



Evidence-led improvements to the DAS Maths Programme

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Abstract

A case study on *The Teaching of Maths to Students with Dyslexia: A Teachers' Perspective* by authors Muhamad, Walker and Rosenblatt, drafted in 2015 and published in the *Asia Pacific Journal of Developmental Differences*, Vol. 3, No. 2, 2016, looked at the perceptions of three DAS Maths teachers and how they viewed the teaching process.

Four main challenges for Mathematics teachers emerged from the analysis of the qualitative structured interviews that were conducted in the research by Muhamad et al. Namely, inadequate training, content area language barriers, cognitive style implications and their impact on maths learning, and addressing and remediating students' anxiety towards learning maths and the impact on their self-esteem. Of interest to the Maths team in particular was "inadequate training" which was cited as one of the challenges faced by the teachers interviewed. This paper therefore aims to highlight the training pathways for DAS Maths Teachers which are currently in place since Muhamad et al., (2016), conducted the case study and teacher interviews in 2014.

Keywords: maths, dyslexia, teacher training

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We would not hesitate to agree with Muhamad, Walker and Rosenblatt (2016), that teacher training and support are important aspects of professional development. However, it is especially important for teachers working with our profile of students with co-morbidities to understand the connection between mathematics difficulties their students face and dyslexia which are often overlooked. The learning needs of students with dyslexia are often unmet in the regular mathematics classrooms (Malmer, 2000). This is we believe the most challenging aspect which our teachers face and the task of the Maths team in supporting the Maths teachers with the necessary tools to assist their students to bridge the gaps in their understanding of Maths concepts.

Background of DAS Maths Programme

In Singapore, mathematics is a compulsory subject for all students in primary education. Yet, it is a challenging topic for many students with dyslexia as it involves processes that are affected by their learning difference, such as rapid fact retrieval, working memory and processing speed.

The Essential Maths Programme since its inception in 2009 at the Dyslexia Association of Singapore (DAS) was designed as a 1-hour weekly mathematics remediation programme to help students with dyslexia experience success in the subject. The DAS Essential Maths Programme was officially launched in 2009, but work on its development started much earlier. The curriculum was developed by a team of experienced educational therapists who

were passionate about teaching mathematics. The rationale behind this programme is due to requests from parents for a dyslexia-friendly mathematics intervention for their children. Parents cited that their children had problems understanding mathematics concepts in school, performing mathematics algorithms and procedures accurately, experienced difficulty with retrieving maths facts quickly and solving word problems. These issues can be attributed to their dyslexia (Jordan, Wylie & Mulhern, 2010; Traff & Passolunghi, 2015). This programme was thus developed to address this need.

Programme Description

The teaching methodology adopted aims to keep in touch with the mainstream school maths syllabus, with the aim of bridging the gap between the student's ability and mainstream syllabus by addressing areas they are weaker in.

The teaching methodology is based on the needs of the child, with a strong emphasis on concept-building, addressing areas of skill deficit.

Overview of DAS Maths Programme

The DAS Maths Programme, is recommended for students with dyslexia who have specific areas of difficulty that can affect their mathematical performance such as poor short term and working memory, reversals in words and numbers, problem with sequencing and difficulty with reading word problems. The SES Maths Programme is supporting around 266 dyslexic children to cope with their Maths learning difficulties and to

