Evaluating the Progress of Dyslexic Children on a Small Group Maths Intervention Programme in Singapore

DYSLEXIA ASSOCIATION OF SINGAPORE
HELPING DYSLEXIC PEOPLE ACHIEVE

Rationale for the Essential Maths Programme
The DAS Essential Maths Programme which was started in 2009, aims to support students attending the Dyslexia Association of Singapore who continue to have persistent difficulties in mathematics, through a dyslexia-friendly mathematics intervention programme. The current enrolment is 250 students.

Maths Challenges Our Dyslexic Students Encounter
- Understanding mathematics concepts in school
- Performing mathematics algorithms
- Performing mathematical procedures accurately
- Experienced difficulty with retrieving mathematics facts
- Difficulty solving word problems
- Understanding the language of mathematics

These issues can be attributed to their dyslexia.
(Jordan, Wylie & Mulhern, 2010; Traff & Passolunghi, 2015).

Student Profile
- Primary 1 (7 years) to Primary 6 (12 years)
- Diagnosis of Dyslexia

DAS Maths Adopts the Orton-Gillingham (OG) Principles (Gillingham and Stillman, 1997).
- Cumulative
- Simultaneously Multi-sensory
- Structured
- Emotionally sound

Schedule of Classes (Weekly 1-hour classes with a ratio size of a maximum of 4 students to 1 teacher.)
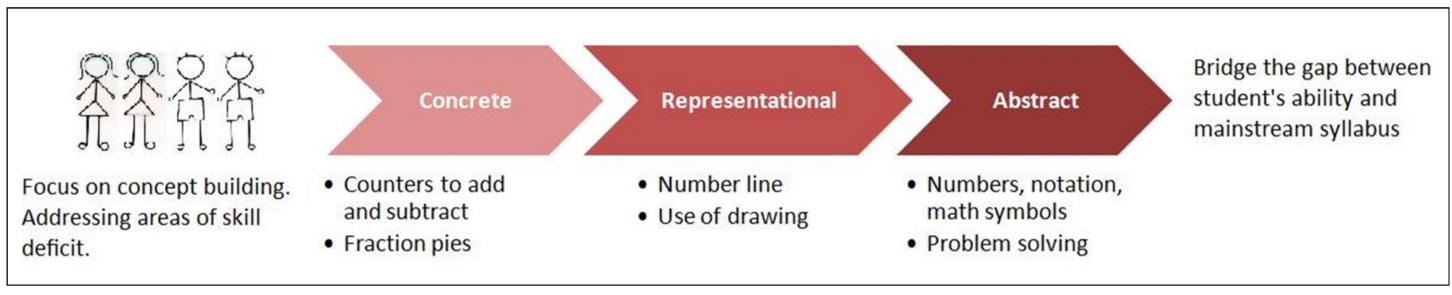Topics taught:
- Addition/Subtraction of Whole Numbers
- Multiplication/Division of Whole Numbers
- Time
- Fractions
- Decimals
- Geometry
- Ratio
- Percentage

Teaching Methodology
The C-P-A (Concrete – Pictorial – Abstract) method has been effective in promoting conceptual understanding in mathematics (Anstrom, 2006) and is endorsed by the Singapore's Ministry of Education in 2007.
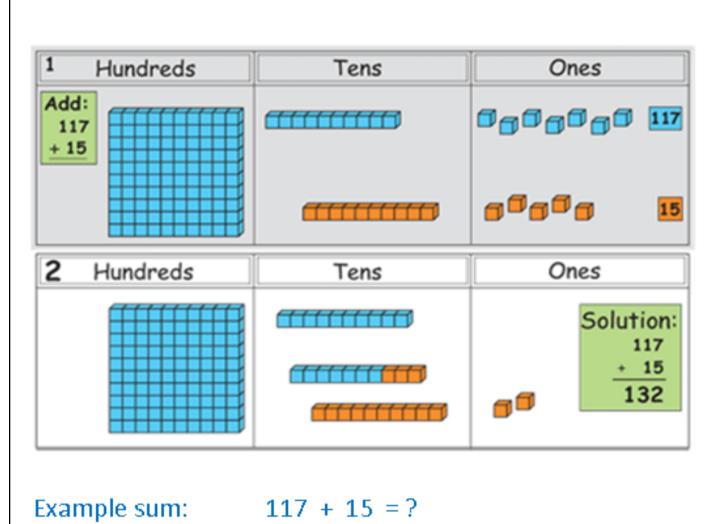The C-P-A method has been adapted by the DAS Maths Curriculum team to the **C-R-A (Concrete – Representational – Abstract)** approach. C-R-A is a dyslexia-friendly pedagogical approach.

