

Papua New Guinea Sample TIMSS Science Test Report

Analysis of Grade 6, 7 & 8 students' performance of a sample Trends in International Mathematics and Science Study (TIMSS) Science test for Papua New Guinea (PNG)

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Abstract:

The purpose of this report is to highlight Papua New Guinea Primary School students' performance for Science Education. This report is based on a sample TIMSS Science test conducted with a sample population. The items of the sample paper were taken from Grade four Science test for different TIMSS assessment years.

Science is globally seen as the fundamental element to the survival, sustenance and advancement of human life. These vital aspects can only be realised if Science Education has a strong foundation in the school curriculum and is effectively delivered and monitored.

PNG Science curriculum begins at Primary Education level and progresses to higher levels with complex content and context.

A Sample Science test was conducted with Grade six, seven, eight and first year of teacher trainees. The results of the sample test uncovered critical concerns for PNG educators, curriculum planners, teachers and universities to address sooner than later.

The report concluded with practical recommendations for considerations for immediate actions to be taken based on the issues discovered from the findings of the sample TIMSS Science test analysis.

1. Introduction

As the world continues to face the challenges of 21st century, there is no better means of establishing competitive foundation in the current increasingly demanding global economy than having a universal recognition of the effectiveness of a country's education system. This is the key element for any envisaged output of intended social and economic policies.

Education is the main agent of change and is profoundly associated not only in a country's economic and social development but also in the personal development of its population (IEA 2004). It is recognised as one of the principal means whereby

social and economic inequalities and inequities can be minimised.

Consequently, the only means of such world and regional recognition is to undertake regular monitoring of educational performance and its experiences and practices that go with it. This is fundamentally important because how and what decisions basic policy makers, administrators, teachers or main stakeholders make in the educational arena and how and what information education system will deliver and shape lie at the heart of international and regional studies of education like Trends in International Mathematics and Science Study (TIMSS), Early Grade Reading Assessment (EGRA), Programme for International

Student Assessment (PISA) or the Pacific Island Literacy and Numeracy Assessment (PILNA).

About PNG sample TIMSS science test report

This report contains information about a sample Trends in International Mathematics and Science Study (TIMSS) Science test conducted in Papua New Guinea. The test was administrated by Naruto University of Education academic professors who were part of JICA trainers and consultants assigned to PNG. This study is first of its kind in PNG for science education at Primary Education level to experience the kind of science content, contextual understanding and the application of scientific knowledge and reasoning skills which are assessed globally. This sample science test acts as an international instrument tested in PNG to assess the effectiveness of science teaching and the level of performance standards. The results of the sample test shows an image of PNG science literacy and performance against other countries globally. The results are presented for the general and overall performance and it also breaks down into gender, grades and schools.

2. What is Trends in International Mathematics and Science Study (TIMSS)?

Trends in International Mathematics and Science Study (TIMSS) is a series of International Assessments of the Mathematics and Science knowledge of students around the world. The participating students come from a diverse set of educational systems (countries or regional jurisdictions of countries) in terms of economic development, geographical location, and population size. TIMSS is one of the studies established by the International Association for the Evaluation of Educational Achievement (IEA) aimed at allowing educational systems to compare students' educational achievement and learn from the experiences of others in designing effective education policy. This study was first conducted in 1995, and has been performed every 4 years thereafter. In most of the cycles the study assesses 4th and 8th grade students. Therefore, some of the participating educational systems have trend data across assessments from 1995 to 2011 (IEA 2004)

3. Significance of Science Education

Science is fundamental in life because it has direct application to nearly all aspects of life and society, from sustaining human survival through the maintenance and improvement of human health to understanding and solving local, regional, and global environmental issues. Students need vital foundation in early scientific literacy to enable them to acquire basic scientific knowledge and thinking and reasoning skills not only to be thoughtful citizens engaged in public discussions on important social issues involving science, but also to be prepared to make contributions through a wide range of careers in science, medicine, and technology. Science education provides a critical foundation for students' future careers and life success.

4. Significance of the Sample TIMSS science test report

There are four categories of significance for this same timss report; International, National, community, and the teacher training level. At the international level, this report will inform our international partners in education about Papua New Guinea's academic performance level against international benchmarks as part of the global partner.

At the National level, it will provide insights to the country in general on the type of science knowledge and skills planned and delivered at the foundational years of learning and how well this knowledge is comprehended and applied in different contexts. In addition it indicates the level of performance for Papua New Guineans against the international science benchmarks.

At the community level, the report will inform the schools and the teachers about the acquisition and application of basic science knowledge and skills in the daily lives. It will influence and motivate them to reassess and review their normal practices, strategies and resources and to aim at improving the quality and the effectiveness of science lessons delivery and the output expected from the students.

At the Teacher Education Division, it will motivate the training sector to ensure that the science curriculum is appropriately planned and aligned to the overall national science curriculum.

Most importantly, that the students are adequately and correctly trained on various scientific skills and concepts. Thus, as new teachers, they should be able to deliver correct knowledge and skills to the students and these knowledge and skills can be sustained overtime which will in turn influence both effective teaching and learning and high achievement standards for PNG.

5. Papua New Guinea Science Education in context

In PNG, science is one of the core or compulsory subjects taught in the schools.

The current science curriculum at Primary level is organised into two sub-levels. The lower primary curriculum and the upper primary curriculum with "Environmental Studies" course at lower primary and 'science' at upper primary. In addition, the focus for Environmental Studies is mainly on Life Science relating to the environment and what is around the environment, the features, usage, management and protection of environment.

The science at upper primary teaches Life Science (Living things), Physical Science (Science in the Home), Earth Science (Earth and beyond) and also emphasis working scientifically as an important element that teaches students how to apply scientific skills in different contexts.