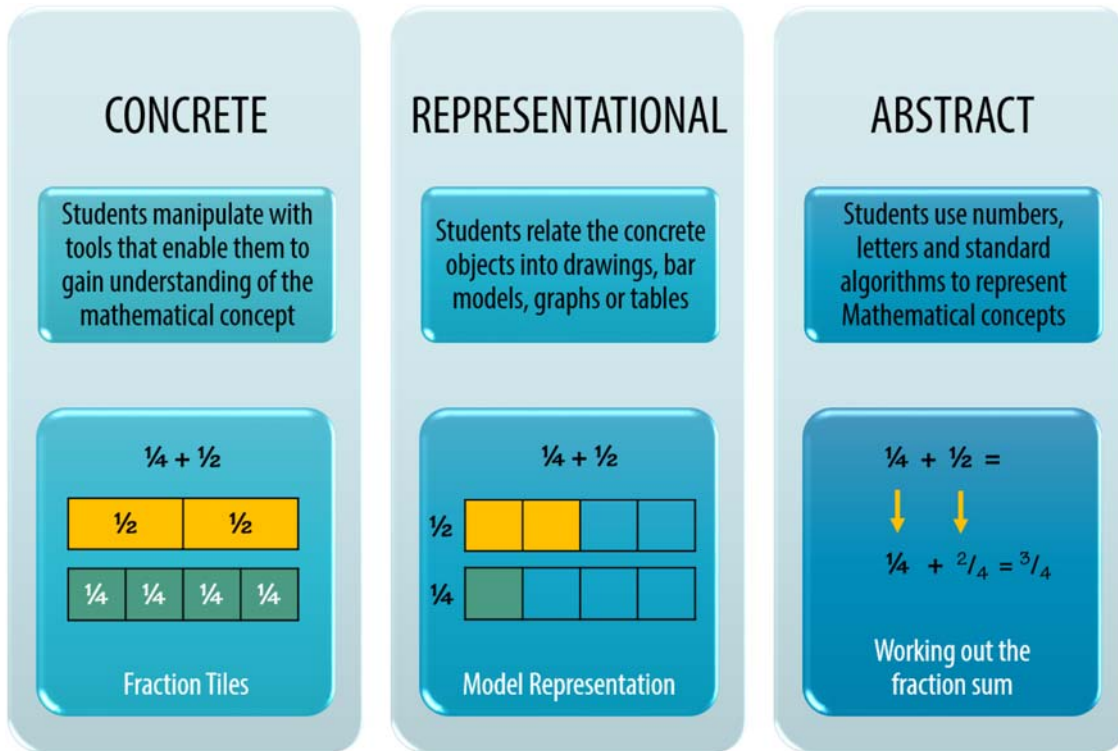


Figure 1. CRA Approach

maximise their true potential.

Theoretical Framework & Teaching Approaches

Every stage of learning ensures that the student links mathematical ideas in a progressive and cumulative way.

Our students are also taught to solve problems using Polya's Four Step Process approach—understand the problem, plan a strategy, solve the sum and check the working. (Polya, 1945)

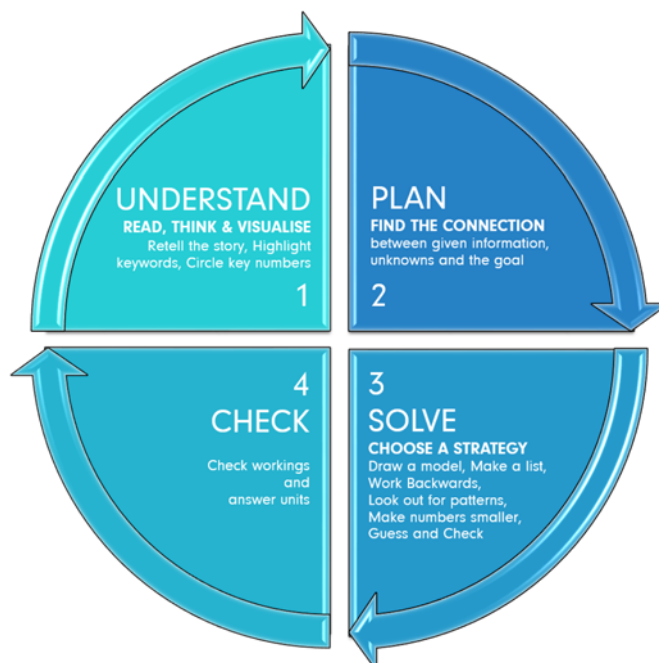


Figure 2. Polya's Four Step Process Approach

Teacher Feedback on their training needs:

In April 2016, the Maths team conducted a survey for all our Maths teachers in order to understand their views towards training, their students' confidence, and their challenges.

Findings from the 2016 Maths teacher survey:

No of participants: 24 DAS Maths Dual Specialists who were actively teaching Maths classes. They varied in terms of teaching experience, and length of service as an Educational Therapist at DAS.

Q1. How Sufficient is your training?

Training can of course always be improved but it appears that most Maths

teachers are happy with what they have received or are currently receiving.

Q2. What additional training do you think would help you become more competent in teaching Maths?

For this question the replies were coded:

Marshall Cavendish Training

The Marshall Cavendish Course was mentioned as benefiting:

"Courses like the Marshall Cavendish is great"

Others cited training by topics and methodology such as the Marshall Cavendish course whereby the course is topical.