C-R-A Approach

Focus on concept building. Addressing areas of skill deficit.

Concrete
- Counters to add and subtract
- Fraction pies

Representational
- Number line
- Use of drawing

Abstract
- Numbers, notation, math symbols
- Problem solving

Bridge the gap between student's ability and mainstream syllabus

Concrete Stage
Example of **Concrete** stage (Use of tangible manipulatives): *Using base ten cubes to work out sums*

Example sum: 117 + 15 = ?

Representational Stage
Example of **Representational** stage (Use of 2D drawings): *Visualising the sum by writing given information in a model*

60 cookies

Example sum: John has 60 cookies. He ate one quarter of the cookies and shared the remainder equally with his 9 friends. How many cookies did each friend get?

1 unit → 60 ÷ 4 = 15
3 units → 15 x 3 = 45
45 ÷ 9 = 5

Abstract Stage
Example of Abstract stage:
3/4 x 12 = 9

- Abstract Reasoning Stage
- Use of symbols and word problems

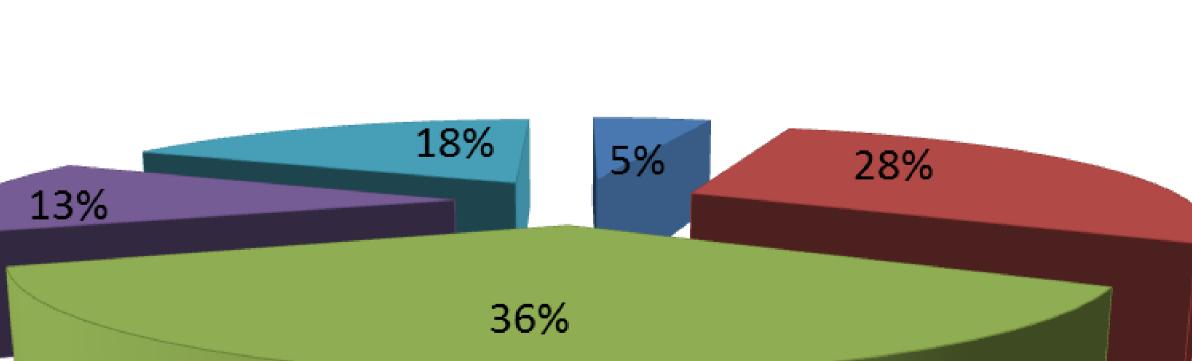## Problem Solving Approaches - Polya's Four Step Processes (1945)

Purpose Of Study
I. Evaluate our students' progress by measuring how much learning had taken place topic by topic on a small group mathematics intervention programme
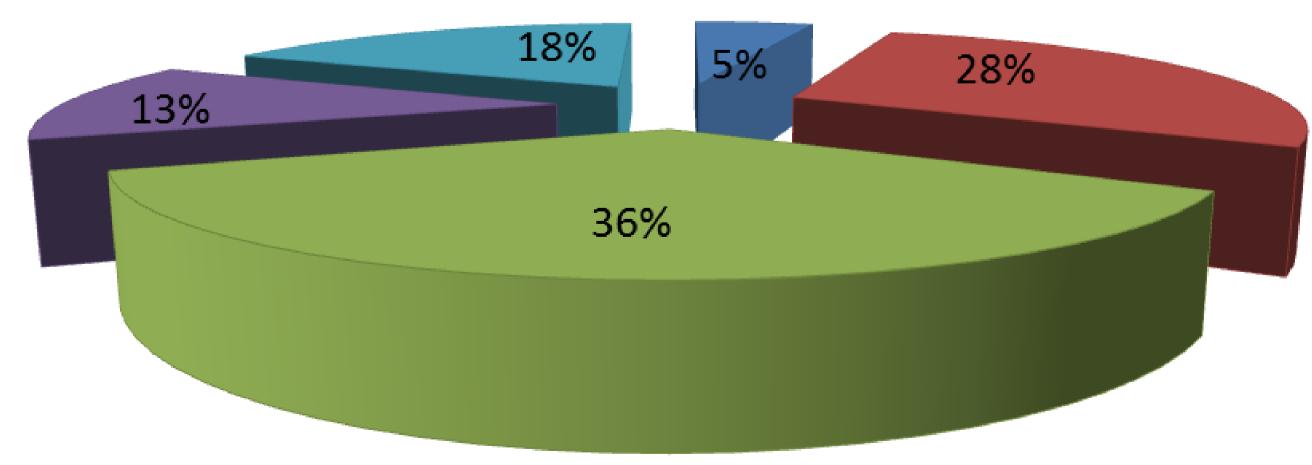II. Identify teaching priorities across topics based on students' performance

