative impacts on students' learning in a large class size

In a large class size, teachers would find it a challenge to attend to individual learning needs of students. The large number of students in class had resulted in acute shortage of resource books to cater for every student and teachers' needs. Text books play very important roles in improving students' learning in primary education (Robert, 1984). Teachers and students rely on the resource books to guide them in their learning in schools every day. Constructing learning centres, subject corners and remedial activities can be challenge to teachers in crowded rooms. Development of learning centres in class is a great way in addressing the varying learning needs of students. Not all students learn the same way. Some are fast learners while others are slow in learning. When teachers set up such learning environment, it can address the needs of the majority in class.

Teaching and learning

Teaching impacts the performance of students' numeracy results. Teaching should be more interactive between and teacher and students. Learning becomes meaningful through social constructivism (Lev Vygotsky, 1974). Students bring some numerical knowledge from their societies that teachers need to build on. When students are engaged in doing mathematics in ways that are similar to doing mathematics in out-of-school situations, they will learn better (Masingila, 1993). Students should be engaged in practical mathematics activities where they discover answers for themselves which become lasting experience for them. Teachers should see themselves as facilitators of learning in class rather than transmitters of mathematical knowledge (Matang, 2002. p.29).

In the phase of current changes in curriculum reforms in Papua New Guinea, teachers are required to keep abreast on what the mathematics curriculum entails. Staff in-services and trainings on teaching, assessment and evaluating of students' learning in mathematics are required. Teacher professional development is very important that help teachers to teach students in ways which lead to learning improvements (Bruce & Showers, 2002). Teaching, assessment and evaluation enhances performance in mathematics and other courses which help teacher and students to improve academically. Ongoing support by supervisors through lesson observations and peer-teaching help teachers overcome challenges they are faced with in teaching numeracy.

The performance of numeracy for grade 8 students in the years 2008 to 2013 is a challenge for schools in Papua New Guinea. The achievement had not reached the required pass mark of 80 due to lack of resources, high enrolment leading to overcrowding in class resulting in poor performance by teachers leading to poor results in grade 8 examinations.

METHODOLOGY

Low performance in grade 8 examination is an emerging issue in schools in Papua New Guinea. Students' performance for all subjects in primary schools is low since 2008 (DoE, 2013). Serious concerns are raised by the concern bodies and Government authorities on the issue of low performance in all subjects. Grade eight students have not been performing well in their exams (National research institute, 2013).

When the grade eight students perform lower than the set cut off mark, the provinces lower their cut off marks so that required the number of students are selected to secondary schools. This means that students who are selected to enrol grade 9 have not generally

scored above average. This suggests that many of them may be weak in some or all of the subjects. This may mean that the secondary school administrations may need to provide remedial programs to upgrade the weaker students reading, writing and numeracy levels before they are taught new areas of knowledge in the various subjects offered in secondary school level of education.

This research project intends to explore why students were not performing well in numeracy as well as expected in the grade eight national examinations. In order to understand the factors that impact low performance on numeracy in grade 8 in Papua New Guinea, this research was developed to identify;

- Factors that contribute to low performance of numeracy
- Support systems that are in placed in schools to address the numeracy performance.

A mixed method of data collection was used in this study. In qualitative method, the data collected were in form of questionnaires, interviews, lesson observation and focus group discussion. In the quantitative approach, the data were collected using numerical values based on the responses of participants on the statements to indicate their levels of agreement based on the numeracy lessons carried out in school. The research participants were selected using the non-probability sampling were there was good representative of data which is replicable, solid and relevant (Alexiades 1996, Bernard 2002)

THEORETICAL PERSPECTIVE

The theory that was used to guide this research was the Social Constructivism Theory. The Social constructivist theory focuses on how people learn through interactions with each other (Vygotsky, 1979). This theory guided the researcher to understand the classroom dynamics where teachers and children interact with each other during mathematics lessons. Learning in class becomes effective when there is social interaction between students and teachers or students between students in their social environment. Students understood concepts better when they use their prior knowledge about mathematics from their society as Hogan, D., & Tudge, J.R (1999 p.46), stated '…peer collaboration can facilitate better performance.' The students build from what they already know to what they need to know (known to unknown) as pointed out by Vygotsky, 1979 in his discussions on learning through social interaction. Theory of cognitivism was also used in this study as Piaget, 1987 stated that learning materials in class should involve the appropriate level of students' motor or mental operations.

