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UNIVERSITI BRUNEI DARUSSALAM

Connecting Visual Representations and Action Research in the Teaching and Learning of Mathematics

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Invited Speaker Presentation

Sultan Hassanal Bolkiah Institute of Education, Universiti Brunei Darussalam, Bandar Seri Begawan, Brunei Darussalam

Classroom Action Research

What is 'Classroom Action Research (CAR)' ?

- Systemic inquiry with the aim of informing practice in a particular situation.
- For instructors or educators to discover **what works best** in their **own classroom situation**, thus allowing informed decisions about their teaching.

The benefits on the use of CAR:

Improves teaching, documenting one's own teaching, and renew your excitement in teaching (providing a new lens for examining your teaching).

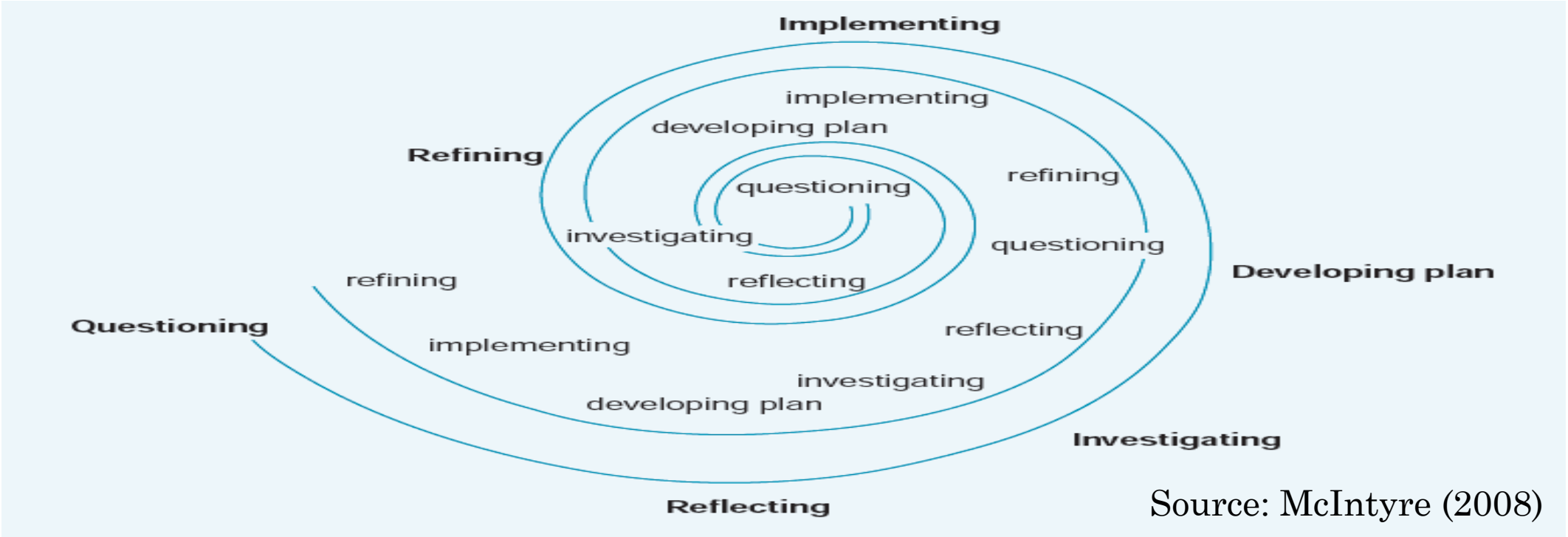
(Mettetal, 2002-2003)

What is Action Research ?

- An approach to research that used **successive cycles** of *planning*, *action*, fact finding about the result of the action (*observation or collection*), and *reflection or reviewing*.
- This circular or more accurately spiral process has become an essential, defining element of action research.
- Confusion can be caused by the fact that in education, the terms *action research*, *teacher research*, and *practitioner inquiry* (or *practitioner research*) are often used almost interchangeably.

(Check & Schutt, 2011)

What is Action Research ?



Source: McIntyre (2008)

Action research as a **recursive process** – A process that loops back on itself and "involves a spiral of adaptable steps" that include questioning a particular issue, reflecting upon and investigating the issue, developing an action plan, and implementing and progressively refining the plan.

(Check & Schutt, 2011, p. 263)

What is Action Research ?

- Action research in its strict sense refers to research activities that use a **cyclical, action reflection model** to investigate and attempt to make change in an organisation, for example, a whole school or in a single class or a few classes.
- Action Research is collaborative or participative, reflective, critical, systemic, cyclical, and focuses on change and strategic improvement of practice.
- The research method employed in Action Research, is entirely determined by the researcher, given that the **primary focus is to improve practice**.

