Study Note

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A Comparative Analysis of Malawi and Japanese Mathematics Textbooks

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Abstract：This write up is an analysis of the Japan and Malawi Mathematics textbooks' composition and structure, to establish how best they are well designed to help learners achieve the noble objective of critical skills acquisition. It is being written as a step towards a research being conducted aiming at comparing and contrasting the Japanese and Malawian Mathematics content and teaching strategies and methodologies in as far as the element of instilling thinking in learners is concerned.

1. Introduction and background information

The Fourth Sustainable Development Goal on Education (SDG 4) calls to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all". Access to appropriate learning materials is listed as a key strategy for achieving the first means of implementation under SDG4 related to providing inclusive and effective learning environments for all. This therefore explains the need for textbooks in education and why must not only be available to learners, but also contain relevant and well-structured content.

Text books play an important role in education context (Richards, J.C. 2005):

i. They provide structure and syllabus which is the central core of the instruction process.
ii. They help standardise instruction so that students from different geographical areas under the same syllabus may receive similar content and hence be tested in the same way.
iii. They maintain quality because their content is mostly tried and tested basing on sound learning principles and that are paced appropriately.
vi. They provide a variety of learning resources especially if accompanied by other supporting instrument such as Workbooks, CDs, videos, and a comprehensive teaching and studying guide.
v. Are efficient is such a way that they save teachers time enabling them to devote their time to teaching rather than materials production.
vi. They can train teachers especially if they have limited experience
vii. They are visual appealing with their design and production making them more attractive to their users and hence promote their own intended cause.

The idea for the need to compare the two countries' textbooks was hatched basing on statistics revolving mathematics education for the two countries. For Malawi, it has been noted that:

i. Many learners have over some time performed poorly in Mathematics, in both secondary school and primary school national examinations (MANEB, 2007-2016).
ii. Primary school learners in Malawi only master the lower levels of Mathematical numeracy (SEACMEQ, 2010).
iii. The teaching and learning of Mathematics in Malawi primary schools is not that effective, and this continues in secondary Mathematics and further. (SMASSE, 2015)

This is worrying considering that Mathematics is a very important subject for development of capacity in other sciences which collectively install the much needed reflective and critical thinking skills in learners (Isoda, M & Katagiri, S., 2012), to be used in their socio-economic development and that of the country

as a whole.

As for the Japanese side, the Mathematics lesson has special and unique characteristics (Akihiko, T. (2006) such as:

i. Student-centred instruction using problem solving as a foundation
ii. Structured problem solving
iii. Carefully selected word problems and activities, and their cohesiveness
iv. Extensive discussion (Neriage)
v. Emphasis on blackboard practice (Bansho).

This, coupled with the good performance of Japanese students in mathematics (TIMSS, 2015), explains why the Japanese approach to Mathematics education was chosen as a model to this study and textbook analysis.

This comparative analysis has been done for Malawi and Japan Mathematics textbooks for the first 9 years. This is so because despite the fact that Elementary and High School for both countries take 12 years, there are no English textbooks for Japan senior High School, such that to deviate away from the language challenge, only those classes whose English textbooks are available were chosen.

The comparative analysis framework used is as designed by Huntley, M. A. (2008) which has three main areas of interest:

i. Curriculum information
ii. Content variables
iii. Instructional variables

2. Education systems' structure for Japan and Malawi

A look at the general structure of the two countries' education systems and mathematics structure reveals the following:

Table 2.1: Japanese and Malawian education systems compared

ATTRIBUTE	JAPAN	MALAWI
School levels	❖ Kindergarten (Up to the age of 6) ❖ Elementary (6 years) ❖ Junior High School (3 years) ❖ Senior High School (3 years) ❖ Tertiary School (minimum of 4 years for the first degree)	❖ Kindergarten (up to the age of 6) ❖ Primary school, (8 years) ❖ Secondary school, (4 years) ❖ Tertiary school (4-5 years for the first Degree)
Average mathematics learning duration	752 hours per year.	992 Hours per year.
Guiding Principle	Objective based (i.e. it focuses on what has been planned to be done or achieved within a particular specified amount of time).	Rationale based (i.e. focuses on the reasons or intentions for a particular set of thoughts or actions).
Mode of Teaching and Learning	Practically learner-based approach where Mathematical thinking, such as exploring, developing, and understanding concepts, or discovering multiple solutions to the same problems are achieved: ❖ begins with a complex problem ❖ focuses on developing mathematical thinking ❖ devotes most time to mathematical reasoning and understanding ❖ makes explicit links between concepts ❖ there is more doing of mathematical activities ❖ relatively small classes and easy to manage	Combines both learner-centred and Teacher-centred approaches where not much is done to help learners deeply understand the concepts to be able to independently develop thinking capabilities: ❖ relies on a textbook ❖ focuses on developing a mathematical skill ❖ devotes most available time to practising routine procedures ❖ features isolated tasks ❖ there is more listening from a teacher talking ❖ relatively large classes (up to about 200 leaners in a class)
Class streaming	No ability grouping is practised	Students of different abilities are typically divided into different teaching groups.
Language used	Japanese language at all levels except in few and special private schools.	English (Second Language) from Grade 5. In Grades 1-4, local language is used.

Content	Focuses on 4 major areas: i . Numbers and calculations ii . Quantities and Measurements iii . Geometric figures iv . Quantitative Relations	Focuses on 6 major areas: i . Numbers, Operations and Relationships ii . Accounts and Business Studies iii . Space and Shapes iv . Patterns, Functions and Algebra v . Measurements vi . Data handling (Using Graphs, Tables and Models)

Source MEXT, 2017 & M.I.E, 2012

3. CURRICULUM INFORMATION

3.1 Title

A strong curriculum is focused on critical thinking and strong 21st century communication skills. It also consists of the transmittal of relevant information, fosters an innovative climate and creativity in order to fit the needs of today's classrooms that are comprised of students with diverse needs (Barret, S. 2017). Students therefore need to be able to apply what they learn and create new and innovative products or ideas, determine various ways to solve problems, and be able to take a stance on issues by being able to apply reasoning and logic to justify their thinking. For this to be achieved, a proper name for the curriculum in line with this important aspect.

Course of Study is the name for the Japanese curriculum and the Malawi curriculum does not have a known name. "Course of Study" as a name helps provide the direction to continue to aim to nurture in students "Zest for life" based on the educational principles expressed in the revisions to the Basic Act on Education (MEXT, 2017). Course of Study enriches the content of education and increase the number of classes, with an emphasis on the balance between acquiring basic and fundamental knowledge and skills and fostering the ability to think, make decision, and express oneself.

It can therefore be quickly noticed how well organised and systematic the Japanese curriculum is as compared to its Malawian counterpart, at least in as far as the name of the curriculum and what it signifies is concerned.

3.2 Authors

The credibility of an author is very important in determining the quality of a textbook. People with vast experience in the education sector are more likely to contribute towards the textbook from a wide variety of angles using their experiences and exposure let alone the vast content mastery that they have. The Japanese curriculum is authored by University professors and Teachers with vast experience and content mastery of the subject.

The Malawian textbooks are also authored by teachers and there is also an inclusion of Ministry of Education officials not to mention teacher trainers. However, little representation by people who are far knowledgeable and exposed beyond the level of the curriculum implementers makes the Malawian textbooks to fall behind their Japanese counterparts.