METHODS OF RESEARCH

In this research, mixed methods were used to collect data. This method is combination of both the qualitative and quantitative. The two approaches can be combined because they the goal of understanding the world in which we live (Haase and Myers 1988 p.46). Furthermore, King et al. (1994 p.46) claimed that both quantitative and qualitative research share unified logic and that the same rules of inference apply to both.' In quantitative, the data was expressed in the form of numbers. The qualitative method is focused on data that were written or descriptive. Text data was organized and analysed to determine what information the data was showing.

METHODS OF DATA COLLECTION

The data that was collected in this research was in forms of interviews, questionnaires, lesson observations and focused group discussions. Using the non-probability sampling, the research participants were selected using purposive sampling. Interviews and questionnaires were developed to find out the support systems, programs and resources available in school for students and teachers' use. Students were also interviewed on the support provided at home towards their learning. In the lesson observation, lesson delivery, students' participation and the use of resource books were observed. Adequacy of the resource books for teachers and students were noted during numeracy lesson.

Sampling

The sampling of the research can be individual or community. However the sampling technique is chosen, there must be a good representative so that the data collected is replicable, solid and relevant (Alexiades, 1996, Bernard 2002). For this particular study, the participants of the research project were made up of a grade eight class of 65 students and fifteen upper primary teachers. Purposive sampling was considered in selecting the participants in the view that grade 8 students and upper primary teachers could provide required information on the research topic.

Case Study

There are different types of case studies that could be used in research. The common ones are; explanatory case study which was used to answer questions that explain the real-life situations that are too complex for the survey. In evaluation language, the explanation would link program implementation with program effects (Yin, 2003). Exploratory case study was used to explore situations in which the interventions being evaluated but does not have clear set of outcomes (Yin, 2003). Descriptive case study is used in form of narrative

where questions are answered orally to describe and evaluate outcomes.

Of all the case studies, exploratory was used to gain insight into the structure of the issue to develop hypothesis, models or theories to explore into the issue of low performance on mathematics by primary students in their examination which had been ongoing concern since 2008.

Ethics of research

A letter was sent to the Principal Education Advisor seeking approval for the study to be conducted in a primary school under his administration. The approval was granted for the study to go ahead. The copy of the letter from the principal education advisor with a letter seeking the permission for the study from the primary school principal was presented at the study site. The permission was granted by the school's gate keeper. Consent forms for the participants were administered to upper primary school teachers and grade 8 participants for the parents to sign to allow their children to participate in the study. Eighteen teachers and 36 students returned their consent forms indicating their agreement in taking part in the study. Data were collected from the questionnaires, interviews, lesson observations and focus group discussion. The electronic copy of the interviews was encrypted with a code in the device to ensure that no one gets access to the copy. The data was collected for the study purpose only and should be destroyed at the end of the study project. Identities of participants were protected by the use of pseudonyms.

Limitations

Due to the limited time and financial limitations, the samples were small therefore generalizations cannot be made in this particular study. The interviews were conducted and questionnaires were given to only selected grade 8 class and upper primary teachers. The study site and sampling were chosen based on the above factors.

Conclusion

The methods of data collection were mixed methods using interviews, questionnaires, lesson observations and focused group discussions. Two support questions were used as guides to gather the data. The first question asks for the " factors that contribute to low performance of numeracy" and the second asks for the " support systems are in place in schools to raise numeracy performance." Purposive sampling was used to select participants to provide relevant data to the research topic. The research was guided by the social constructivism theory that support learning through social interaction. The participants' identities were protected for the purpose of the study.

DATA ANALYSIS AND INTERPRETATIONS

Resources

In order to explore the issue of resource books further, the students and teachers were asked whether they had mathematics textbooks. The information gathered was presented below.

Students' Resources

A grade eight class of 65 students was selected for the study. Thirty-seven parents gave their consent for their children to participate in the study program. The student participants were asked whether they had mathematics textbooks to use during their mathematics lessons. The information on this is presented in the excerpts below.

Student 1

There are no…. any mathematics text book. Teacher only write (sic) on the front (meaning board) and we copy into our books.

Student 2

No one share maths text book with me because we don't have any maths text book in our class.

Student 3

The teacher has (sic) no maths text book to give it (sic) to the students to use it (sic). She always writes on the blackboard and we all copy.

Of the 37 students that participated in the study, the data indicated from the questionnaires that there were no students' maths books. They reported that all the mathematics notes and activities were written on the board by the teacher and students copy into their books.