(Check & Schutt, 2011)

SHBIE a Graduate School *since August 2009*

Sultan Hassanal Bolkiah Institute of Education (SHBIE) is a Graduate Faculty in Universiti Brunei Darussalam.

From a humble beginning in 1956 as *Maktab Perguruan* (Teacher Education College), the Institute has grown to become a Graduate School of Education in 2009.

SHBIE a Graduate School *since August 2009*

Initial Teacher Preparation

To offer professional training to graduates who choose to become teachers through the Master of Teaching (MTeach) programme.

Graduate Professional Development

To provide high quality professional development through the Master of Education (MEd) by Coursework and by Research, Master in Counselling and PhD in Education.

Continuing Professional Development

To offer a suite of bespoke programmes and professional development courses for practitioners.

School Partnership

To develop capacity in the education system through collaboration.

Master of Teaching

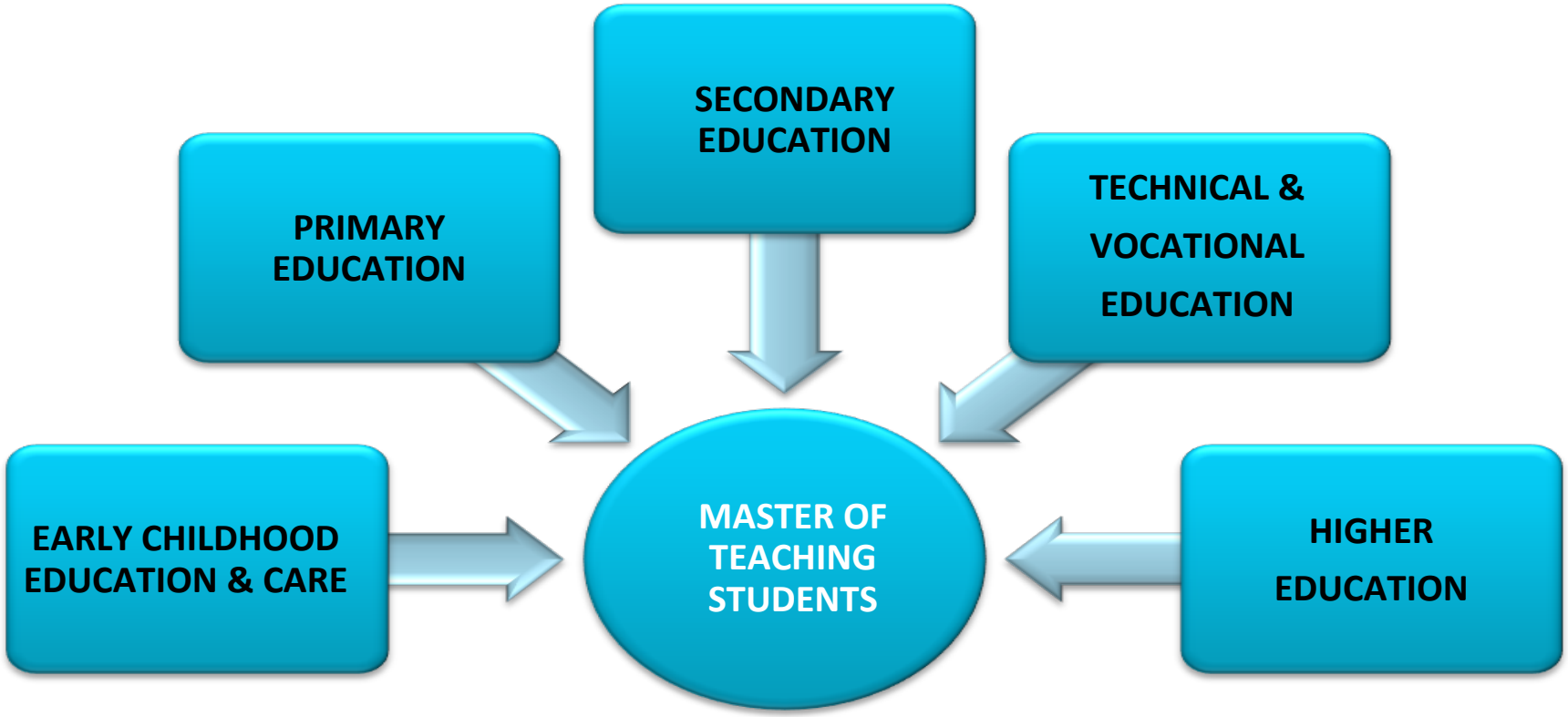
"Nurturing Our Legacy"

SHBIE's Master of Teaching Programme prepare Teacher Candidates with relevant learning theories, understanding of how to apply these theories in actual classroom and opportunities to master research skills necessary to improve student outcome.

Upon completion of the MTeach programme, our graduates are expected to be:

- Master of their subject matter pedagogies,
- Reflective and Innovative teacher,
- Research-informed teacher,
- Lifelong learner, and
- A Professional.