3.3 Publisher

The credibility of the publisher is also very important in determining the quality of the textbooks. The experience, reliability and efficiency of a publishing company really matters in the publication of high-quality textbooks. Japan textbooks which are used for this comparison are published by Shinko Shuppansha KEIRINKAN Co., Ltd, 2011, and Malawi textbooks are published by Malawi Institute of Education (M.I.E, 2007). Both these publishers are known to be experts at their job.

3.4 Ancillary materials

These are items which are not particular part of the textbook, but play a very big role in helping textbook users to better and easily understand the content and even help them for independent use of the textbook.

"Textbook publishing for higher education is a highly competitive industry. Instructors always have many options from which to choose when it comes time to decide on adopting a book for a particular class. Increasingly, textbook publishers aim at differentiating themselves by offering an array of ancillary materials to support student learning and instructional planning, such as multimedia CD-ROMs,

special websites, or even uniquely tailored classrooms within course management systems such as Chalk or white board." (Comins, D. & Waters, L. 2010, p2).

Table 2.1: Ancillary materials used in Japanese and Malawian textbooks

Japanese Textbooks Ancillary Materials	Malawian Textbook Ancillary Materials
❖ A special message to students at the beginning of the textbook congratulating them for making it to the new grade and encouraging them to expect even a funnier and useful approach of mathematics in the textbook. There is also a message to parents on how they can help their child in his or her upcoming mathematics adventure. ❖ Instructions on how best mathematics can be learned. ❖ Guidance on how each book can be used. ❖ Math dojo: which has all kinds of math-related activities to make learning funnier. ❖ Note-taking hints. ❖ Valley fold of various shapes which makes understanding of the concepts easier and fun ❖ Summary and an insight of what to expect in the next grade. ❖ Footnote script on some traditional or historic event which is in way or the other related to mathematics.	❖ Messages in how HIV/AIDS can be prevented and managed. ❖ How to take care of the textbooks by outlining what to do or not do to ensure they are well taken care of.

MEXT (2017) & MIE, (2007).

3.5 Context

This is the extent to which materials align with the predetermined Standards. The standards of Equity, Curriculum, Teaching, Learning, Assessment, and Technology have been used as determined by the National Council of Teachers of Mathematics (NCTM), an organisation based in Canada and USA, which presents itself as a public voice of Mathematics education, supporting teachers and leaners to ensure equitable mathematics teaching and learning of the highest quality through vision, leadership, professional development and research.

3.5.1 Equity:

Textbooks need to have a wide coverage across all genders, learning abilities and social statuses to provide learners with a good opportunity to learn from a very wide and variety of angles without feeling segregated. Diagrams and articles in Japanese textbooks are well documented to ensure this is achieved. In Malawian textbooks, equity in terms of gender illustration is achieved but the lack of many practice problems and diagrams makes it hard for students who are slow learners, let alone those in rural areas where teaching and learning materials are insufficient or not available.

3.5.2 Curriculum:

MEXT censors all content in the textbooks in line with the laid-out quality standards. This is systematically done and strictly observed at all level of education to ensure a high compliance rate. Emphasis is placed on instilling in learners the critical life skills of the 21st century and there is a constant assessment as to how far such goals are being implemented such that every 8 years, there is a curriculum review to keep it well up to date with the ever-changing challenges the world is facing.

In the Malawian textbooks on the other hand, Curriculum is well documented and illustrated except for having a greater teacher centered approach which consequently doesn't prepare learners to be more independent to face life challenges on their own.

3.5.3 Teaching and Learning:

In Japanese textbooks, teachers' role is mainly supervisory, where most activities are performed by the students themselves. The textbooks are systematically written to enable learners to study on their own. The numerous beautiful diagrams ensures there are high levels of curiosity and interest on the part of learners. This in the end is more likely to encourage learners to study and learn the concepts by themselves.

In a Malawian setting, there is a lot of teaching being done as opposed to learning. The teacher is the source of almost all information with student being reduced to recipients. This is mainly attributed by the textbooks which do not provide enough platform for independent study by the students themselves, such

as lack of enough practice problems, examples and applicability in real life. Consequently, learning is not achieved to a greater extent due to the teacher centeredness coupled with the fact that classes are usually large in terms of students' numbers.

3.5.4 Assessment:

Japanese textbooks have a very carefully set up assessment procedure to ensure any lapses on the part of learners are detected early and treated accordingly.

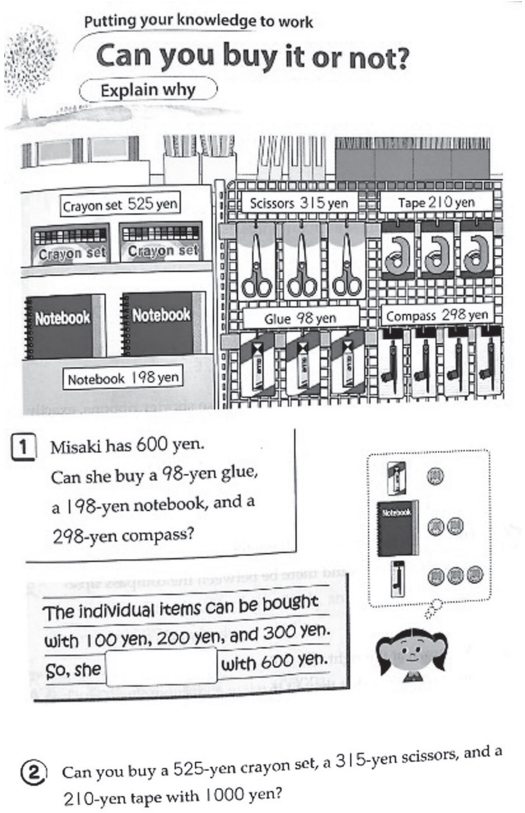


Figure 3.1: KEIRINKAN, (2011) Grade 3A p.59

In Malawian textbooks, assessment is mainly in form of written problems, which lack proper guidance and interest in leaners. The dilemma as to whether or not the teachers are able to check and individually help every student facing problems raises more questions than answers: high number of students under one teacher's responsibility in most schools is very high, and does not tally well with the amount of time available. Figures 3.1 and 3.2 below illustrate assessment on money usage and addition problems as presented in the two textbooks:

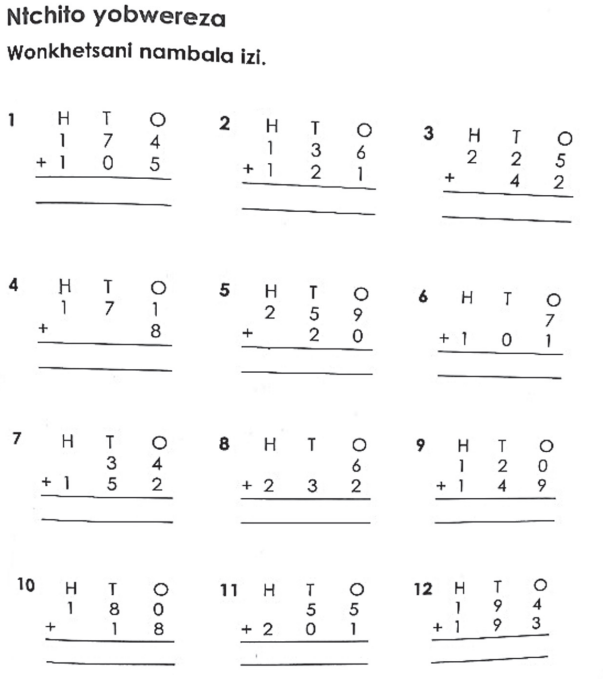
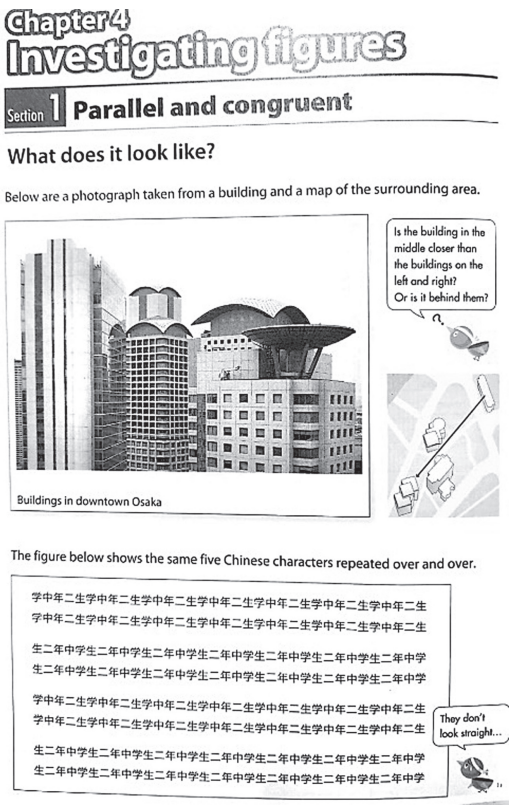


Figure 3.2: M.I.E., (2007) Std 3 p.11

3.5.5 Technology:

Use of various technological problems and stories helps a lot in making the kind of mathematics being taught to be technologically sound. In a Japanese textbook, Students are always doing various activities for their learning; this gives them a good platform to manipulate various learning materials and hence familiarize themselves with them and be able to consequently apply them to understand the modern technological world. An example is how parallel lines are linked to the world of technology, and how linear functions are used technology to plan a train service diagram plus how addition is illustrated using the Akashi-Kaikyo bridge, the longest suspension bridge in the world as shown in figures 3.4 and 3.5.

In Malawian textbooks, the use of tools is to a little extent, most probably due to lack of enough such materials, or large numbers in classes in relation to the amount of time available, or even lack of creativity on the side of the teacher to design the locally available materials and make them substitute the materials subscribed in the text books.



Chapter 4
Investigating figures

Section 1 Parallel and congruent

What does it look like?

Below are a photograph taken from a building and a map of the surrounding area.

Buildings in downtown Osaka

Is the building in the middle closer than the buildings on the left and right? Or is it behind them?

The figure below shows the same five Chinese characters repeated over and over.

学中年二生学中年二生学中年二生学中年二生学中年二生学中年二生学中年二生
学中年二生学中年二生学中年二生学中年二生学中年二生学中年二生学中年二生

生二年中学生二年中学生二年中学生二年中学生二年中学生二年中学生二年中学
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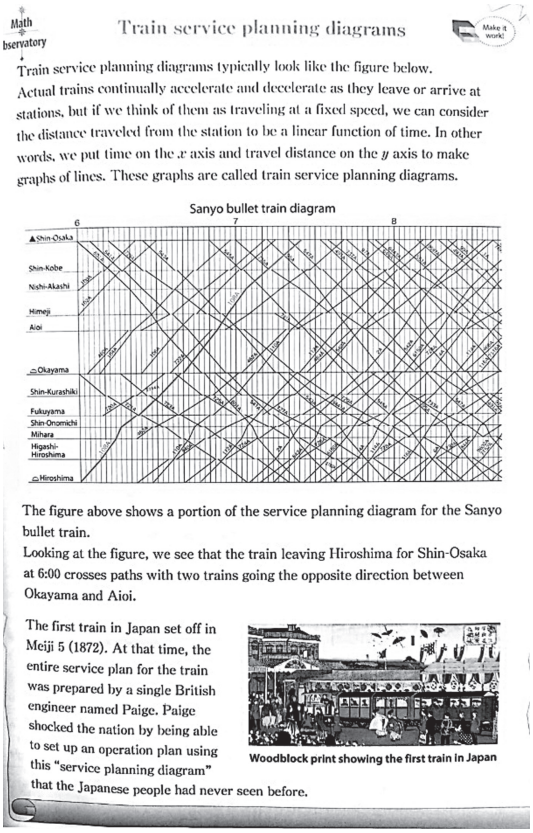
生二年中学生二年中学生二年中学生二年中学生二年中学生二年中学生二年中学
生二年中学生二年中学生二年中学生二年中学生二年中学生二年中学生二年中学

They don't look straight...

Figure 3.3 (Above): Source: KEIRINKAN (2011) Grade 8 pp 82



Math Observatory

Train service planning diagrams

Make it work!

Train service planning diagrams typically look like the figure below. Actual trains continually accelerate and decelerate as they leave or arrive at stations, but if we think of them as traveling at a fixed speed, we can consider the distance traveled from the station to be a linear function of time. In other words, we put time on the x axis and travel distance on the y axis to make graphs of lines. These graphs are called train service planning diagrams.

Sanyo bullet train diagram

6 7 8

Shin-Osaka
Shin-Kobe
Nishi-Akashi
Himeji
Aioi
Okayama
Shin-Kurashiki
Fukuyama
Shin-Onomichi
Mihara
Higashi-Hiroshima
Hiroshima

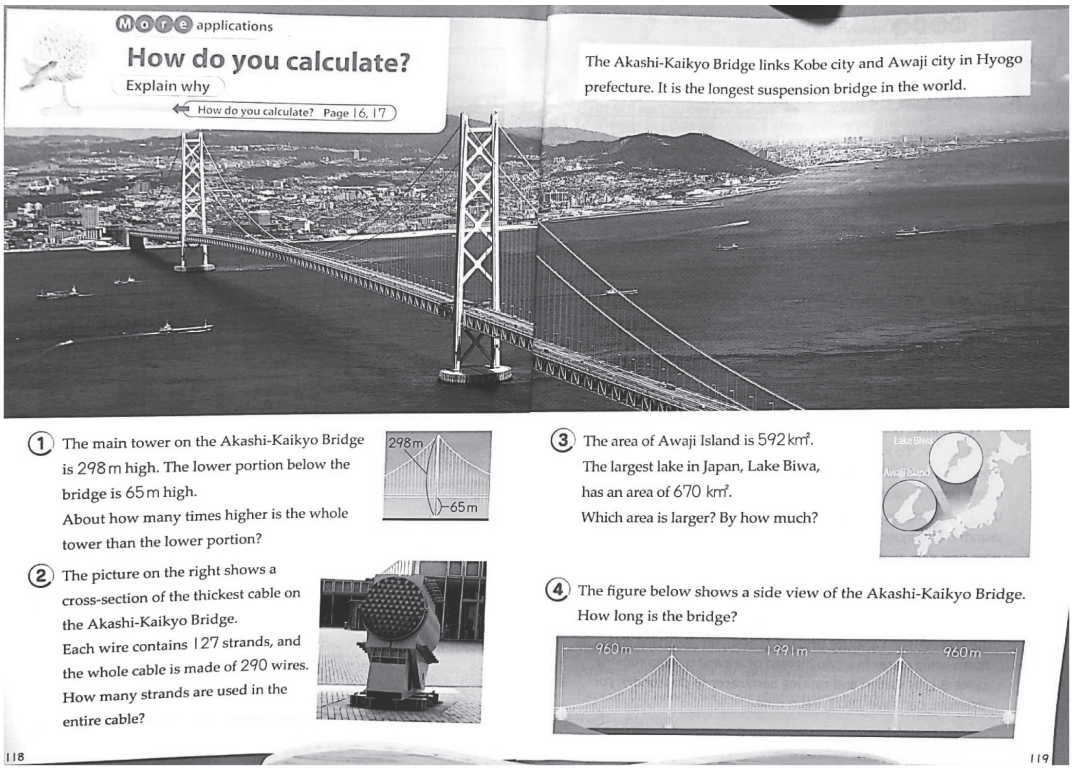
The figure above shows a portion of the service planning diagram for the Sanyo bullet train.