Demographics
- The current study involved 39 participants between the school-going grades of Primary 2 (8 years) and Primary 5 (11 years)
- Receiving intervention for at least six months with the DAS Maths Programme

Breakdown of 39 students by grade levels.
P2 / 2   P3/11   P4/14   P5F/5   P5S/7
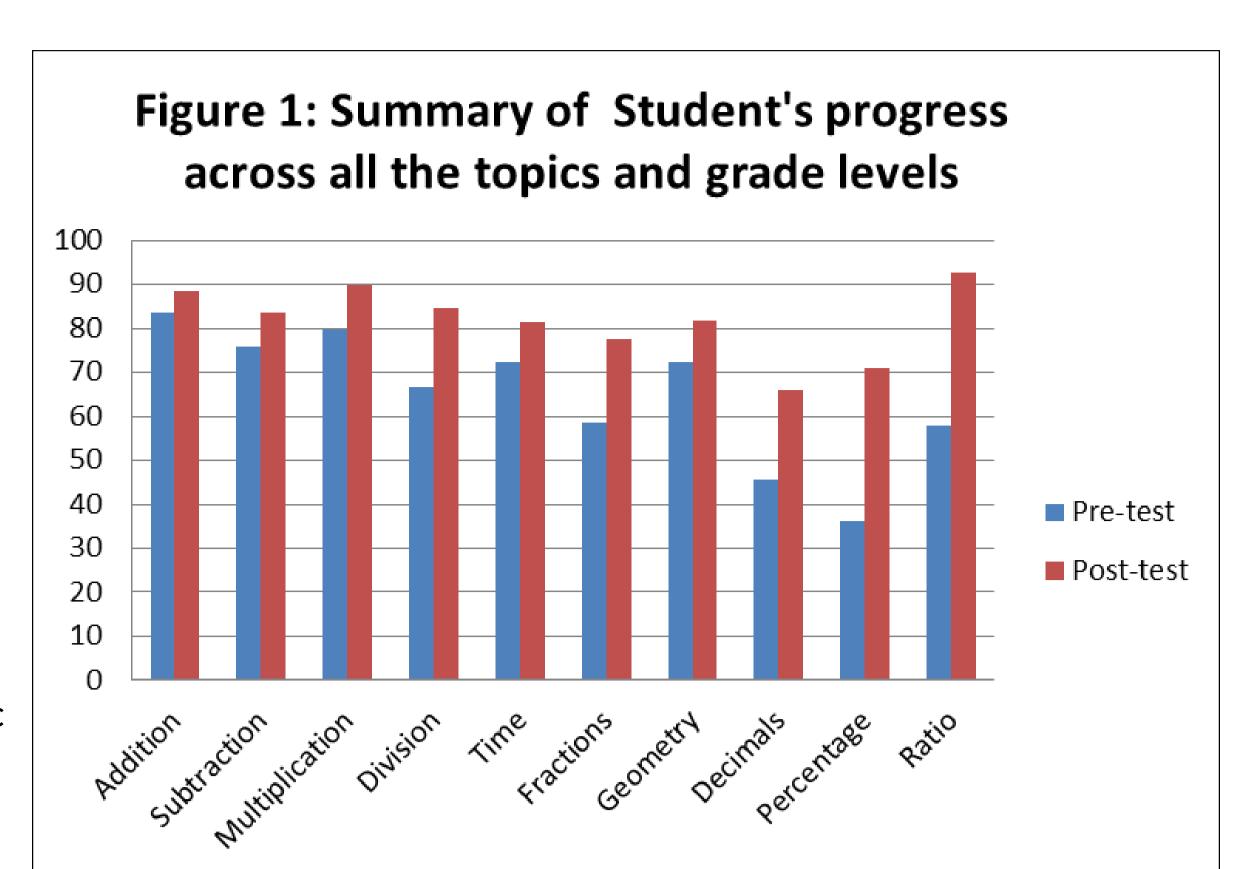