Master of Teaching (MTeach): Areas of Specialisation



MTeach Research in SHBIE, UBD

The **MTeach** Research Exercise 12 Modular Credit Core Module Outline (100% Coursework – Summative Assessment):

ET-5203-E/P/S/V/H Research Exercise (ECEC/Pri Ed/Sec Ed/VTE/Higher Ed)

Aims: *This module will provide students with the opportunity to conduct site-based research under supervision. It will enable the students to link research with the improvement of practice in a chosen area of investigation.*

Module Content:

- **Carry out an action research study** working independently under supervision of a member of Faculty.
- Investigate systematically, questions related to the design of teaching and **the improvement of learning** in the student's specialist area.
- Demonstrate in-depth knowledge of the focus of the research.
- Demonstrate the capacity to engage in reflective, critical analysis of data to **improve learning outcomes**.
- Write a research report of publishable standard.

The Present Study

Investigating the ***alternative teaching strategies*** implemented by pre-service teacher candidates enrolled in a graduate teacher education programme (MTeach) in the graduate faculty (SHBIE) at Universiti Brunei Darussalam

The Present Study

Alternative Teaching Strategies

Visual Representations

The Present Study

Alternative Teaching Strategies

Different Types of Visual Representations:

Pictorials, Drawings, Animations, Comics, Story-telling in the form of images, Graphic Organisers, Maps, Diagrams, Sketches, Visual Metaphors

The Present Study

Why Visual Representations?

Benefits in using visual representation during the lessons for the students:

- ✓ Develop students' interest in learning mathematics.
- ✓ Assist students to visualise and remember the mathematical concepts.
- ✓ Visualise the mathematical concepts.
- ✓ Beneficial for learning process.
- ✓ Improve students' mathematics achievements.

The Present Study

TC	MTeach RE Title	Mathematics Topic	Year Level	Sample
TC1	Investigating the Effects of Using Comics for Lower Primary School Students in Solving Mathematics Word Problems	Mathematics Word Problems	2	13
TC2	The Use of Comics in Teaching Order of Operations for Secondary Mathematics Students	Order of Operations	7	33
TC3	Using Drawings and Comics to Enhance the Learning of Addition and Subtraction of Fractions	Addition and Subtraction of Fractions	7	38
TC4	Using Drawings and Comics in Aiding Lesson on Multiplication and Division of Integers	Multiplication and Division of Integers	7	33
TC5	The Use of Comic in Converting Between Fractions, Decimals and Percentages in Secondary Mathematics Classrooms	Converting between Fractions, Decimals and Percentages	9	34
TC6	The Effects of Using Comics in Teaching Distance Time Graph for Upper Secondary Mathematics Students	Distance-Time Graph	10	38
TC7	Using Pictorial Representation as an Alternative Teaching Approach for Solving Simultaneous Equations	Simultaneous Equations	10	29

The Present Study

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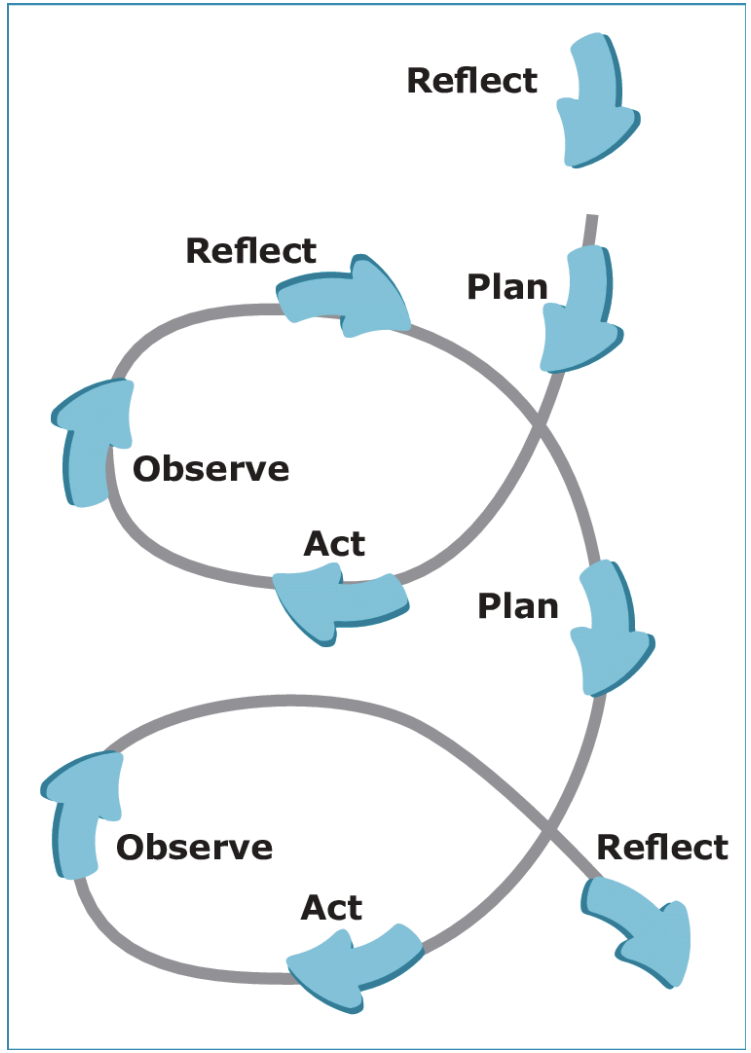
Focus of Research Questions