6. Profiles of the country and participating institutions

Geographically, Papua New Guinea (PNG) lies in the Southern Hemisphere just below the equator in the Eastern South Pacific. The country shares its island with her neighbouring country of Indonesia. Her other nearest neighbours include Solomon Islands and Nauru to the east, Australia to the South, and Federated States of Micronesia to the North. PNG has a land area of approximately four hundred and sixty three thousand square kilometres (463 000 km²). The land is made up of different physical features such as swamps, mangroves, lakes and rivers, mountains and foothills, savannah, grassland, beaches and ridges and forest. According to the 2011 National census, PNG has a population of about seven million, of which eighty five (85%) percent are rural dwellers and fifteen (15%) percent are urban. PNG also has a remarkable growth rate of about 2.9% annually.

6.1 Profiles of the participating schools

There were four institutions involved in the sample TIMSS Science test. For the benefit of this report, the three primary schools will be labelled as A, B, C and D for the Primary Teacher training College.

Primary school A: The school is located in Central Province, outskirts of Port Moresby, the capital city of Papua New Guinea and is about forty five minutes' drive from the capital city. It is a rural school. The students' main language of communication or their lingua-Franca is Hiri Motu. English language is used as the language of instruction in the school.

Primary School B: The school is located in the North West of Port Moresby and is about twenty two kilometres from the capital city. The school is one of the semi-rural schools of Central Province situated in one of the busiest industrial spots in PNG. The students' main language of communication is Hiri Motu. English language is the language of instruction in the school.

Primary School C: Primary School C is an urban school situated in the capital city of Port Moresby. The students come from different parts of Papua New Guinea. The language of instruction is English and the main communication language students' use outside of the school is Tok Pisin. The school has one of the highest enrolment population in the city and also one of the top academic performing primary schools in Papua New Guinea.

Teachers college D: Teacher College D is a teacher training institute for primary school teachers. It is located outside of Port Moresby and is about 30 minutes' drive from Jacksons International Airport. It is one of the teachers' college that has a large portion of its enrollment from very remote parts of Papua New Guinea. The language of instruction for the training institutions is English while a combination of English and Tok Pisin is the daily language of communication.

6.2 About PNG curriculum Development

Papua New Guinea has a centralised national curriculum. The development of National Education Goals and intended curriculum are administrated and managed by the Ministry of Education through Curriculum Development Division. The curriculum developed is not subject to change by the teachers

at the school level rather teachers are encouraged to be creative and effective in the delivery of the prescribed curriculum. The Curriculum Development Division structure is categorized according to the schooling level; Elementary, Primary and Secondary. The Elementary has three sub-level; Elementary Preparatory, Elementary one and Elementary two. The Primary level consist of two sub-levels; lower primary that consists of Grade 3, 4, and 5 while the senior primary consists of Grade 6, 7 and 8. The Secondary level has two sub-levels; Lower secondary that consists of Grade 9 and 10 and Upper Secondary that has Grade 11 and 12. The curriculum is planned and designed according to these categories.

The curriculum is organized into Key Learning areas which form as the main organizers of the entire curriculum. There are five Key Learning Areas which include; Language, Mathematics, Science, Personal Development and Culture and Community. The subjects for each of the levels of learning are then organized into each of the key learning areas according to the compatibility of the knowledge, skills and attitude. The curriculum materials are then planned and developed according to the goals and intentions of the curriculum and Education vision.

PNG National Education System is mandated and guided by the following mission statement

To facilitate and promote the integral development of every individual, develop and encourage an educational system which satisfies the requirement of Papua New Guinea and its people, establish, preserve and improve standards of education throughout Papua New Guinea, make the benefits of such education available as widely as possible to all of the people and make education accessible to the poor and physically, mentally and socially handicapped as well as to those who are educationally disadvantage. (NDOE 1983)

7. How was the TIMSS science test designed and administrated?

The sample TIMSS Science test was designed by abstracting test items which were administrated from the previous Fourth Grader TIMSS science test (2003, 2007 and 2011) and combined to form as a sample test and administrated to PNG sample population. The items tested content, cognitive domains and scientific skills from the following

science categories: Life science, Physical science and Earth Science. The sample test was compiled to test students understanding of simple and complex information, the ability to use simple tools and machines, understanding of daily routines, procedures and science processes and investigating and understanding the natural world around them. The rationale was to assess the students' demonstration of strength in knowing science against applying scientific knowledge and reasoning skills. The sample test was conducted with Grade 6, 7, 8 and teacher trainees of a teachers college with the ages range from 10 years youngest to 38 years oldest. A total of 12 test items were identified and selected with a fifteen point responses taking into account item number 8 which had four responses for the item.

7.1 TIMSS science content domains assessed

According to TIMSS Science Assessment Framework 2007, the three science content domains which covered the science topic areas and assessed in TIMSS 2007 for Grade four level included; Life Science, Physical Science, Earth Science. The framework contained the topic areas of each content domain which also included the following: *Life science*: Characteristics and life processes of living things; life cycles, reproduction, and heredity; interaction with the environment; ecosystems; human health. *Physical Science*: Classification and properties of matter; physical states and changes in matter; energy sources, heat, and temperature; light and sound; electricity and magnetism; forces and motion. *Earth Science*: Earth's structure, physical characteristics, and resources; Earth's processes, cycles, and history; Earth in the solar system. (Mullis, I.V.S.et al. TIMSS 2007)

The Cognitive domains used in the test corresponded to the test items that students required for the content and the skills were organized into three main domains: Knowing, Applying and reasoning. *Knowing* included the following skills: Recall and recognize; define; describe; illustrate with examples; use tools and procedures. *Applying*: Compare, contrast, classify; use models; relate; interpret information; find solutions; explain. *Reasoning*: Analyze, solve problems; integrate, synthesize; hypothesize, predict; design, plan; draw conclusions; generalize; evaluate; justify. (Mullis, I.V.S.et al. : TIMSS 2007)

7.2 Total number of participants in each school and grade

Table 1: Total number of respondents per school

| Schools | Frequency | Percent |
|---------|-----------|---------|
| A | 92 | 24.7 |
| B | 102 | 27.4 |
| C | 94 | 25.3 |
| D | 84 | 22.6 |
| Total | 372 | 100.0 |

Table 2: total number of respondents per grade

| Grade | Frequency | Percent |
|--------|-----------|---------|
| 6 | 134 | 36.0 |
| 7 | 78 | 21.0 |
| 8 | 76 | 20.4 |
| year 1 | 84 | 22.6 |
| Total | 372 | 100.0 |