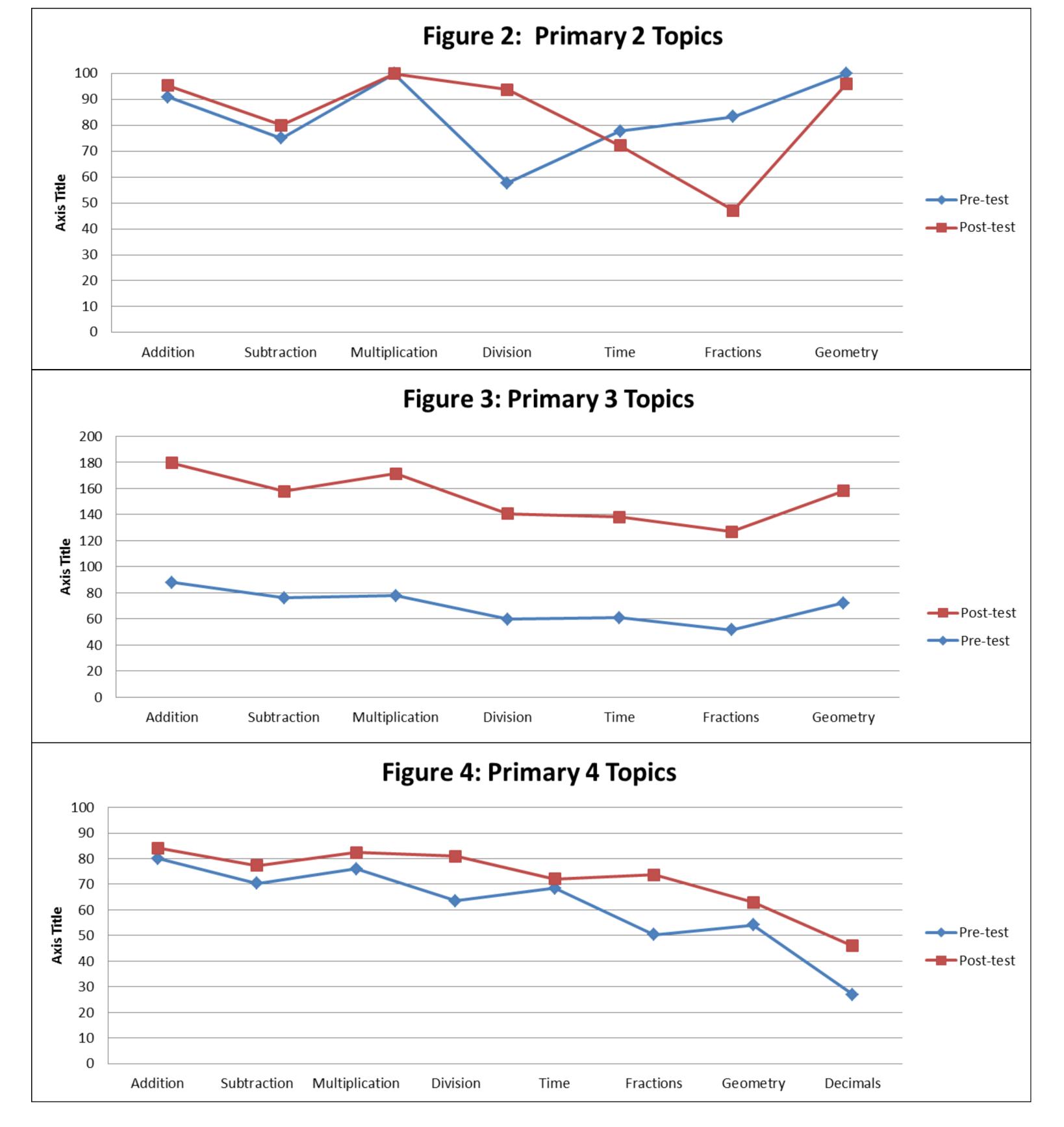5%   28%   36%   13%   18%

Methodology
- Guided by Topical Mathematics, the items in this instrument were designed in–house with reference to the 2007 Primary Mathematics Syllabus (Ministry of Education, Singapore)
- Paper and pencil tests were first administered according to the students chronological grade level
- Each test consisted of conceptual, skill-based and application questions for all concepts within each core topic taught in the school year
- Students were allowed a maximum of two hours to complete the test without the use of calculators
- Their results were analysed using a within-subjects t-test
- The test included a combination of computational questions and word problems
- Students were administered the first test in November 2013 and then a copy of the same test six months later (May 2014)

Results from the Pre-test and Post-test (Main Findings)
Results show for all grade levels a statistically significant improvement in all 10 topics targeted, including addition, subtraction, multiplication, division, time, fractions, geometry, decimals, percentage and ratio.

The data was evaluated on two levels: (a) by topic, and (b) by level.
- Summary of student's progress across all topics in Figure 1 Illustrates data evaluated by topic
- Figures 2 to 5 illustrates data evaluated by grade level and topics

Figure 1: Summary of Student's progress across all the topics and grade levels

Figure 2: Primary 2 Topics

Figure 3: Primary 3 Topics

Figure 4: Primary 4 Topics

- Figure 5 consists of data from P5s in both Standard and Foundation stream. Streaming examination in Primary 4 (i.e. when an average child is between the ages of 9.5 to 10 years old)
- Based on their results, students are streamed into Primary 5 Standard (Higher Ability) or Primary 5 Foundation Stream (Lower Ability)

Figure 5 A: Primary 5 Foundation Topics

Figure 5B: Primary 5 Standard Topics

Discussion
- The main aim of the study was to evaluate the use of a comprehensive test of Singaporean primary maths developed in-house as a measure of progress for dyslexic students on the DAS small group maths intervention programme