The central focus of the TCs' research questions were targeted to:

- ✓ Investigating the effects of using visual representations or comics on students' performance.
- ✓ Examining the students' perceptions on the implementation of visual representations or comics as one of the tools in the learning of the Mathematics topics.

Research Design: Action Research



For Cycle 1:

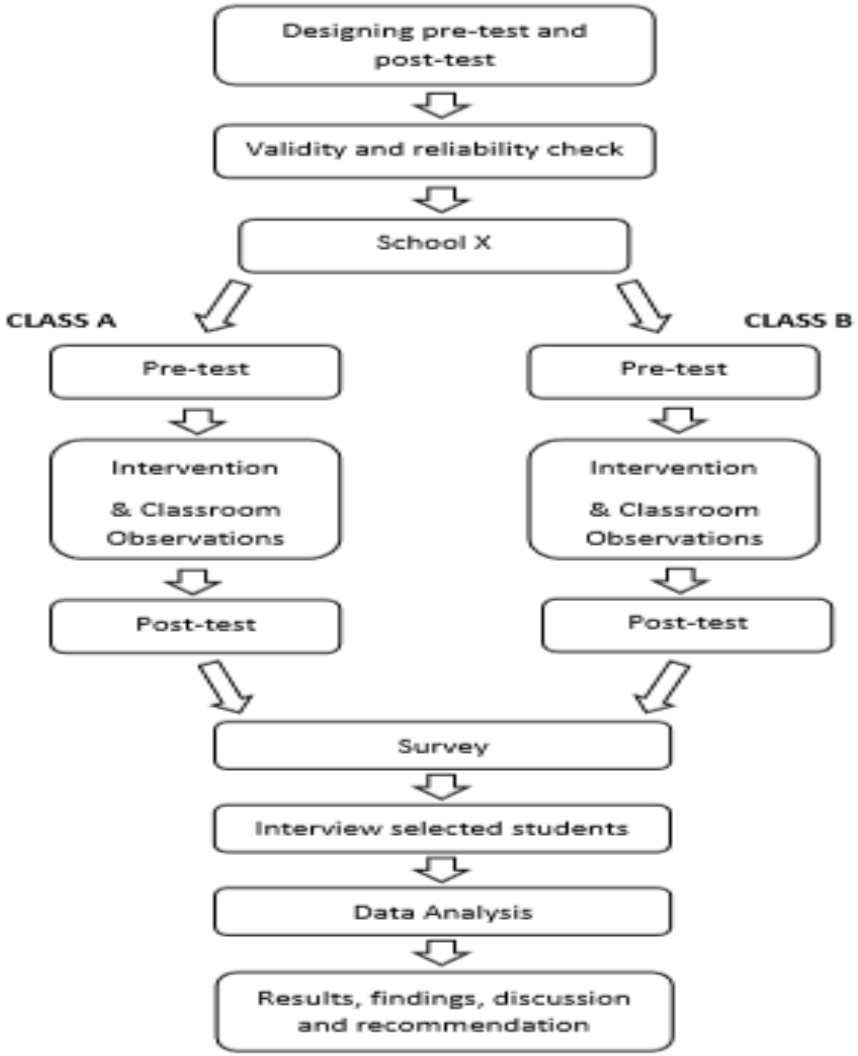
- Detailed planning must be made in designing the intervention lesson(s), creation of instruments, the when, what, where, why and how?
- Implementations of the plan.
- Data collection and/or observations from using the instruments.
- Reviewing or reflecting from the results obtained.