Looking at the figure, we see that the train leaving Hiroshima for Shin-Osaka at 6:00 crosses paths with two trains going the opposite direction between Okayama and Aioi.

The first train in Japan set off in Meiji 5 (1872). At that time, the entire service plan for the train was prepared by a single British engineer named Paige. Paige shocked the nation by being able to set up an operation plan using this "service planning diagram" that the Japanese people had never seen before.

Woodblock print showing the first train in Japan

Figure 3.4 (Right): Source: KEIRINKAN (2011) Grade 8, pp 81



More applications

How do you calculate?

Explain why

How do you calculate? Page 16, 17

The Akashi-Kaikyo Bridge links Kobe city and Awaji city in Hyogo prefecture. It is the longest suspension bridge in the world.

(1) The main tower on the Akashi-Kaikyo Bridge is 298 m high. The lower portion below the bridge is 65 m high.
About how many times higher is the whole tower than the lower portion?

298m
65m

(2) The picture on the right shows a cross-section of the thickest cable on the Akashi-Kaikyo Bridge.
Each wire contains 127 strands, and the whole cable is made of 290 wires.
How many strands are used in the entire cable?

(3) The area of Awaji Island is 592 km². The largest lake in Japan, Lake Biwa, has an area of 670 km².
Which area is larger? By how much?

Lake Biwa
Awaji Island

(4) The figure below shows a side view of the Akashi-Kaikyo Bridge.
How long is the bridge?

960m 1991m 960m

118 119

Figure 3.5: KEIRINKAN (2011). Source: Grade 4B, p 118

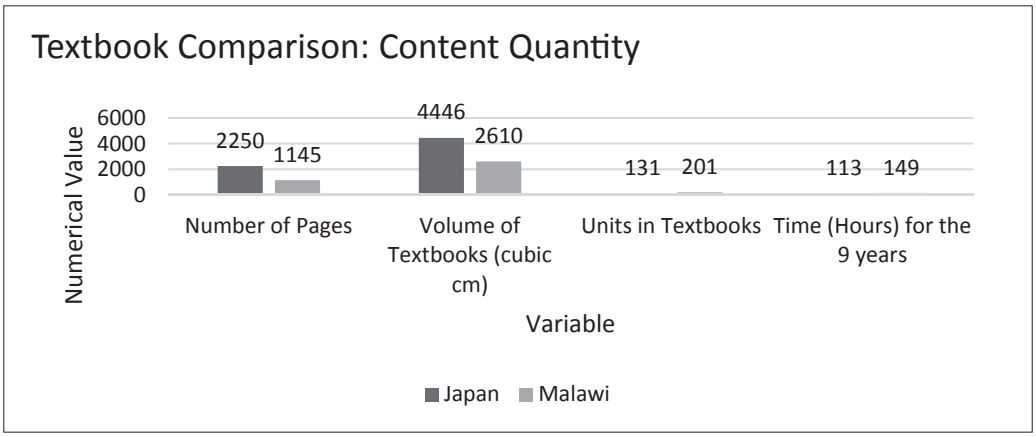
4. CONTENT VARIABLE

4.1 Structural Organisation

This refers to physical features of the curriculum such number of units/modules per grade, soft cover/ hard cover and many other such attributes.

Table 4.1 illustrating the structural organisation of Japanese and Malawian Mathematics textbooks

Japanese Textbooks				Malawian Textbooks			
GRADE	NO. OF TEXTBOOKS	NO OF PAGES	NO. OF UNITS	GRADE	NO. OF TEXTBOOKS	NO OF PAGES	NO. OF UNITS
1	1	160	20	1	1	81	13
2	2	264	24	2	1	124	24
3	2	256	19	3	1	100	27
4	2	272	17	4	1	137	28
5	2	267	15	5	1	120	6
6	2	284	15	6	1	111	30
7	1	273	7	7	1	139	29
8	1	205	6	8	1	142	30
9	1	269	8	9	1	191	14



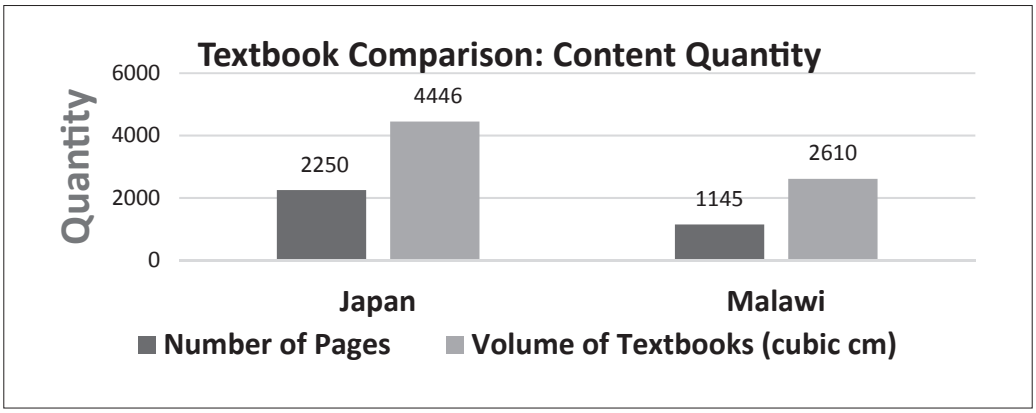


Figure 4.1: Bar graphs summarising Table 4.1

4.2 Depth / Breadth of Content

Content in Japanese textbooks is wide enough as evidenced by more independent topics observed under content variable, let alone having more high-level topics taught at an early stage. Content is deep enough in Malawian textbooks but only lack critical learner-centred and participatory approaches and well-illustrated aids such as diagrams that are needed to enable learners understand the concepts well and independently.

4.3 Presentation of Content

This measures the extent to which students practice problems similar to worked out examples versus their engagement in a sequence of exploratory tasks; and also, to what extent are problems set to represent situations in real world contexts.