Teachers Resources

In order to explore the issue of resources further, primary teachers were selected to participate in this study.Of the 27 upper primary teachers, 18 participated in the interview on the availability of teachers' resource books. All participants indicated that there were insufficient resource books to help them in their lessons. Below are some of the excerpts by teachers on the resource book issues.

Teacher 1

Teachers' resource books in the schools are a

problem. Teachers need resource books to teach effectively. Lack of teaching resource book, learning is not effectively and not interesting.

Teacher 2

Math resource books are our greatest problem. We lack teaching materials that has led to low numeracy lessons being taught not effectively.

Teacher 3

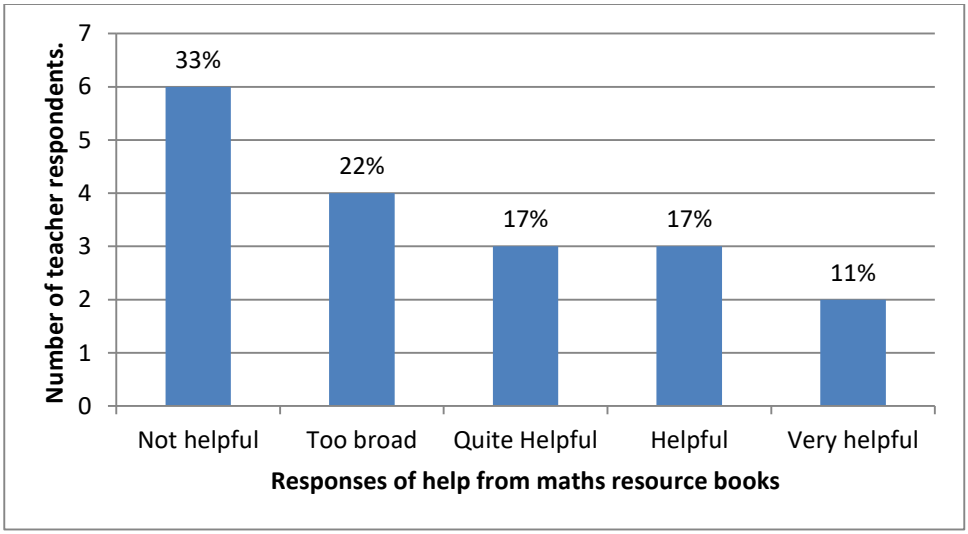
Insufficient resources. We have only few books for example 8A we have two teachers' guide that only two teachers use while others go without teachers resource books. Sometimes it's very frustrating when we want to teach a lesson and we find out that we don't have the guide.

The insufficiency of resource books was further discussed in a focus group discussion on a morning briefing before administering the questionnaires. A general discussion was allowed for teachers to discuss issues. A teacher raised the question to the principal if the school board had photocopied teacher guides to be given to teachers who were missing on the resource books. A teacher commented that she had used her initiative to photocopy a resource book for her own use.

The above data collected through excerpts from students and teachers pointed to a similar challenge of resource shortage for students and teachers. The students had no resource books to refer to for all their lesson activities. The upper primary teachers were sharing very limited teacher's guides and resource books. These data collected through interviews, questionnaires and focus group discussions further supported the study by Rena, 2010 that identified there was a challenge in resources in primary schools in Papua New Guinea. This challenge further affected the students' performance as Lockheed and Verspoor, 1991, stated 'the results of students' performance in their subject areas can be easily assessed by the presence or absence of resource books.'

The study further interviewed the teacher participants on the help they receive by using the maths teachers' resource books in their teaching. Below is a graph showing the responses teachers gave on the maths resource books.

Figure.2: Usefulness of maths resource books



Of the 18 participants, 33% stated that the resource books are not helpful. Twenty two per-cent (22%) had said that the resource books were too broad while 17% said they were quite helpful and another 17% said that the resource books are helpful. Few (11%) stated that the resources books and guides are very helpful. Of all the responses, majority of teachers responded negatively on the usefulness of the maths resource books. This may clearly indicate that most teachers do not understand how to use the mathematics resource books to assist in their lessons.