7.3 Age and Gender frequency of participants

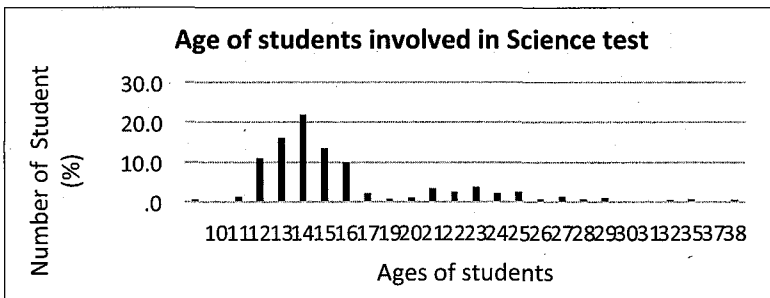


Figure 1: ages of students

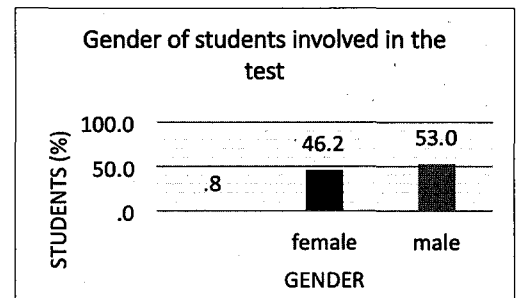


Figure 2: gender/sex of students

7.4 Content & context of sample test items

Table 3: Content, context & performance of test items

| Main science category | Content topics | Cognitive domain and the facilitating items |
|-----------------------|--|--|
| Life Science | Structure, functions and life process in organisms, Reproduction Interaction with the environment | Conceptual understanding, reasoning Items: 1, 7, 12 |
| Physical Science | Forces and motion Chemical change Physical states and changes in matter, Properties of matter | Reasoning and analysis, Conceptual understanding and applying Items: 2, 3, 5, 6, 9, 11 |
| Earth Science | Earth in the solar system & universe, Earth processes Earths structure & physical features | Conceptual understanding and Applying Items: 4, 8, 10 |

The table above shows the science category, content and the cognitive domain tested in the sample TIMSS Science test. The content and cognitive domain were based on the TIMSS benchmarks for fourth graders and tested with grade six, seven and eight students in Papua New Guinea.

8. Results of the sample TIMSS test performance

8.1. Overall performance for the total respondent population

Figure 3 shows the overall performance of the respondents for the sample TIMSS science test. The

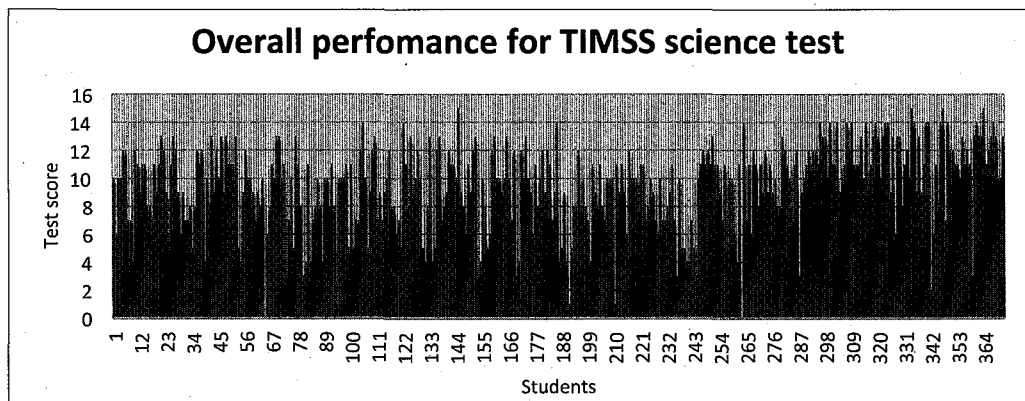


Figure 3: Performance of total sample student population

test total score point was fifteen (15). Also in Figure 3, it shows that they were few respondents with high accuracy and few with extremely low accuracy

while the majority scored between six and ten score points.

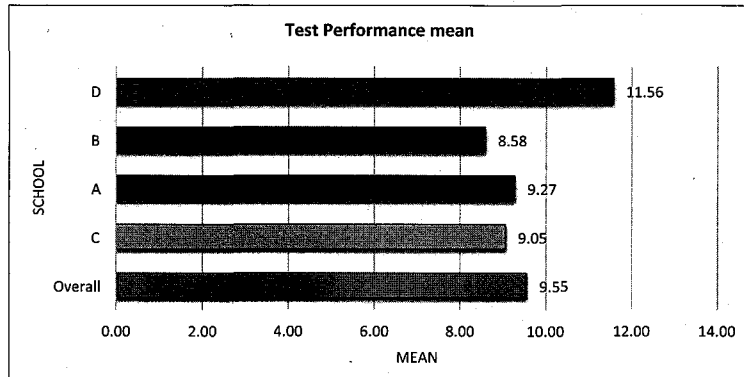


Figure 4: School performance mean

The graph shown in figure 4 shows the mean performance of participating schools

According to the information, the average score the Primary schools achieved was below ten points. The results shows that Primary school A had the highest mean, then followed by Primary School C and Primary School B respectively. School D (Teachers College) had a performance mean of 11.56.

8.2 Primary School performance for specific items

Out of the three hundred and seventy two (372) respondents, two hundred and eighty (288) eight were primary school students of which forty seven percent (47%) were grade 6, twenty seven (27%) grade 7 and twenty six (26%) were grade 8 students. The subsequent pages show the performance of primary school respondents according to the schools, sex groups and grade levels.

Table 4 shows the accuracy level for each school for each test item or question.