4.3.1 The Japanese textbooks have some wonderful elements on this

- ❖ Extensive practice using the exercise activities provided.
- ❖ Learners are able to quantify volume of rectangular boxes, cubes and other shapes as well as derive formulas by grade 5.
- ❖ Mostly, real life examples are given with full coloured photographs and pictures to illustrate a particular point.

4.3.2 The Malawian textbooks on the other hand are designed to present content such that they:

- ❖ Do not do much to help learners grasp even the most basic concepts in time e.g. counting numbers up to 1 Billion is until grade 7 yet their Japanese counterparts are able count up to 92 trillion by grade 4.
- ❖ Mostly use imaginary examples which are sometimes ambiguous in nature. An example is where an item such as a cup is used for demonstrative purposes, but has non-similar properties in terms of colour and size with the one it is to be compared against as shown in figure 4.2. One wonders which colour or size is to be used because at this level, the learners need to understand simple problems in one variable.

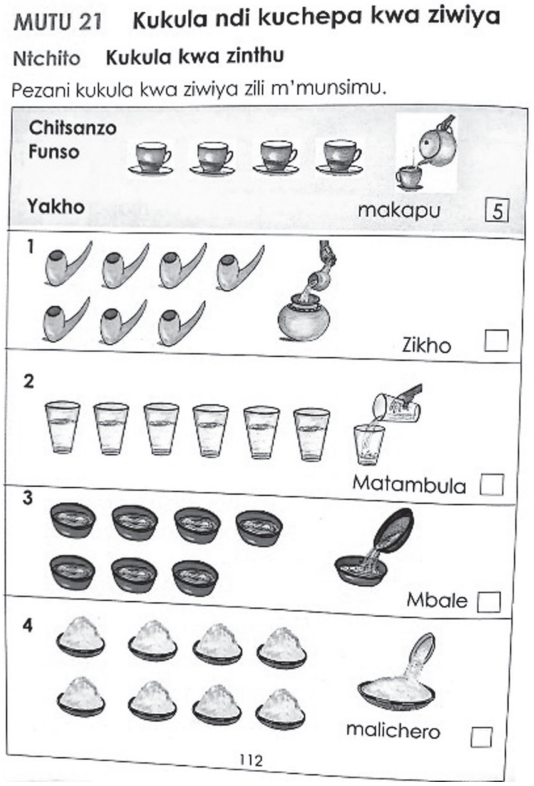
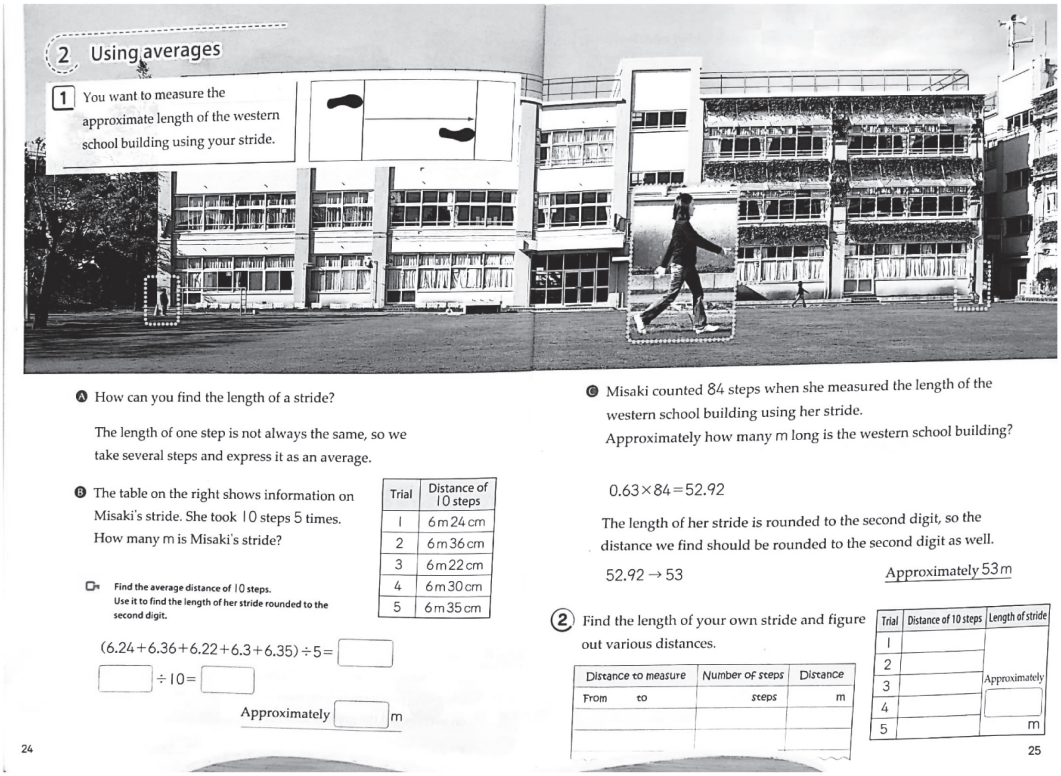


Figure 4.2: M.I.E (2007), standard 2 textbook, p 112.

4.4 Worked out Examples

Japanese textbooks have an extensive use of high-level questioning techniques to induce thinking among learners. The use of visual real-life examples is also extensively used. A good example is in grade 5B of a Japanese textbook versus a Malawian Standard 7 textbook, where presentation of averages is compared. The approach is mostly learner centred for the Japanese textbook and teacher centred in the Malawian textbook.

In Malawian textbooks, examples are not deep enough to allow leaners study with understanding by themselves let alone lack of visual real-life examples, not to mention interesting and curiosity stimulating activities as the situation is especially in textbooks from grade 5. They are also usually too slow to enable learners graduate to fast and sophisticated thinking.



2 Using averages

1 You want to measure the approximate length of the western school building using your stride.

A How can you find the length of a stride?

The length of one step is not always the same, so we take several steps and express it as an average.

B The table on the right shows information on Misaki's stride. She took 10 steps 5 times. How many m is Misaki's stride?

Trial	Distance of 10 steps
1	6m24cm
2	6m36cm
3	6m22cm
4	6m30cm
5	6m35cm

Find the average distance of 10 steps.
Use it to find the length of her stride rounded to the second digit.

(6.24+6.36+6.22+6.3+6.35)÷5= ☐

☐ ÷10= ☐

Approximately ☐ m

C Misaki counted 84 steps when she measured the length of the western school building using her stride.
Approximately how many m long is the western school building?

0.63×84=52.92

The length of her stride is rounded to the second digit, so the distance we find should be rounded to the second digit as well.