Support from Teachers

Students have different learning intelligences that need to be attended to individually (Gardner, 1984). Not all students are same in their learning abilities. To find out the support from their class teacher, the students were asked how much individual help they receive from the teachers to support them in their learning of mathematics in class

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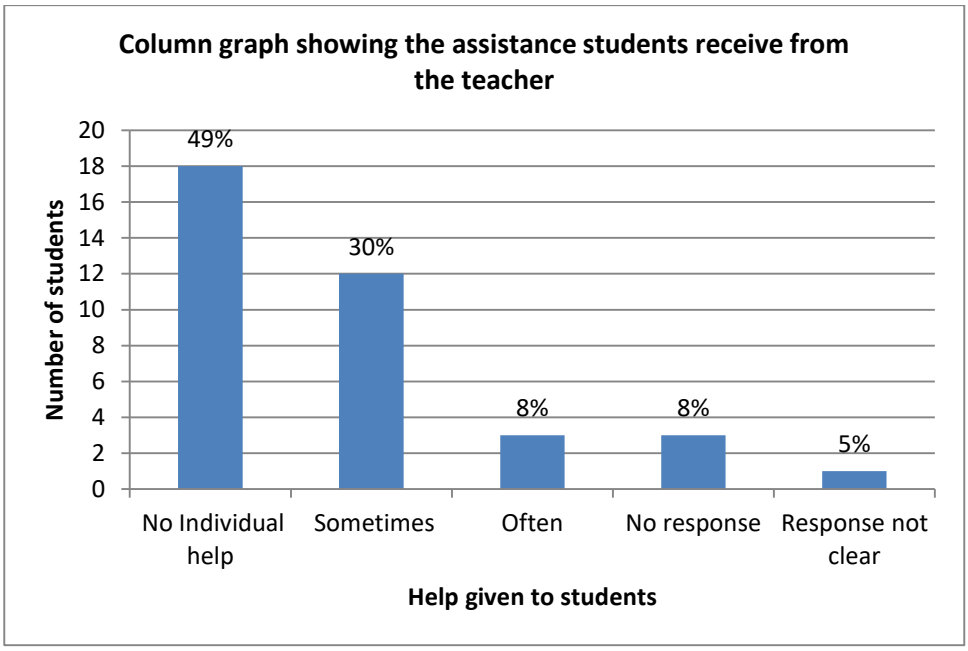
Figure 3: Individual assistance students receive from teachers



As the information in figure 2 showed 49% of the student participants stated that they did not receive individual assistance during their mathematics lesson while 30% stated that they were given such support only sometimes and 8% did not respond and responses were not clear. Only 5% reported that they were supported in their mathematics lessons often.

The above data was supported with statements of the type of individual assistance given by the class teacher with the excerpts below,

Student 1

I don't receive help from my maths teacher. The help I receive is when she stands in front and teach (sic).

Student 2

The teacher don't (sic) have enough time to go around and help each one of us individually. This is because we are too many and it's hard for her to help each one of us.

Student 3

I receive help from the teacher when she was standing at the front and teaching us. There is no time to talk to individual students.

This data indicates that the participants' class size is large. This may be one of the reasons why most of these students are not supported individually during their mathematics lessons. This may also infer that because of the large class size, most of the participants may not be supported well to understand mathematical content and basic concepts. It could be suggested here that teacher's individual support for students is challenging because of large number of students in this class. This observation is supported by Earthman (2002), Yaman and Uygulamada, (2009) and Burnet (1995) studies which found that overcrowded classroom conditions hinder teachers' attention to individual students and slows down the progress of students. Earthman (2002, p.11) also pointed out that when class sizes increase, 'teachers tend to cover only basic topic lessons according to time for the learning areas.' This seems to be the practice in these participants' class.

The participants were asked whether they had a study timetable for study after school. Of the 36 students that participated in the study, 31 reported that they did not have study timetable at home. Only five reported that they had a study timetable at home. This data is supported by the excerpts below from students' interviews.

Student 1

Yes, I do have a study timetable at home but I don't follow it most of the time.

Student 2

Not really because I have too many work to do

because I am helping my family to cook and wash plates and other work. So I don't have time to study.