Table 4: School performance and accuracy for each item

| School | Percentage (%) of correct answer | | | | | | | | | | | |
|---------------|----------------------------------|------|------|------|------|------|------|------|------|------|------|------|
| | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 |
| A | 96.7 | 37 | 63 | 73.9 | 50 | 53.3 | 48.9 | 69.6 | 41.3 | 72.8 | 33.7 | 62 |
| B | 99 | 25.5 | 57.8 | 84.3 | 40.2 | 47.1 | 41.2 | 62.7 | 45.1 | 63.7 | 30.4 | 48 |
| C | 95.7 | 25.5 | 61.7 | 78.7 | 45.7 | 53.2 | 29.8 | 75.5 | 54.3 | 67 | 27.7 | 60.6 |
| Overall (%) | 97.2 | 29.2 | 60.8 | 79.2 | 45.1 | 51 | 39.9 | 69.1 | 46.9 | 67.7 | 30.6 | 56.6 |
| International | 86.4 | 44 | 66.1 | 69.9 | 56.6 | 72.1 | 61 | 58.4 | 55.9 | 68.9 | 39.3 | 56 |

According to table 4, it was interesting to note that the respondents performed relatively low in most of the physical science items. The shaded boxes indicated that the accuracy of that particular item is lower than the Grade 4 international average accuracy. It also indicated that the schools had difficulty with

the conceptual understanding and application of knowledge and skills for physical science items. The low performance on physical science curriculum could be caused by poor lesson delivery and lack of practical experiments or that the curriculum content is poorly aligned at the Primary education level.

8.3 Grade performance for specific items

Table 5: Grade accuracy for each item in percentage (%)

| Grade | Percentage (%) of correct answer | | | | | | | | | | | |
|---------------|----------------------------------|------|------|------|------|------|------|------|------|------|------|------|
| | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 |
| 6 | 97 | 23.1 | 59.7 | 79.1 | 44.8 | 46.3 | 34.3 | 72.4 | 52.2 | 64.2 | 28.4 | 57.5 |
| 7 | 100 | 32.1 | 59 | 80.8 | 43.6 | 46.2 | 32.1 | 62.8 | 35.9 | 69.2 | 39.7 | 59 |
| 8 | 94.7 | 36.8 | 64.5 | 77.6 | 47.4 | 64.5 | 57.9 | 69.7 | 48.7 | 72.4 | 25.0 | 52.6 |
| Total | 97.2 | 29.2 | 60.8 | 79.2 | 45.1 | 51 | 39.9 | 69.1 | 46.9 | 67.7 | 30.6 | 56.6 |
| International | 86.4 | 44 | 66.1 | 69.9 | 56.6 | 72.1 | 61 | 58.4 | 55.9 | 68.9 | 39.3 | 56 |

According to table 5, PNG Upper primary (Grade 6, 7 & 8), accuracy level for the twelve science items tested is relatively lower than the Grade 4 international accuracy average. Out of the twelve items, there were only four items that PNG's accuracy was higher than the Grade 4 international accuracy average.

There are several factors that could have influence students performance standards in science. Firstly there is a possibility that the curriculum

content is not aligned well to the assessment and instruction. Secondly, there could be lack of effective teaching in the classrooms. Or there could be limited resources to support science lesson delivered. The significance of this image is that the disparity of science performance between PNG upper primary students' and Grade 4 students on average globally is a concern that should be addressed at the national level immediately.

8.4 Gender accuracy for specific items

Table 6: Gender accuracy for each item

| Sex | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 |
|------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Female | 95.6 | 31.6 | 62.5 | 75.7 | 45.6 | 55.1 | 46.3 | 69.8 | 49.3 | 64 | 27.9 | 52.9 |
| Male | 98.7 | 27.3 | 59.3 | 82 | 44.7 | 47.3 | 34 | 70 | 45.3 | 70.7 | 33.3 | 60 |
| Intaverage | 86.4 | 44 | 66.1 | 69.9 | 56.6 | 72.1 | 61 | 58.4 | 55.9 | 68.9 | 39.3 | 56 |

According to table 6, it shows that the Grade 6, 7 and 8 male and female respondents had difficulties with physical science items. The shaded boxes shows the accuracy percentage that are lower than the international average accuracy percentage for grade 4 respondents of TIMSS tests. The table also indicates that the male respondents performed slightly better than the female respondents in the sample test.

The significance of the information above is that the level of misconception for physical science

is almost the same for both male and female respondents at the senior primary school level. This could be due to teaching effectiveness issues or the science curriculum development related issues.

8.5 Teacher Training College performance

The information below on table 7 highlights the performance of the Teacher Training College respondents. It also shows the accuracy levels of the sex groups for each item of the sample TIMSS science test.

Table 7: Teacher Training College performance and accuracy for each item

| TTC | Percentage (%) of accuracy from the teacher trainees respondents | | | | | | | | | | | |
|---------------|--|------|------|------|------|------|------|------|------|------|------|------|
| | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 |
| Overall | 86.9 | 69 | 71.4 | 96.4 | 67.9 | 65.5 | 82.1 | 85.7 | 77.4 | 88.1 | 34.5 | 72.6 |
| Female | 94.6 | 59.5 | 67.6 | 97.3 | 59.5 | 70.3 | 81.1 | 91.9 | 81.1 | 86.5 | 29.7 | 73 |
| Male | 80.9 | 76.6 | 74.5 | 95.7 | 74.5 | 61.7 | 83.0 | 80.9 | 74.5 | 89.4 | 38.3 | 72.3 |
| International | 86.4 | 44 | 66.1 | 69.9 | 56.6 | 72.1 | 61 | 58.4 | 55.9 | 68.9 | 39.3 | 56 |

According to the information on table 7, the respondents from the Teacher training College performed relatively well although the level of misconception of various science content and context is still observed. It also shows that the performance for item 11 is extremely low. There is a possibility that the lessons conducted lacked practical

experiments and secondly it is possible that the content is missing in the science curriculum.

In addition, the information shows that the performance of male and female respondents was almost similar although there were slight differences observed.