Repeat or if necessary, re-design for ***Cycle 2***

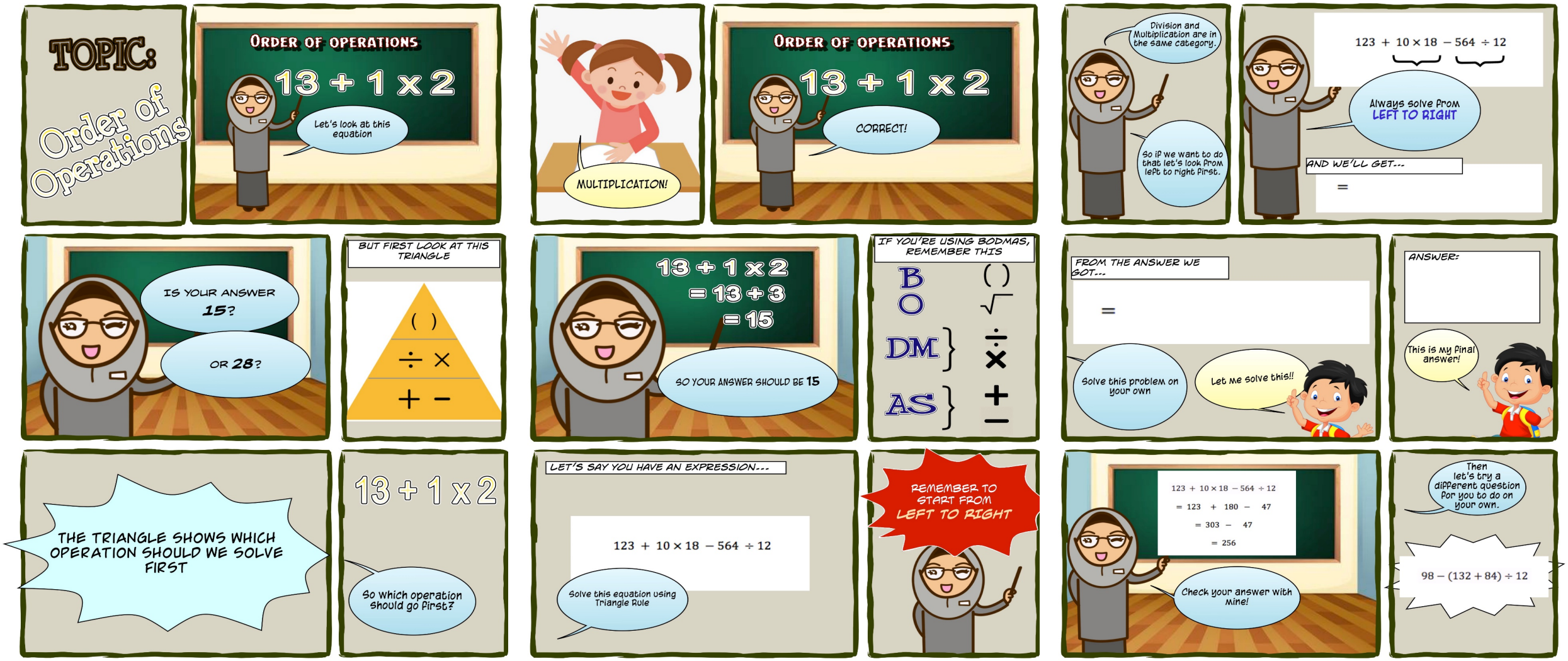
Repeat or if necessary, re-design for ***Cycle 3***