Student 3

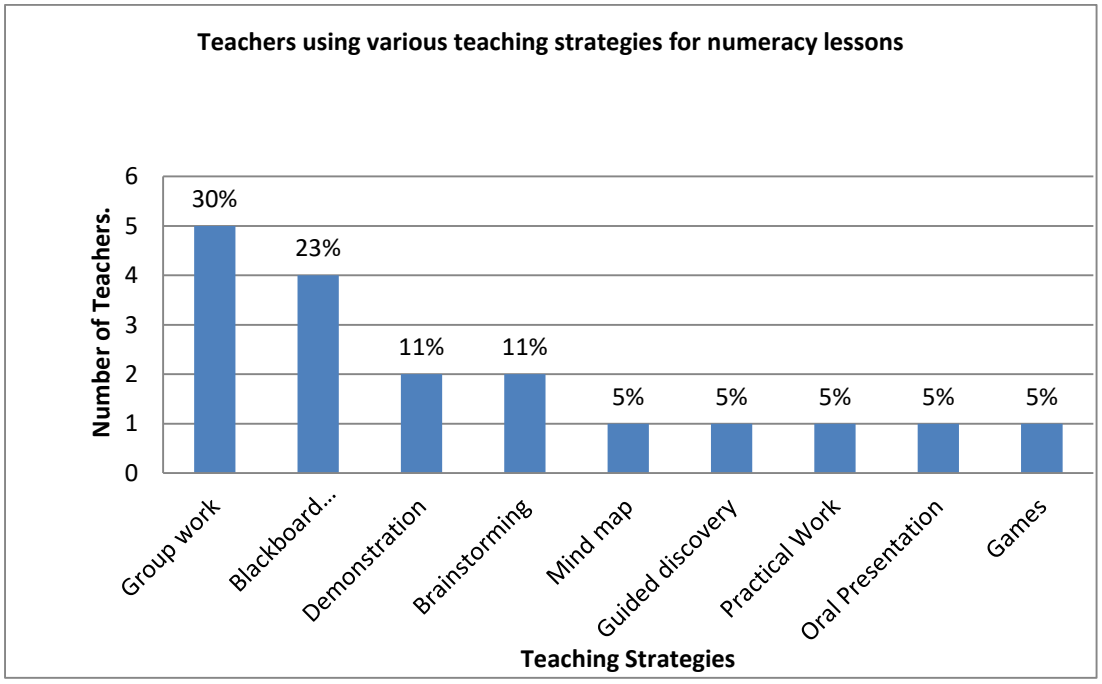
No, I don't have study timetable to follow at home. When our maths test is ready our teacher use to tell us to study because you will do your maths test that's why I study at home.

This data shows that most of the students do not have a study timetable for study at home. This may suggest that parents do not encourage their children to study at home after school. It may also suggest that parents and students may not value studying after school because they may not understand well the role of homework in students' support for learning.

The classroom teaching strategies

There are different types of teaching strategies that teachers are to employ on students. No strategy is better than the other. Every teacher chooses the strategy that best suit the classroom situation and the learning needs of the students. Piaget (1952 p.371) asserted that 'teachers should understand that each individual child's cognitive development does not occur quickly and little, if they progress, they may be assessed on weekly or even monthly basis.' The study was carried out to find out the strategy that teachers find helpful in teaching numeracy lesson in class. Eighteen teachers were interviewed and gave the responses shown in the column graph below.

Figure 4: Graph showing number of teachers using various teaching strategies for numeracy lessons



Of the eighteen teachers who participated in the study, most teachers (30%) said that they apply group work. Twenty-three per-cent (23%) use blackboard explanation while 11% each on demonstration and brain storming and the 5% each for mind map, guided discovery, practical work, oral presentation and games. The teachers who apply group work believe that students learn better when they interact with their peers (Vygotsky 1934). Group work also help the teachers to ensure that students are kept busy on their assigned activities while the teacher attends to the week learners as one of the teachers stated in stated in an interview;

Group work is very helpful to me in my lessons because it gives me time to help the weak students while everyone is busy on their assigned activities. It is also helpful because the fast learners are always helping the slow ones which I see very good so I apply that in most of my lessons.

Most teachers who use blackboard explanation as a helpful strategy stated that it is convenient in