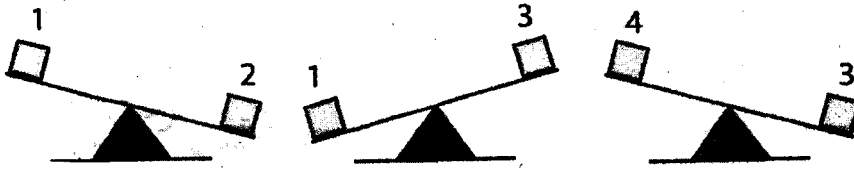
9.Examples of specific item performance and accuracy

TIMSS Science test 2011: Item 2 sample test

Content: Physical Science: Forces and motion;

Cognitive domain: Reasoning

Stephanie has a balance and four cubes (1,2,3,4). The cubes are made of different materials. She puts two cubes at a time on the balance and observes the following results.



What can she conclude about the weight of cube 2?

- ① It is heavier than cubes 1, 3, and 4
- 2. It is heavier than cubes 1 but lighter than cubes 3 and 4
- 3. It is heavier than cubes 3 but lighter than cubes 1 and 4
- 4. It is heavier than cubes 4 but lighter than cubes 1 and 3

| Question 2 | Frequency | Percent |
|------------|-----------|---------|
| error | 12 | 4.1 |
| 1 | 84 | 29.2 |
| 2 | 91 | 31.6 |
| 3 | 50 | 17.4 |
| 4 | 51 | 17.7 |
| Total | 288 | 100.0 |

Table 8: item 2 performance

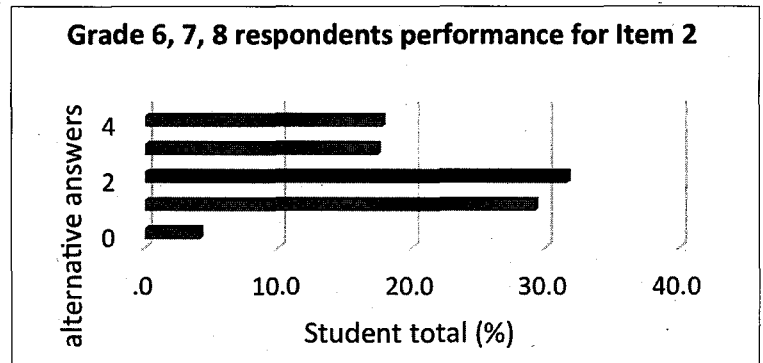


Figure 5: Item 2 performance for primary school respondents

Item 2 tested students' ability to analyse and reason things using a simple balance. Table 8 shows that students had difficulty in analyzing and reasoning the given situation and the level of misconceptions was very high in this science area.

What is significant about this item is that the image could be a representation of the actual situation experienced by the students.

There are number of possible causes for the above performance. Firstly, the teaching effectiveness and practical experiments at that level is lacking, secondly there is a misalignment of science Curriculum from one level to another. Finally, it is possible that the essential resources such as textbooks are not available to support teaching and learning.

TIMSS Science test 2003: Item 3 sample test

At the fourth grade, the aim was to assess students having had four years of formal schooling. This is an item that students reaching the

intermediate benchmark are likely to answer correctly.

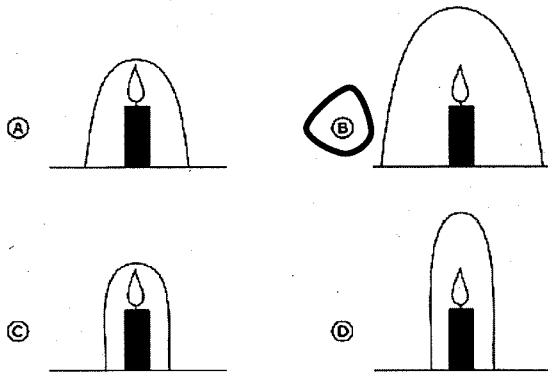
Content: Physical Science

Description: Recognize that a candle in the largest sealed container will be the last to go out.

The picture below show four identical burning candles. Each is covered by a glass container of a different size. Which candle flame will be the last to go out?

Table 9 below shows that the respondents at Grade six, seven and eight performance was lower than the Grade four students at the international level. The Grade 4 international average accuracy for this item was 66%.

The significance of this result is that the level of misconception at upper primary is quite evident.



| Question 2 | Frequency | Percent |
|------------|-----------|---------|
| error | 6 | 2.1 |
| A | 5 | 1.7 |
| B | 175 | 60.8 |
| C | 77 | 26.7 |
| D | 25 | 8.7 |
| Total | 288 | 100.0 |

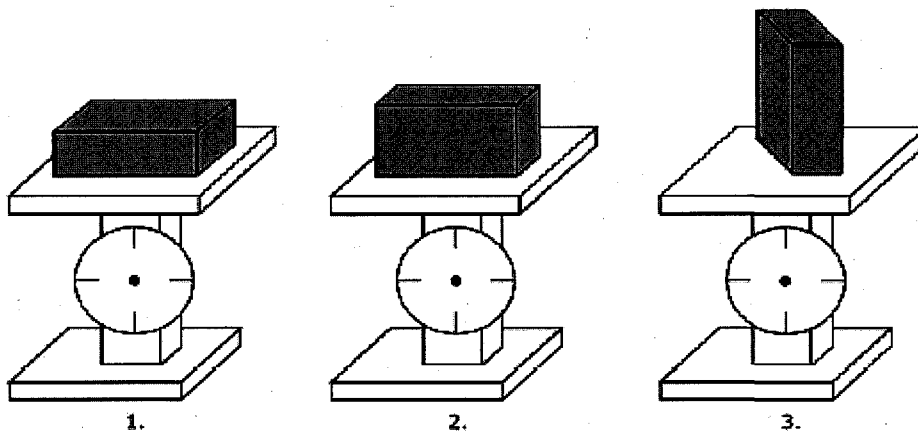
Table 9: item 3 performance

There is a possibility that the respondents were unable to understand the instruction due to language comprehension difficulty or that content of this science area was not taught accordingly.

TIMSS Science test 2007: Item 6 sample test

Content: Physical Science: Cognitive domain; reasoning and analyzing

The same brick is put on a scale in three different ways.



What will the scale show?