And so on…

Framework Design of the Study



Samples of Visuals Used



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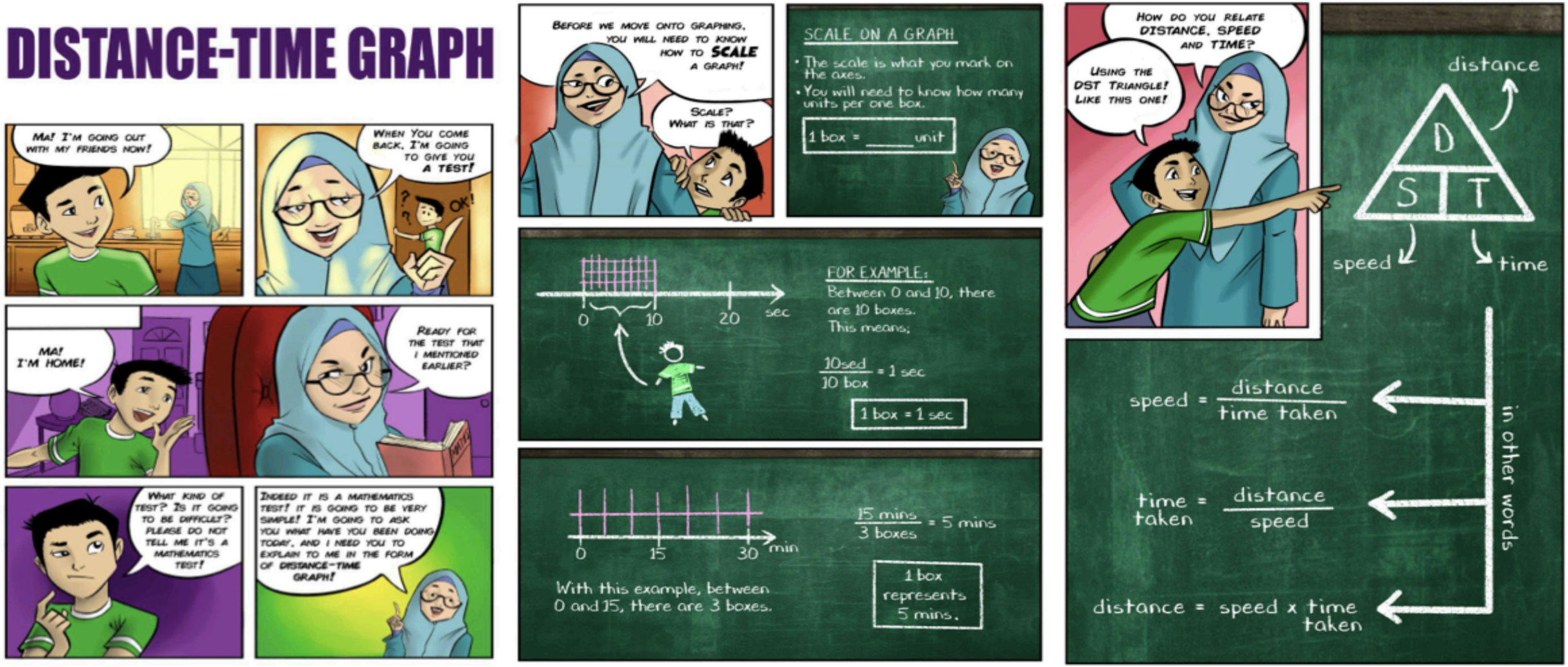
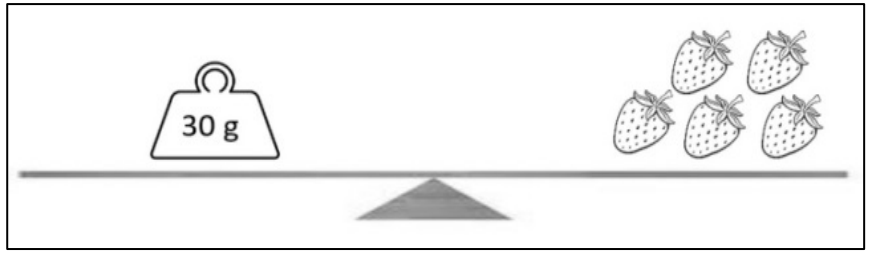
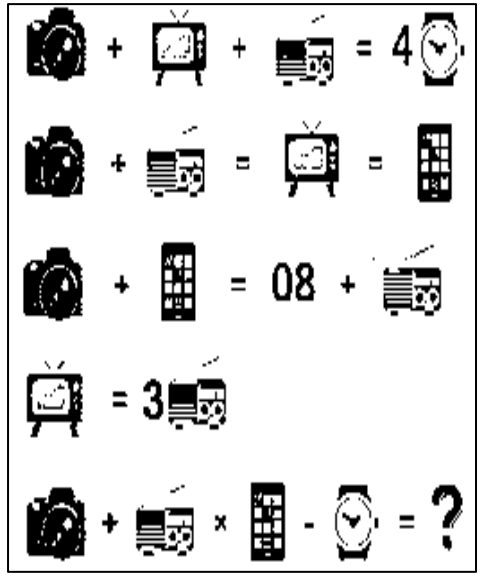


Samples of Visuals Used

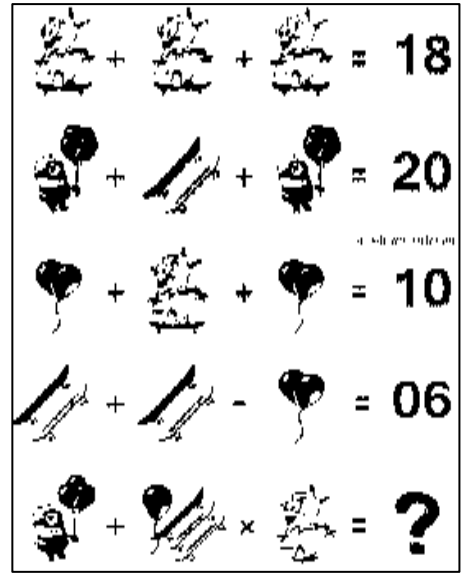
Examples of visual representations for the first lesson:



Second lesson:

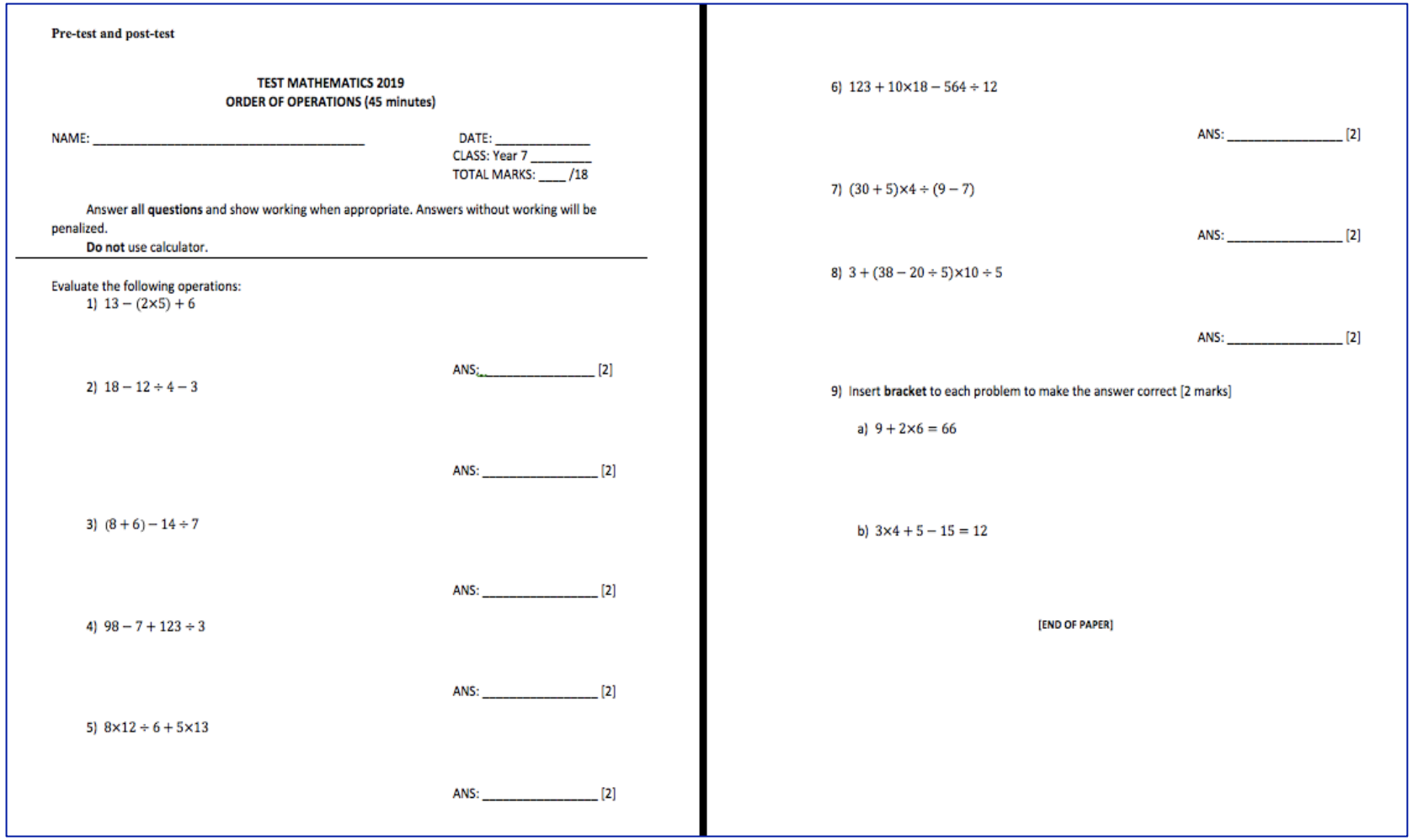


Third lesson:



Instruments Used

In order to measure the effectiveness of the teaching aids used, pre- and post-tests were disseminated, collected and analysed quantitatively.



Pre-test and post-test

TEST MATHEMATICS 2019
ORDER OF OPERATIONS (45 minutes)

NAME: _____ DATE: _____
CLASS: Year 7 _____
TOTAL MARKS: ____ /18

Answer **all questions** and show working when appropriate. Answers without working will be penalized.
Do not use calculator.

Evaluate the following operations:

1) $13 - (2\times5) + 6$

ANS: _____ [2]

2) $18 - 12 \div 4 - 3$

ANS: _____ [2]

3) $(8 + 6) - 14 \div 7$

ANS: _____ [2]

4) $98 - 7 + 123 \div 3$

ANS: _____ [2]

5) $8\times12 \div 6 + 5\times13$

ANS: _____ [2]

6) $123 + 10\times18 - 564 \div 12$

ANS: _____ [2]

7) $(30 + 5)\times4 \div (9 - 7)$

ANS: _____ [2]

8) $3 + (38 - 20 \div 5)\times10 \div 5$

ANS: _____ [2]

9) Insert **bracket** to each problem to make the answer correct [2 marks]

a) $9 + 2\times6 = 66$

b) $3\times4 + 5 - 15 = 12$

[END OF PAPER]

Instruments Used

The students' perceptions were collated from surveys and/or interviews.

Survey Questions

1. What do you think of the topic of Order of Operations?
2. What do you think of using comics in the lesson?
3. In what ways does the comics help you?
4. What do you think of the concept of 'Triangle method' incorporated in the comics?
5. Is there any particular part of the comics that interest you?
6. Does the comic help you understand better?
7. Would you prefer to use comics again in the future lessons?
8. Is there anything about the comics that you would like to change?