52.92 → 53

Approximately 53m

2 Find the length of your own stride and figure out various distances.

Distance to measure		Number of steps	Distance
From	to	steps	m

Trial	Distance of 10 steps	Length of stride
1		
2		
3		Approximately ☐ m
4		
5		

24 25

UNIT 4 Averages

Exercise 4A Finding averages

Example
Question
Find the average of the following numbers: 6, 8, 7.
Answer

$$\text{Average of the numbers} = \frac{6+8+7}{3} = \frac{21}{3} = 7$$

Find the average of the following numbers:

1 10, 16
2 17, 13
3 30, 41, 23, 18
4 33, 42, 21, 16, 32, 36
5 12, 28, 11
6 14, 9, 15, 19, 8
7 50, 47, 31, 52
8 80, 60, 0, 75, 35, 58
9 22, 7, 5
10 20, 24, 27, 29, 30

Exercise 4B Solving practical problems on average

Example
Question
A poultry club collected 20, 18, 14, and 24 eggs in 4 days. What was the average number of eggs collected per day?
Answer

$$\text{Average number of eggs} = \frac{20+18+14+24}{4} = \frac{76 \text{ eggs}}{4} = 19 \text{ eggs}$$

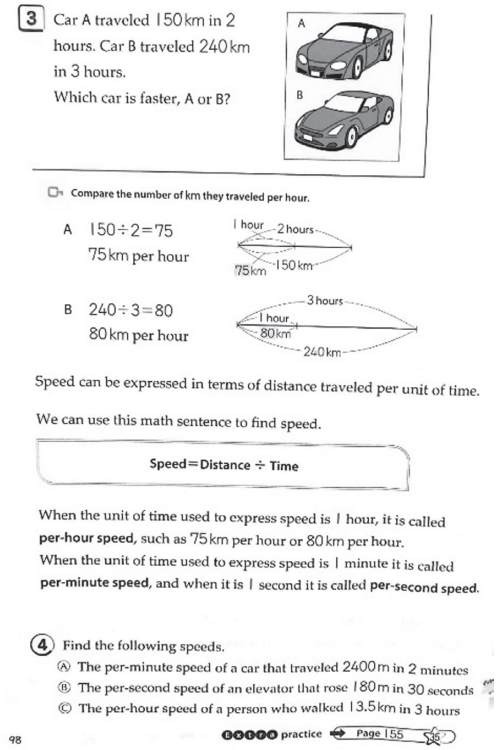
1 John scored the following marks out of hundred: English 65, Mathematics 76, Chichewa 85, Agriculture 70, Life Skills 68, Science and Technology 72, Social and Environmental Science 54. Find the average mark scored by John?
2 Three children plucked 10, 12, 8 oranges respectively. Find the average number of oranges plucked.
3 The daily attendance for a certain class was as follows: Monday 50, Tuesday 55, Wednesday 54, Thursday 53, Friday 48. Find the average attendance for the class?
4 Find the average age of these seven learners whose ages are 21, 20, 17, 15, 16, 19 and 18 years?
5 The average income of 6 workers is K10,500.00. Find the total income for the 6 workers.
6 The average temperature for 4 days is 26°C. If the average temperature for 3 days is 24°C. Find the temperature of the fourth day.
7 The average mass of three bags of groundnuts is 124kg. If two of them have masses of 130kg and 180kg respectively. Find the mass of the 3rd bag.

Figure 4.3 (Above). Source: KEIRINKAN (2011) Grade 5A and figure 4.4 (Below).
Source: M.I.E (2007), Standard 7.

4.5 Definition and rules

Japanese textbooks have an outstanding definition of terms and rules right within their appropriate topic e.g. Grade 5B Averages pp20-21, speed in grade 6A p98, parts of a circle, grade 3A p33, conditions for congruence Grade 8 p102 & p118, just to mention afew.

It is noted that in the Malawian textbooks, most definitions are not even provided, especially in primary school textbooks, such as a topic on Averages in a standard 7, p18 as shown in figure 4.4 above. However, definition of terms improved from a grade 9 textbook.



3 Car A traveled 150 km in 2 hours. Car B traveled 240 km in 3 hours.
Which car is faster, A or B?

Compare the number of km they traveled per hour.

A 150 ÷ 2 = 75
75 km per hour

B 240 ÷ 3 = 80
80 km per hour

Speed can be expressed in terms of distance traveled per unit of time.

We can use this math sentence to find speed.

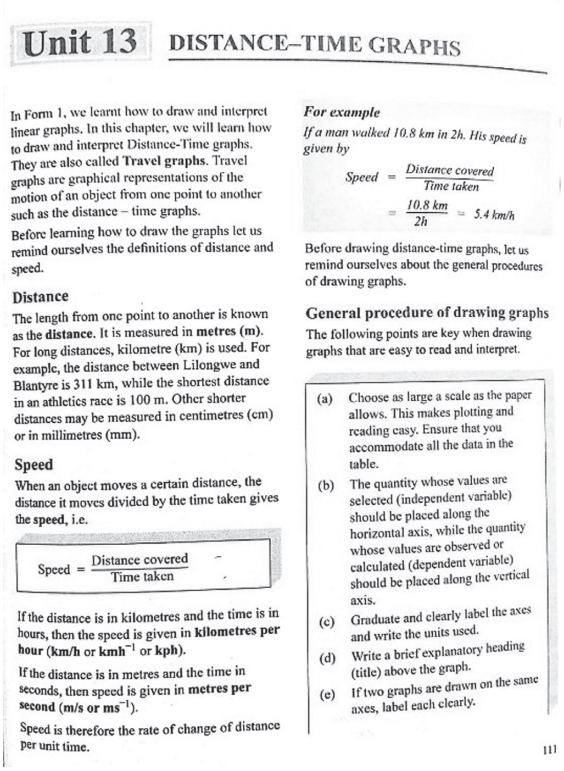
Speed = Distance ÷ Time

When the unit of time used to express speed is 1 hour, it is called **per-hour speed**, such as 75 km per hour or 80 km per hour.
When the unit of time used to express speed is 1 minute it is called **per-minute speed**, and when it is 1 second it is called **per-second speed**.

4 Find the following speeds.
Ⓐ The per-minute speed of a car that traveled 2400 m in 2 minutes
Ⓑ The per-second speed of an elevator that rose 180 m in 30 seconds
Ⓒ The per-hour speed of a person who walked 13.5 km in 3 hours

98 practice Page 155

Figure 4.5. Source: KEIRINKAN (2011), Grade 6A, p 98



Unit 13 DISTANCE–TIME GRAPHS

In Form 1, we learnt how to draw and interpret linear graphs. In this chapter, we will learn how to draw and interpret Distance-Time graphs. They are also called **Travel graphs**. Travel graphs are graphical representations of the motion of an object from one point to another such as the distance – time graphs.

Before learning how to draw the graphs let us remind ourselves the definitions of distance and speed.

Distance

The length from one point to another is known as the **distance**. It is measured in **metres (m)**. For long distances, kilometre (km) is used. For example, the distance between Lilongwe and Blantyre is 311 km, while the shortest distance in an athletics race is 100 m. Other shorter distances may be measured in centimetres (cm) or in millimetres (mm).

Speed

When an object moves a certain distance, the distance it moves divided by the time taken gives the **speed**, i.e.

$$\text{Speed} = \frac{\text{Distance covered}}{\text{Time taken}}$$

If the distance is in kilometres and the time is in hours, then the speed is given in **kilometres per hour (km/h or kmh^{-1} or kph)**.

If the distance is in metres and the time in seconds, then speed is given in **metres per second (m/s or ms^{-1})**.

Speed is therefore the rate of change of distance per unit time.

For example

If a man walked 10.8 km in 2h. His speed is given by

$$\text{Speed} = \frac{\text{Distance covered}}{\text{Time taken}} = \frac{10.8\ km}{2h} = 5.4\ km/h$$

Before drawing distance-time graphs, let us remind ourselves about the general procedures of drawing graphs.