1. 1 will show the greatest weight.
2. 2 will show the greatest weight.
3. 3 will show the greatest weight.
- ④ All will show the same weight

| Question 2 | Frequency | Percent |
|------------|-----------|---------|
| error | 7 | 2.4 |
| 1 | 40 | 13.9 |
| 2 | 59 | 20.5 |
| 3 | 35 | 12.2 |
| 4 | 147 | 51.0 |
| Total | 288 | 100.0 |

Table 10: item 6 performance

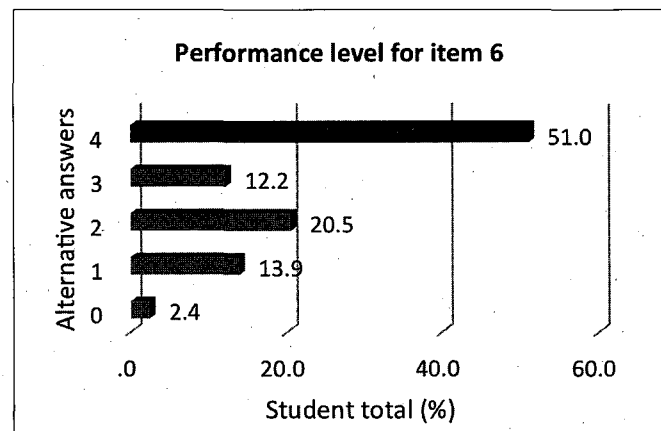


Figure 6: item 11 level of accuracy

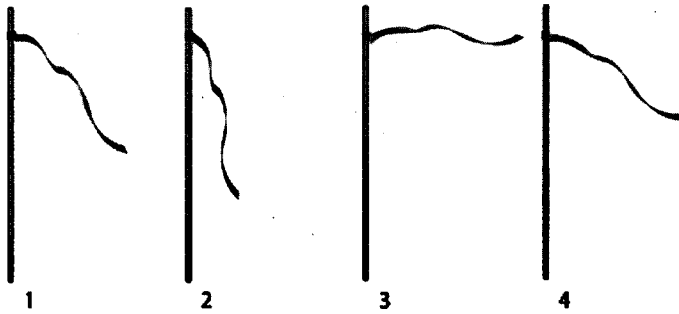
The results of item 6 shows that half of the respondents had misconceptions about the concept and the cognitive domain tested. The Grade 4 international average for this item is 72%

The misconception could be caused by either not teaching the concept effectively or that the content is not properly aligned across the grade levels.

TIMSS Science test 2007: Item 8 sample test

Content: Earth Science: Earth processes; cognitive domain: Applying.

A ribbon is tied to a pole to measure the wind strength as shown below.



Write the number 1, 2, 3, 4 in the correct order that shows the wind strength from the strongest to weakest.

Answer: _____, _____, _____, _____

Table 8: Percentage of frequencies for item 8.

The correct response for this item is in this order: 3, 4, 1, and 2.

Incorrect responses include having it in reversed

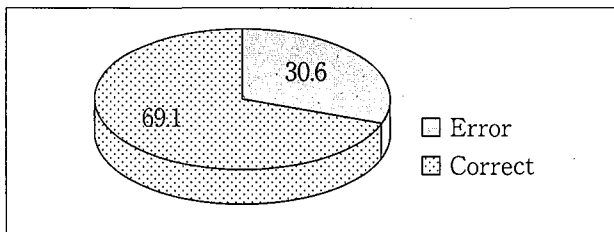


Figure 7: item 8 level of accuracy

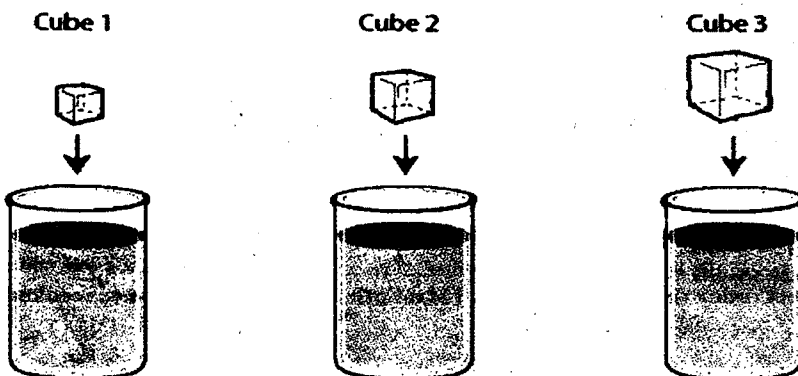
order, mixed sequence, crossed out, not marked and erased numbers against the pole.

The pie graph shows that about 69% of the respondents got the order correct while about 31% had difficulty in ordering the strength of the wind according to the item.

TIMSS Science test 2007: Item 11 sample test

Content: Earth Science: Physical Science; Properties of matter: cognitive domain: Applying

[11] Susie has three ice cubes of different sizes She places each ice cube into a the same volume of water, as shown in the diagram.



What happens to the ice cubes when they are placed in the water?

- ① Cubes 1, 2, and 3 will sink.
- ② Cubes 1, 2, and 3 will float
- ③ Cube 1 will float, and cubes 2 and 3 will sink.
- ④ Cubes 1 and 2 will float, and cube 3 will sink.

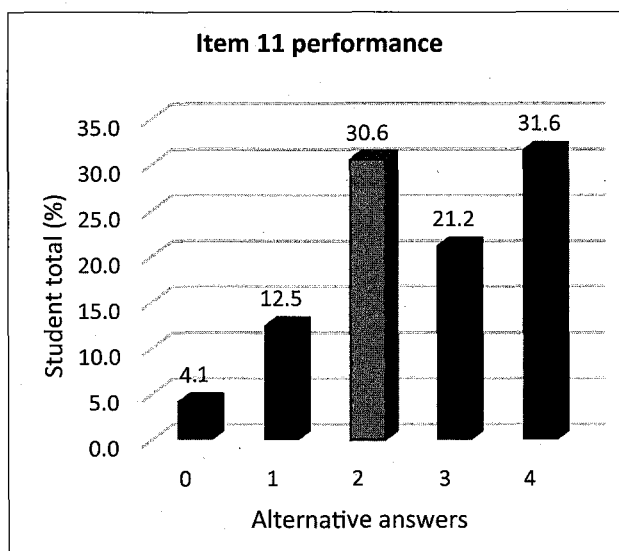


Figure 8: item 11 level of accuracy

Figure 8 shows that the level of accuracy for item 11 is very low. Out of the 288 respondents, only 30.6% got the answer correct while majority of the respondents had wrong answer.