- Analysis grade by grade shows that at each grade level some topics show much greater improvement than others, with fewer topics showing progress at higher grades
- This may be a result of harder topics being introduced later in the primary phase, and there may also have been less progress because of poor retention when topics were taught a longer time before the test
- Therefore, we find that although they do show some improvement, the students are still not matching up to their expected school standards

Limitations
- Duration of annual testing may take up to 2 hours for each student to complete
- Students reported feeling unmotivated to complete the paper
- Some students displayed task avoidance

Future Directions
- Shorten the test without affecting its psychometric properties
- Based on the feedback, the team will look into how to shorten the test without affecting its psychometric properties
- We may also need to consider ways to recruit non-intervention children as controls to measure the unique contribution of the programme
- A follow up study has been conducted in 2015 with the following inclusions to the annual testing for more effective triangulation of data

1. Steve Chinn's 15-min norm-referenced mathematics test (Chinn, 2012) would be able to give us an equivalent measure of our students' mathematical performance.
2. Maths attitudes test.

Samples of Student and Parent Positive Feedback for the Maths Programme
Dear Teacher Albel
The DAS Math Programme has met my expectations in building a firm foundation for my son. The programme is able to simplify and using more hands-on approach to make mathematical concepts concrete for the children to understand. The worksheets are also not intimidating for him and he enjoys attending the classes.
Ms Albel is also extremely patient and understanding to empathise the kids' challenges and difficulty in grasping the computation and perception. Thank you.
Thanks for your effort and confidence in Harold.

I am interested in Math because when i was in P1, I was not good in math. After I learn math with DAS, I become more smarter than before. I can even pass Math in my school Math Exam.

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