General procedure of drawing graphs

The following points are key when drawing graphs that are easy to read and interpret.

(a) Choose as large a scale as the paper allows. This makes plotting and reading easy. Ensure that you accommodate all the data in the table.
(b) The quantity whose values are selected (independent variable) should be placed along the horizontal axis, while the quantity whose values are observed or calculated (dependent variable) should be placed along the vertical axis.
(c) Graduate and clearly label the axes and write the units used.
(d) Write a brief explanatory heading (title) above the graph.
(e) If two graphs are drawn on the same axes, label each clearly.

111

Figure 4.6: Source: MIE (2007) Form 2 p 111

5. INSTRUCTIONAL VARIABLES

5.1 Instruction Model

The type of instructional model used by the textbooks and its corresponding role is the central focus of discussion on this segment.

5.1.1 The Japanese textbooks are noted to be aligned towards the Personal development model whose main focus is on

- ❖ High self-concept and self-esteem.
- ❖ Positive and self-direction and independence.
- ❖ Creativity and curiosity.
- ❖ The development of affect and emotion.

This model is based on 3 major categories

- ❖ Facilitative teaching with emphasis on affective orientation as defined by Carl Rodgers.
- ❖ Increasing personal awareness with focus on developing an awareness and fulfilment of individual potential.
- ❖ Synectics with focus on the development and application of creativity.

5.1.2 On the other hand, the Malawian textbooks are observed to be following the Information processing model where

- ❖ focus is on concepts and principles developed in cognitive psychology
- ❖ concept attainment involves categorizing information
- ❖ causal reasoning, interpretation of data and formation of principles and theories are the main major thinking guidelines
- ❖ intellectual development revolves around the influence of maturity on thinking and reasoning.

5.2 Use of Class Time

The Japanese textbooks have a remarkable amount of time dedicated to students actually doing the work by themselves. This is in form of the extensive exercises, pair and group discussions, experimentation, role play. A teacher mostly plays the facilitatory role.

The Malawian textbooks places much focus on teacher centredness with most activities designed to be carried out by the teacher. Learners are simply treated as recipients of information from the teacher with little or no participation themselves.

5.3 Teachers' Role

The analysis on use of class time leads into a conclusion on the role performed by teachers: A facilitator to students in a Japanese setting, and a main source of information and explanation for the Malawian situation.

5.4 Students' Role

5.4.1 Japanese textbooks are designed to ensure that students

- ❖ Discuss with other students.
- ❖ Role play in various activities.
- ❖ Practice with the various practice problems that are provided.
- ❖ Think on ways to come up with solutions to various problems at hand as encountered in daily life endeavours.

5.4.2 Malawian textbooks on the other hand ensures students play the role of

- ❖ Listening to the teacher as he/she teaches.
- ❖ Writing down the teacher's work from the chalk board.
- ❖ Writing exercises as given by the teacher.

5.5 Use of Small Group Work

Japanese textbooks provide a conducive environment for an extensive use of small groups among learners to enable them discuss and interact with each other. This is made easier owing to the fact that students' numbers in classes are usually small and easier for a teacher to handle.

As for the content design in the Malawian textbooks, coupled with the fact that classes are usually too big for one teacher to realistically perform meaningful class activities, there is a limited use of any class activities to enhance teaching and learning.

5.6 Use of Tools

This is definitive of to what extent are students expected to use manipulatives and technology.

Since the Japanese students are always doing various activities for their learning, it gives them a good platform to manipulate various learning materials and hence familiarise themselves with them and be able to consequently apply them to understand the modern technological world.

Use of tools among Malawian students is concluded to be to a little extent, probably due to lack of enough such material, or large numbers in class in relation to the amount of time available, or even lack of creativity on the side of the teacher to design what locally available materials can be used in place of the materials subscribed in the text books which may not always be available.

5.7 Assessment

Japanese textbooks have many exercise problems given within each topic, at the end of the topic, and at the end of the text book in a form called the Maths Dojo where a number of application problems are given to not only asses leaners` understanding, but also spark their interest further. Some assessment is also done through the various activities that the learners will undertake in the course of learning.