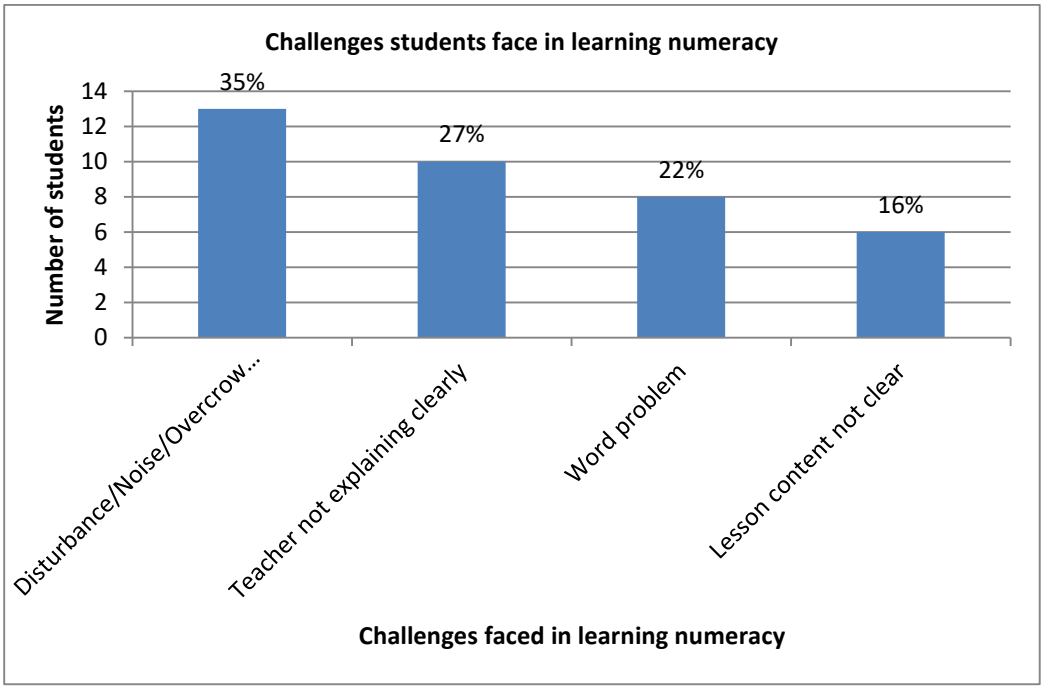
addressing the whole class in a crowded classroom as well as absence of students' textbooks. During a focus group discussion after a maths lesson, the class teacher stated that she cannot be able to move around to supervise the work of students nor invite them to her desk because of the large number of students (65) inside a room capable of accommodating 20 students to sit comfortably.

The data collected indicated that most teachers apply group work and blackboard explanation as major teaching strategies to cater for the big number of students in class.

Challenges in learning mathematics

The students were asked about the challenges they face when learning mathematics in class. The column graph below is showing the responses from the students.

Figure 5: Graph showing the challenges students face in learning numeracy.



Thirty-six per-cent of the students reported that they were challenged in their learning by noise from the crowded classroom while 28% did not clearly understand the teacher. Another 13% reported that the lesson content was not clear and therefore created learning difficulty while 22% had difficulty in understanding word translation and this affect their learning of mathematics.

This data is supported by the excerpt below from the researcher's journal record.

The mathematics lesson on the topic 'Fraction' was conducted in a crowded classroom. The students were seated three in a desk. The desk size in this classroom can sit only two students comfortably. During the mathematics lesson, laughter was heard at the corner of the room near the door's exit. Six students, 4 girls and two boys, decided to sit on the floor right in front of the teacher while the lesson was being conducted. One male student seems in his mid-twenties, decided to stand at the back placing his exercise book on the wall while copying notes from the board. The lesson was conducted in tokpisin as most students understand and speak better. There was a lot of noise heard from the opposite room as the class teacher was yet to come into the room.

These data showed that the student participants' focus on their mathematics learning was disturbed by the noise level created in a crowded classroom. It also showed that the teacher's explanation of mathematical concepts was not clear and the lesson content was not fully covered from the introduction to the conclusion. This supports other data in this study which showed that the learning of mathematics was challenging in the large size class and when mathematical concepts and content were not explained well during the lesson.

Enrolment

The high enrolment of students was a major issue identified in this research. Teachers and students had expressed similar concerns of overcrowding leading to shortage of resources. The large class sizes had a lot of impact on the teachers' performance and assistance towards individual needs of learners. Below is the enrolment record for grade 8 classes taken from the study site.

Table. 1, Grade 8 classes enrolment for year 2018

Class	Males	Females	Total
8A	24	35	**59**
8B	32	36	**68**
8C	26	35	**61**
8D	32	33	**65**
Total	**114**	**139**	**253**

The table above indicated that the enrolment of students in a class has exceeded over the teacher per student ratio of 1: 30. This suggests that there was over enrolment of students in class that affected the teaching performance of teachers and students as well. This supports the view by Earthman (2002), Yaman, and Uygulamanda, (2009) and Burnet (1995) that overcrowded classroom conditions hinder teachers' attention to individual students and slows down the progress of students.