It indicates that the level of misconception is high among the respondents and this could relate to the actual situations in the schools.

From the item, it also illustrates the performance level of Grade 6, 7 and 8 for the physical science

content and cognitive domain tested.

There is a possibility that the student are unable to contextualise the content or that the physical science lessons need to be effectively taught in the schools.

10. Assessing the influences of choices between items

Item 9 influence on item 11

Table 11: Comparing item 9 influence on item 11

| Question 9 | | Question 11 | | | | | Total | |
|------------|--------------|--------------|-------|-------|-------|-------|-------|-------|
| | | 0 | 1 | 2 | 3 | 4 | | |
| Question 9 | 0 | Count | 4 | 2 | 8 | 2 | 0 | |
| | | % within Q9 | 26.7% | 56.7% | 53.3% | 13.3% | 0% | 100% |
| | | % within Q11 | 33.3% | 2.8% | 9.1% | 3.3% | 0% | 5.2% |
| | 1 | Count | 0 | 0 | 7 | 4 | 4 | 15 |
| | | % within Q9 | 0% | 0% | 46.7% | 26.7% | 26.7% | 100 |
| | | % within Q11 | 0% | 0% | 8% | 6.6% | 4.4% | 5.2% |
| | 2 | Count | 1 | 16 | 46 | 29 | 43 | 135 |
| | | % within Q9 | 0.7% | 11.9% | 34.1% | 21.5% | 31.9% | 100% |
| | | % within Q11 | 8.3% | 44.4% | 52.3% | 47.5% | 47.3% | 46.9% |
| | 3 | Count | 6 | 14 | 20 | 22 | 37 | 99 |
| | | % within Q9 | 6.1% | 14.1% | 20.2% | 22.2% | 37.4% | 100% |
| | | % within Q11 | 50% | 38.9% | 22.7% | 36.1% | 40.7% | 34.4% |
| 4 | Count | 1 | 4 | 6 | 4 | 7 | 22 | |
| | % within Q9 | 4.5% | 18.2% | 27.3% | 18.2% | 31.8% | 100% | |
| | % within Q11 | 8.3% | 11.1% | 6.8% | 6.6% | 7.7% | 7.6% | |
| Total | Count | 12 | 36 | 88 | 61 | 91 | 288 | |
| | % within Q9 | 4.2 | 12.5 | 30.6 | 21.2 | 31.6 | 100 | |
| | % within Q11 | 100 | 100 | 100 | 100 | 100 | 100 | |

Item 9 and item 11 of the sample test both assessed the science category physical science on the content topic, properties of matter and cognitive domain; applying. Table 11 shows the influence of item

9 on item 11 choice and accuracy. The information indicated that although there was slight influence of item 9 to item 11, it did not have a great influence and impact on the accuracy level of both items.

Item 10 influence item on 11

Table 12: Comparing item 10 influence on item 11

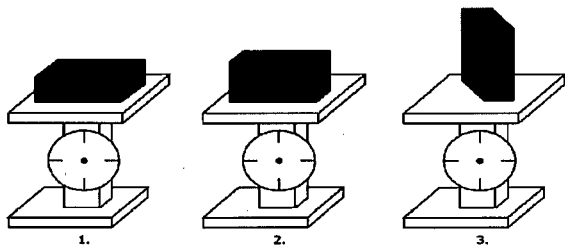
| | | Question 11 | | | | | Total | |
|-------------|--------------|--------------|-------|-------|-------|-------|-------|-------|
| | | 0 | 1 | 2 | 3 | 4 | | |
| Question 10 | 0 | Count | 7 | 0 | | 1 | 1 | 9 |
| | | % within Q10 | 77.8% | 0% | 0% | 11% | 11% | 100% |
| | | % within Q11 | 58.3% | 0% | 0% | 1.6% | 1.1% | 3.1% |
| | A | Count | 0 | 7 | 19 | 12 | 29 | 67 |
| | | % within Q10 | 0% | 10.4% | 28.4% | 17.9% | 43.3% | 100 |
| | | % within Q11 | 0% | 19.4% | 21.6% | 19.7% | 31.9% | 23.3% |
| | B | Count | 4 | 25 | 62 | 46 | 58 | 195 |
| | | % within Q10 | 2.1% | 12.8% | 31.8% | 23.6% | 29.7% | 100% |
| | | % within Q11 | 33.3% | 69.4% | 70.5% | 75.4% | 63.7% | 67.7% |
| | C | Count | 1 | 2 | 4 | 0 | 1 | 8 |
| | | % within Q10 | 12.5% | 25% | 50% | 0% | 12.5% | 100% |
| | | % within Q11 | 8.3% | 5.6% | 4.5% | 0% | 1.1% | 2.8% |
| D | Count | 0 | 2 | 3 | 2 | 2 | 9 | |
| | % within Q10 | 0% | 22.2% | 33.3% | 22.2% | 22.2% | 100% | |
| | % within Q11 | 0% | 5.6% | 3.4% | 3.3% | 2.2% | 3.1% | |
| Total | Count | 12 | 36 | 88 | 61 | 91 | 288 | |
| | % within Q10 | 4.2% | 12.5% | 30.6% | 21.2% | 31.6% | 100% | |
| | % within Q11 | 100 | 100 | 100 | 100 | 100 | 100 | |

Secondly, a cross tabulation was done on item 10 and item 11 to check if the former choice had an influence on the latter. Table 12 shows the significance level of one choice to another. According to the information, the choices made for item 10 had some influence on item 11 alternative choices which also had an effect on the accuracy level.

Item 6 influence on item 11

The content of Item 6 and item 11 were based on Properties of matter in Physical Science domain. The students were tested on the application of the skills of reasoning and analysis based on the conceptual understanding of the curriculum content.