Instruments Used

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Survey Questions

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Interview questions

No.	Question
1	Did you like using the visual representation in solving simultaneous equations?
2	What do you like about using visual representation?
3	Did you find it easy?
4	Did you find it useful?
5	Which part did you find it difficult?
6	Which part did you find it confusing?
7	Did visual representation help you to understand the equations better?
8	Do you want to use visual representation to solve problem after this?
9	Can you explain how you solve this problem using visual representation?
10	Is the transition from visual representation to symbolic equations easy?

Summary of Findings

Based on the descriptive statistics data analyses, the overall mean score of the post-test is ***higher than*** the overall mean score of the pre-test, thus showing ***improvements in the students' results*** after the intervention lessons.

The paired sample t-tests conducted in evaluating the impact of the intervention on students' scores for the respective Mathematics topic tests indicated ***strong evidences*** that the interventions of using visual representations have ***positive impacts and significant improvements*** on all the participants' test scores for the tests.

Summary of Findings

Overall Theme 1: Students' Views on the Use of Comics

- ✓ Students had positive views towards comics in general.
- ✓ Majority agreed that using comics made the lessons fun and interesting.
- ✓ From the classroom observations, students gave positive reactions to the comics, and the classroom environment throughout the lessons was overall positive.

Summary of Findings

Overall Theme 2: Impact on Students' Learning and Engagement

- ✓ There were engagements among the students during the paired discussions.
- ✓ Social constructions between the students and teacher during the lesson were also present.
- ✓ Students who preferred using comics during the lessons revealed that comics helped them remember the concepts better and thus, helped improve the results of their post-test.
- ✓ The use of comics in teaching mathematics is crucial due mainly to the fact that it makes studying fun and enjoyable.

Summary of Findings

Overall Theme 3: Comics Constructs and Emotions

- ✓ Majority of the students enjoyed comics because of the colours.
- ✓ Comics have colours which affect the emotions of students.
- ✓ When comics are used in teaching, they trigger positive emotions which help students learn more effectively.
- ✓ The use of comics and colours made the Mathematics lessons more understandable and memorable.
- ✓ Students were attracted to the comic characters that were created.
- ✓ Students' interest in mathematics heightened with the use of comics.
- ✓ When students are taught using a method which makes them feel relaxed, enjoyable and entertained, they tend to remember the information.

Summary of Findings

Overall Theme 4: Inclusivity for the Elementary Levels

- ✓ Introducing cartoon characters in an elementary class makes perfect sense as it makes the learning process more fun.
- ✓ Children who have learning disabilities could also benefit from having using comics in class.
- ✓ Students would not feel as though they are doing academic reading, but rather recreational reading.
- ✓ Beneficial for students with learning disabilities as comics are a form of visual element that aids these students in comprehending the texts.

Challenges Encountered

- Many absentees while conducting the study – Half of the students could not participate in the intervention lessons.
- Inadequate availability of comics to be used in the context of education in Brunei.
- The challenge of locating artists to hire.
- Limited allocation of time given to conduct the intervention lessons due to the need to complete the syllabus and prepare for examinations - Not enough time to do in-depth research.
- Limitation on the use of technology – Lesson disruptions, for example, some technical difficulties involving the *Vertible* (an interactive whiteboard) and the laptop used during the presentation of the comics in the classroom.

Challenges Encountered

- The need to physically print each page of the digital comics and to distribute the comics to all students. This proved to be both tedious and time-consuming, both in terms of human as well as physical resources.
- A few of the students who did not prefer comics still had difficulties getting used to the idea of using comics during the lessons only because it was never been done before and the idea was completely new to them.
- A few students viewed comics as not suitable to be used in the education setting because they viewed comics as non-educational and would prefer to use the traditional notes.

Challenges Encountered

- Mathematics is perceived as a hard or difficult subject for the students.

The main cause was because the students had to remember the formula and steps when dealing with any Mathematics topics. As the years progress, the syllabus introduces new topics which are more in-depth, students slowly perceive Mathematics as difficult and not enjoyable to learn. They observe that the only process of learning Mathematics is by practicing questions and remembering formulas.

Conclusions

Introducing the use of comics in the Mathematics Classrooms in Brunei is still at an infancy stage.

The need to consider the advantages and disadvantages of the use for the benefit of the students' learning and understanding.

Further exposure on the use of comics for the teachers.

Message to Participants

Action research is ***not*** about learning why we do certain things, but rather how we can do things better. It is about how we **can change our instruction to *impact students***.

(Ferrance, 2000, p. 3)

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★ Hasita Haji Abdul Rahman
★ Leon Lim Yu Jin
★ Mohammad Khairul Amilin Haji Tengah
★ Nor Azura Hj Abdullah

THANK YOU

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