Teacher professional development

Teachers were interviewed on the school's professional development program to keep well informed of teaching strategies. Having interviewed ten teachers who provided their time for this data collection, the responses received were that there was no in-service program conducted for the year. Five teachers who were in the school for the last three years stated that in-service program has not been so effective over the last two years. Two teachers who hold senior positions in the study site share the same concern that in-service program is a challenge for the school because majority of the teachers do not attend to the program.

ANALYSIS AND INTERPRETATIONS

Both qualitative and quantitative data were used to explore in-depth why the results in the grade 8 national examination showed that students tend to perform lower academically in mathematics compared to language and the combined subjects. The research instruments were developed to collect data on the teaching strategies that were used to teach mathematics skills in grade 8, the available resources that were used to support students' learning of mathematics skills and knowledge, and the assessment strategies that were used to monitor students' mastery of mathematical skill.

Interaction with data

During the data collection, questionnaires were checked for their completeness and consistencies. Some questions may possibly contain answers to one question from another which were verified.

The raw data was collected and carefully analysed based on the three areas. They were 'the resources that support numeracy lessons, teaching strategies and assessment of learning in numeracy'. To minimise errors, incompleteness and gaps in information obtained from participants, editing process was conducted to ensure rich data was at hand. There can be two ways to edit. The first one is to examine all answers to one question at a time. The second is to examine all respondents given to all questions by one respondent at a time (Kumar, R,. 2014 p.296). For this study project, the second approach was used to edit the data.

Support questions

All data collected were compiled and arranged in order to answer two support questions. The first question was' what factors that contribute to low performance of numeracy in primary schools?'. The second question asked for the support systems that are in placed in schools to raise numeracy performance in primary schools. Both support questions will answer the overarching question of 'why there is low performance in numeracy skills in primary schools?'

Triangulation

Triangulation is the combination of two or more data sources to decrease deficiency of single strategy to increase the ability to better interpret the finding (Kimchi,

J., Polivka, B., & Stevenson, J. S. 1991). The data collected from the interviews, questionnaires and lesson observations through qualitative and quantitative approach provided sufficient information on the issue of low performance of numeracy in primary schools.

Coding of data

After editing, it was assumed that the data was clean and ready to be coded. When coding, the variables were measured in research instrument (e.g. if the responses to a question is descriptive, categorical or quantitative). In descriptive, it is describing for example the type of assistance received in numeracy program. In categorical for example responses in level of agreement for example, agree, disagree. Qualitative responses like above average, average, below average were also used in coding. For this study, the data was coded using descriptive and qualitative.

The data that was coded were qualitative and quantitative. For **qualitative** coding, the information was descriptive (eg. example describing how numeracy in-service was carried out in school) or generated through separate qualitative categories (eg. Above average, average, below average) gender (male, female) or an attitude (eg.Strongly favourable, favourable, uncertain, unfavourable). The variables were measured in;

a) Nominal Scale – classifying responses based on a common or shared property or character.

b) Ordinal Scale- from the nominal scale, responses were further categorised into subgroups on basis of a common characteristics in certain descending or ascending order.

Descriptive information goes to **content analysis** where main themes were extracted from the descriptions provided by the respondents to assist in coding the responses.

The way the data was coded depended on the measurement scale in measuring variables at the time of data collection on whether a question is open ended or closed(Kumar, R,. 2014 p.297). Important consideration was given to the types of responses that the instruments would bring into the collection of data.

Developing theme from the data

Themes were developed after reading through the responses and understanding the common meaning (main theme) respondents wanted to communicate. From the responses, themes were developed. The theme became the basis for analysing the unstructured interviews. First codes were assigned to tally the number of times the theme had occurred in the interview. Transcripts of all interviews were classified under different themes. The last thing to do was the integration of themes and responses into the text of own report then interpreting and analysing what the data was showing.

Proposed method of interpretation of data

Interpreting the qualitative data depends on how findings were communicated. There are three ways in writing findings in qualitative research which will be followed;

1. Develop a narrative to describe a situation, episode or event
2. Identify main themes arising from field notes, transcripts of interviews, quoting extensive verbatim (repeated word by word responses).
3. Quantify, by indicating their frequency of occurrence (Kumar, R,. 2014 p.298)

Impacts of the research

It was hoped that the research findings would shed some lights on the impacts of low performance of numeracy skills in primary schools throughout Papua New Guinea. It was assumed that the results for 2008 to 2014, which were not released, will follow the same trend as issues of resource books, teaching strategies and assessment had not been addressed (Devette, &Magury, 2017).