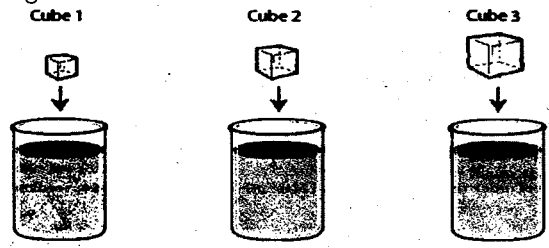
The same brick is put on a scale in three different ways.



What will the scale show?

1. 1 will show the greatest weight.
2. 2 will show the greatest weight.
3. 3 will show the greatest weight.
4. All will show the same weight

Susie has three ice cubes of different sizes. She places each ice cube into an identical beaker containing the same volume of water as shown in the diagram.



What happens to the ice cubes when they are placed in the water?

1. Cubes 1, 2 and 3 will sink.
2. Cubes 1, 2 and 3 will float
3. Cube 1 will float and cube 2 and 3 will sink.
4. Cubes 1 and 2 will float and cube 3 will sink.

Table 13: Comparing Item 6 influence on item 11

| | | Q11 | | | | | Total | |
|-------|--------------|--------------|--------|--------|--------|--------|--------|--------|
| | | Error | 1 | 2 | 3 | 4 | | |
| Q6 | Error | Count | 1 | 0 | 3 | 2 | 1 | 7 |
| | | % within Q6 | 14.3% | 0.0% | 42.9% | 28.6% | 14.3% | 100.0% |
| | | % within Q11 | 7.7% | 0.0% | 2.6% | 2.7% | 0.9% | 1.9% |
| | 1 | Count | 3 | 5 | 16 | 11 | 17 | 52 |
| | | % within Q6 | 5.8% | 9.6% | 30.8% | 21.2% | 32.7% | 100.0% |
| | | % within Q11 | 23.1% | 10.0% | 13.7% | 14.7% | 14.5% | 14.0% |
| | 2 | Count | 2 | 13 | 19 | 10 | 21 | 65 |
| | | % within Q6 | 3.1% | 20.0% | 29.2% | 15.4% | 32.3% | 100.0% |
| | | % within Q11 | 15.4% | 26.0% | 16.2% | 13.3% | 17.9% | 17.5% |
| | 3 | Count | 3 | 5 | 9 | 12 | 16 | 45 |
| | | % within Q6 | 6.7% | 11.1% | 20.0% | 26.7% | 35.6% | 100.0% |
| | | % within Q11 | 23.1% | 10.0% | 7.7% | 16.0% | 13.7% | 12.1% |
| | 4 | Count | 4 | 27 | 69 | 40 | 62 | 202 |
| | | % within Q6 | 2.0% | 13.4% | 34.2% | 19.8% | 30.7% | 100.0% |
| | | % within Q11 | 30.8% | 54.0% | 59.0% | 53.3% | 53.0% | 54.3% |
| Total | Count | 13 | 50 | 117 | 75 | 117 | 372 | |
| | % within Q6 | 3.5% | 13.4% | 31.5% | 20.2% | 31.5% | 100.0% | |
| | % within Q11 | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | |

The information from table 13 shows that item 6 had slight influence on the accuracy level of item 11 however it was not significant. From the cross tabulation analysis, we can say that the students' comprehensiveness about the content connectedness of the two items was limited thus resulting in marking their choices randomly.

We can conclude that the particular cognitive domain is either not taught accordingly or that the specific science curriculum content is missing.

11. Conclusion

To conclude, the information from the sample TIMSS Science test has provided a strong insight for the general level of science education; the understanding and the application of what is acquired from the daily classroom lessons in PNG. A total of three hundred and seventy two (372) respondents were involved from three Primary Schools and one Teacher Training Institute. Two hundred and eighty eight (288) out of the total respondents were primary school students. The test was conducted with Grade 6, 7, 8 students and teacher trainees. The ages for Primary school students ranged from 11 years to 16 years old while the teacher trainees ages

ranged from 19 years old to 38 years old. Out of the total number of respondents involved in the test, fifty three percent (53%) were male respondents while forty six percent (46%) were female respondents. There was a fair representation of rural, semi-urban and urban school context involved in the test despite the fact that the test was conducted in one region only.

The information from the report shows a snapshot of PNG Primary school students' level of scientific literacy and their capacity to define or comprehend scientific concepts, analyse questions or problems and apply required knowledge and skills to solve a given problem. The sample population had problems with reasoning, analysing and applying appropriate skills for different science domains presented. The signs generated from the results of the sample test imply that the primary students generally lack the necessary knowledge and skills to connect scientific concepts to daily situations as reflected in item two, three and item eight.

The significance about this sample TIMSS Science test analysis result was that the items tested were for grade 4 students which TIMSS tested in the previous assessment periods? The overall result shows that PNG performance at upper primary

is relatively lower than the international average performance for Grade four level.

The factors influencing such performance and achievement standards can vary from the quality of teaching and teaching environment to the quality of curriculum materials and the alignment of content standards or learning outcomes to the instructions and assessment. These are just few of the many assumptions and justifications for poor performance in science.

Hence, in order to improve the state of Science education at the Basic Education level in PNG, it is vital to undertake the following as critical recommendations.

Firstly, revisit our curriculum and assess the alignment of the curriculum, assessment and instruction from level one to the last level (Grade 12). Secondly, review and revise the teaching materials and the strategies applied including the science resources supplied or used for teaching science. Thirdly, review the training materials and strategies for the teacher trainees for Elementary and Primary level. There should have prerequisites in place for graduating teacher trainees for all subjects including science before the graduands are sent to the field or employed by the Teaching Service Commission of Ministry of Education.

PNG is part of the global society therefore, the science education planned and delivered should also be in line with the global benchmarks and to meet

the acceptable globally standards. In addition, we should be teaching a science education that will empower the students to use science as a tool in addressing a variety of daily problems and needs including addressing the environmental, social and other related issues in the community. The vehicle to drive this agenda is through education agencies therefore it is vital for the National Department of Education through Curriculum Development Division to review the science education to address the lowering scientific performance standards discovered in the sample TIMSS science test.

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