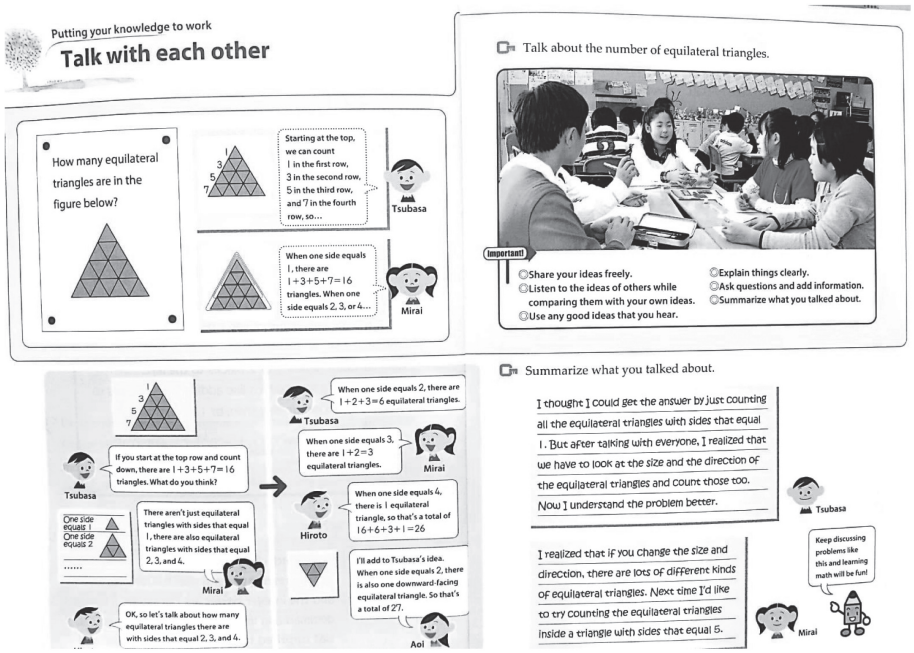


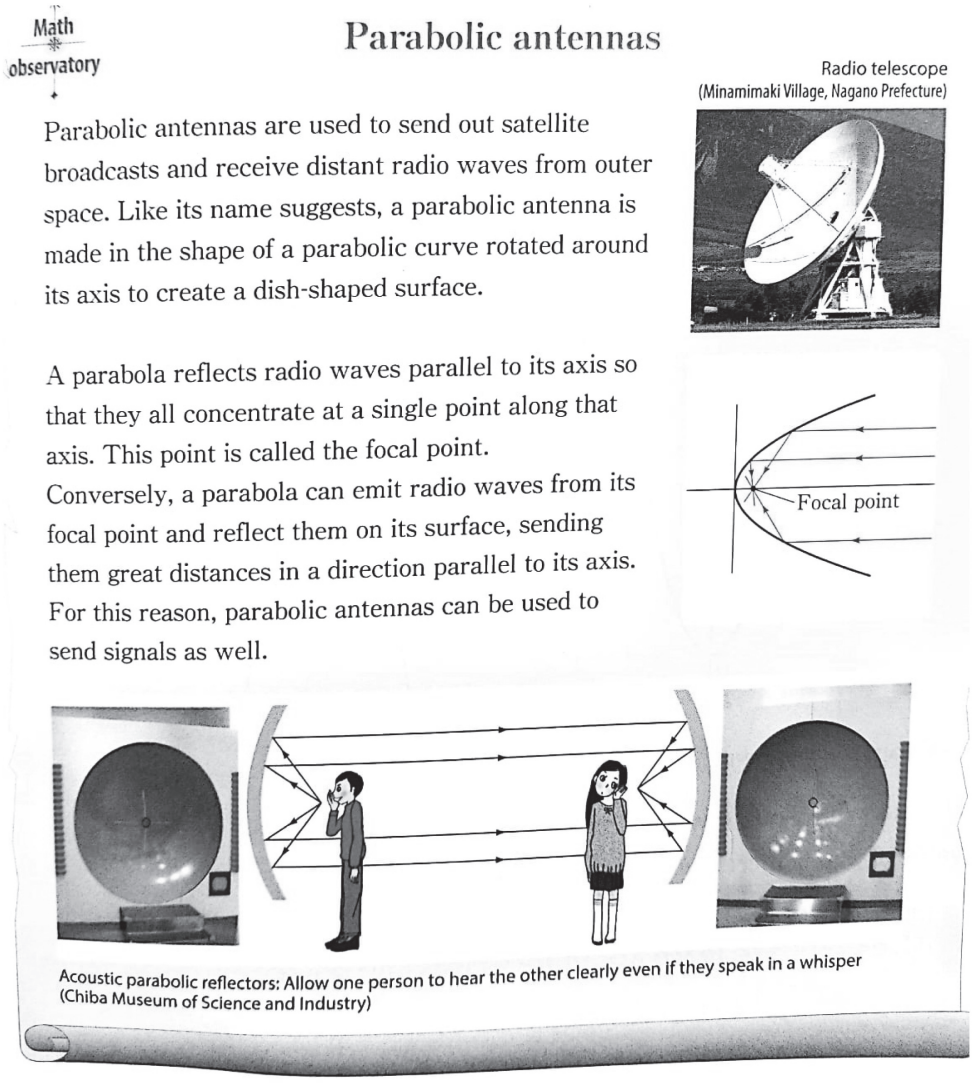
Figure 5.1: KEIRINKAN (2011). Source: Grade 5A, pp 12 - 13

Textbook based assessment in Malawian education system is a challenge because it is mostly done through exercise problems given in the textbooks which as explained earlier, lack proper guidance for independent study.

5.8 Homework

There is no indication in the Japanese textbooks on what specific type of homework is given to learners. However, a number of problems for both practicing newly learnt material and reviewing the previously learned materials are extensively provided. There is even information provided in the textbooks which may induce further inquiry from parents, peers or other sources hence acting like homework e.g. a math observatory article on Parabolic antennas in Grade 9 textbook on page 91, and another Math observatory about 3-4-5 right triangles, p170 of the same book. "Look into math" sections at the end of textbooks as in grade 5A pp123-148 may also serve as a good Homework for the learners coupled with the fact that it is a requirement by MEXT that textbooks be available to every student.

The lack of specificity in the indication of homework is also there in Malawian textbooks. Some practice examples are provided, but they may not be thought provoking enough to qualify being referred to as homework.


Math observatory

Parabolic antennas

Radio telescope
(Minamimaki Village, Nagano Prefecture)

Parabolic antennas are used to send out satellite broadcasts and receive distant radio waves from outer space. Like its name suggests, a parabolic antenna is made in the shape of a parabolic curve rotated around its axis to create a dish-shaped surface.

A parabola reflects radio waves parallel to its axis so that they all concentrate at a single point along that axis. This point is called the focal point.
Conversely, a parabola can emit radio waves from its focal point and reflect them on its surface, sending them great distances in a direction parallel to its axis. For this reason, parabolic antennas can be used to send signals as well.

Focal point

Acoustic parabolic reflectors: Allow one person to hear the other clearly even if they speak in a whisper
(Chiba Museum of Science and Industry)

Figure 5.2: Source: KEIRINKAN (2011) Grade 9, p.91

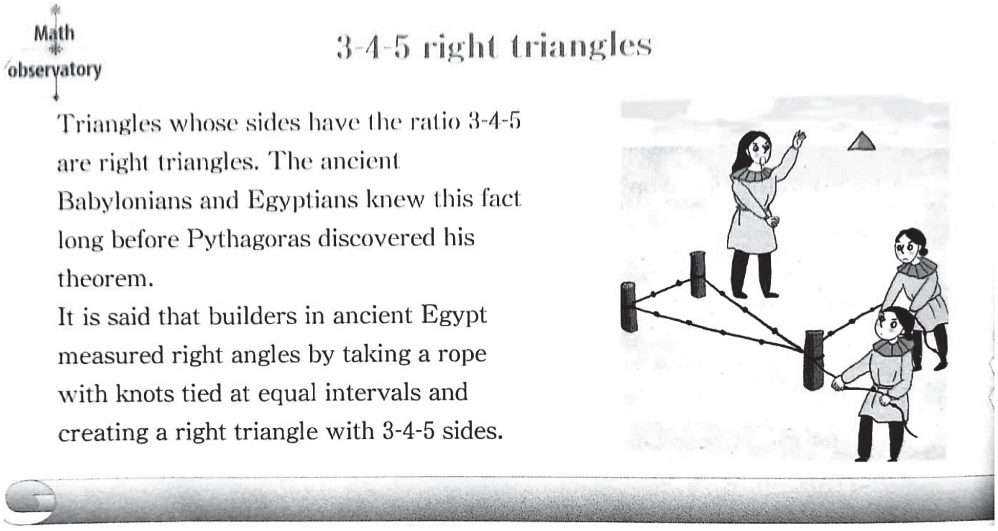


Figure 5.3: Source: KEIRINKAN (2011) Grade 9, p.170

Conclusion

In a nutshell, this write up has analysed the differences and similarities that are there between Japanese and Malawian mathematics textbooks for the first 9 years of school. The major area of interest has been the curriculum information for the textbooks, their content structural organisation, depth, breadth and presentation. The issue of instructional variables was also critically analysed, categorising Japanese and Malawian textbooks as based on personal development and information processing models respectively. The type of methodologies used in textbooks and the various roles performed by both the teachers and the learners during instructions were also put on a scrutiny.

The analysis reveals a number of things as to how effective the education systems of the two countries is concerned, let alone the textbooks themselves. The inclusion of well-illustrated diagrams in colour and the focus on learner centeredness plus ability to enable an independent study by learners are some of the areas which emerged supreme for the Japanese mathematics education. Their structural design to enable learners deeply cover more sophisticated mathematics in the lower classes and that they are constantly prepared to enable to apply the knowledge is solving daily real-life problems is another icing on the cake.

It is therefore quickly noted that the Malawian textbooks are far much behind their Japanese counterparts in as far as leaners' independency and ability to develop critical thinking skills to understand mathematics and real world better is concerned. There is need to ensure there are more diagrams in the textbooks to increase leaners curiosity. This on its own is not enough however, as a number of factors need to be brought into the equation as well such as availability of other teaching and learning materials, teachers' expertise in the delivery of their services, class size, just to mention a few.

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