Upon completion of the study of the issue, the findings would be disseminated to the public by way of journal publication and presentation of the paper during conference and/symposiums. The recommendations at the end of the report may be considered by the authorities responsible to carry out detail study of factors that impact teaching of mathematics and evaluation of the low numeracy performance to work towards addressing the issue.

FINDINGS

The study identified that there was an acute shortage of resource books in primary schools. Students had no textbooks to refer to for their mathematics activities or for revision purposes. All the activities were written on the blackboard by teachers who use limited teachers' resource books to develop lessons. Teachers are also faced with similar issue of resource shortages. All the upper primary teachers share resource books and teacher's guides in preparing and delivering lessons. As a result of above challenge in resource shortages, most mathematic teaching strategies were dictated by the issue of resource books. Most teachers resort to blackboard explanation and group work as the common teaching approach to address the large number of students. This two teaching strategies were chosen as best approach which teachers believe will address the large number of students in class.

The study further discovered that there was lack of individual support given to students by the teachers. Teaching must be directly addressing the individual needs of students. All students have different abilities and their

learning intelligences vary that need to be addressed individually (Gardner, 1984). However, teachers are not paying good attention to weak students who need to be attended individually to address their individual learning needs. The crowded rooms leave no space for teachers and students to move around giving a challenge for the teachers to address students' learning needs. All lesson presentations are seen as an 'one fits all' approach which leaves many students not understanding the lessons well. Group work and blackboard teaching strategies are not only seen as effective methods of teaching but also effectives approaches in managing learning in overcrowded classrooms.

There are challenges discovered in learning mathematics in class. The data indicated that much of the challenges had been contributed by the condition of the rooms in which the students are seated for their lessons daily. The volume of noise was too disturbing for concentration in studying or working on the activities. Students seemed to be uncomfortable when seated in the desks. With the age group of between sixteen and eighteen, the spaces were too minimal for three students to sit comfortably. This may be the result why some students find it more comfortable sitting on the floor rather than on the desks. This is a challenge for students in an overcrowded room.

The study further identified that students do not understand most of the lessons presented by teacher. The level of comprehension was low and is a challenge for them when concepts are explained in English as most speak Tokpisin. The teacher use tokpisin and English interchangeably in teaching in class. The study also indicated that teachers lack knowledge on lesson presentation as students find it hard to understand lesson content presented by teachers. This view was supported by the data in figure 3 that presented that forty-nine per-cent (49%) of them said that the resource books were not helpful to their lesson preparations and presentations.

The high enrolment of students leading to overcrowding is a major issue identified in this research. There was overcrowding in the classrooms that raised a lot of challenges in teaching and administration of the students' learning and assessment in class. An overcrowded classroom condition hinders teachers' attention to individual students and slows down the progress of students (Earthman, 2002). The high enrolment of students has resulted resource scarcity in the school and adding more work stress on teachers to cater for the big number of students in designing relevant assessment tasks to meet the needs of students.

Teacher professional development is an important aspect of developing professional growth of teachers. There are a lot of curriculum developments and changes that have happened in the recent times. For example, there was a shift in curriculum from outcomes based to standards based. These new changes need to be well informed by teachers during in-services. However, the study site was having a challenge to have this vital program.

Conclusion

The numeracy performance of grade eight students had been greatly affected by many factors. The schools had been facing resource shortages as a result of the introduction of Tuition Fee Free Policy in 2012. The policy had addressed the Government's vision of greater access to basic education for all school aged children while creating the issue of quality of education at the expense of quantity. The low numeracy performance of grade eight students in Papua New Guinea in the last ten years is a concrete evidence to note that there are weak areas that need to be well supported if we want to take a great step in improving the performance in the coming years. Further studies must be carried out to understand how students can improve the margin to reach eighty (80) as a national pass mark so that they are selected to secondary schools on merits. These studies can be based on how students are supported at home by parents so in their studies.

Further research can be done on how best teachers can be assisted in implementing lesson contents so that students can understand lessons better and score well in mathematics. Other studies can be done to identify ways in which the students' enrolment may be reduced at a reasonable number to certain sizes of rooms. This can give enough room for teachers to work along the required ratio.

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