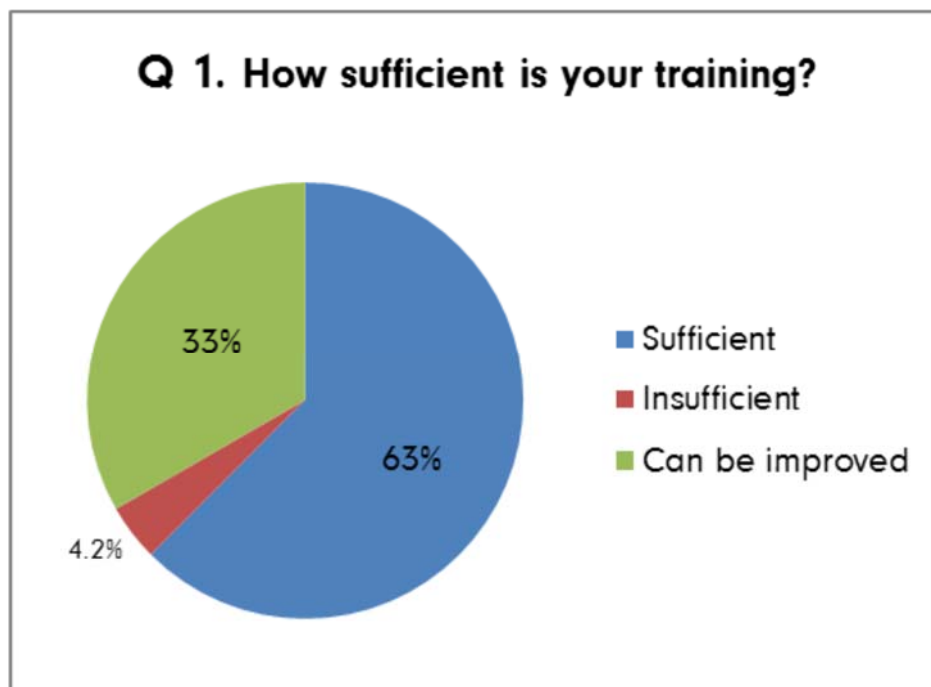


Figure 3. How sufficient is your training

Heuristics

Further information on Heuristics and differentiated instruction and structured teaching approach, came up several times. One participant indicated more sharing of information amongst other teachers. Understanding the processes

slowly progress to the abstract stage.”

From the survey the teachers are clearly strongly in favour of the CRA approach, which they see as applying multi-sensory teaching through the use of manipulative.

Q3. How do you think Mathematics should be taught? (Give a specific example to illustrate)

The other responses were looking at working on problem sums with increasing difficulty and teaching of the concepts.

CRA Approach

Adopting the CRA Approach was the response for almost 19 out of the 24 participants.

Q4. Do you believe your students’ difficulties in maths have any impact on their confidence in doing maths?

“I believe that Mathematics should be taught with the CRA approach. In that sense, students are able to

This question confirms that teachers have a very strong belief that confidence is affected by difficulties that children experience in Maths

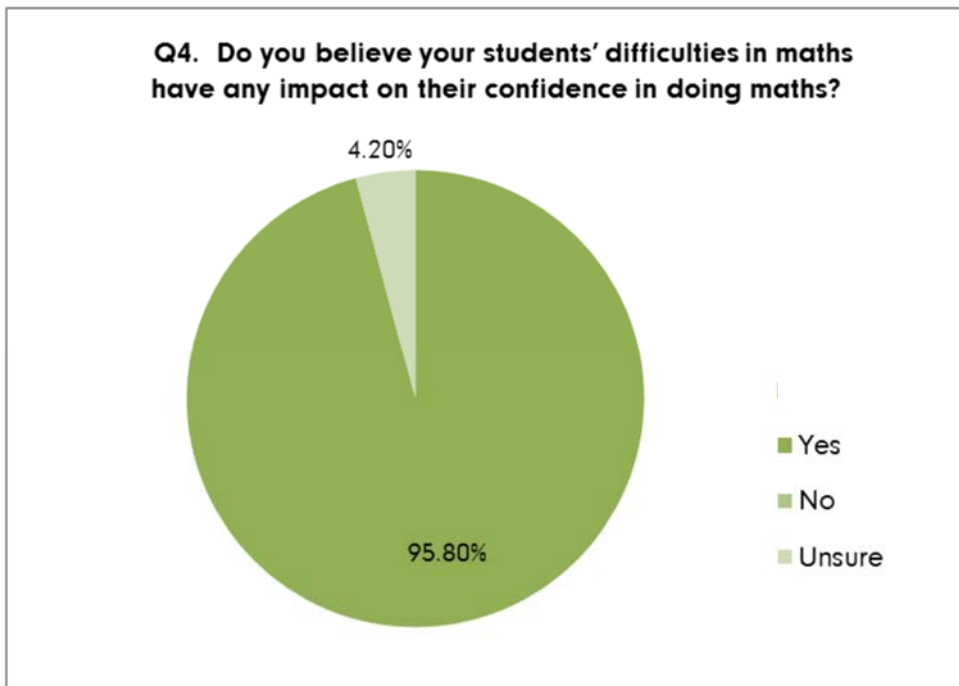


Figure 4. Does your students difficulties in maths impact on their confidence

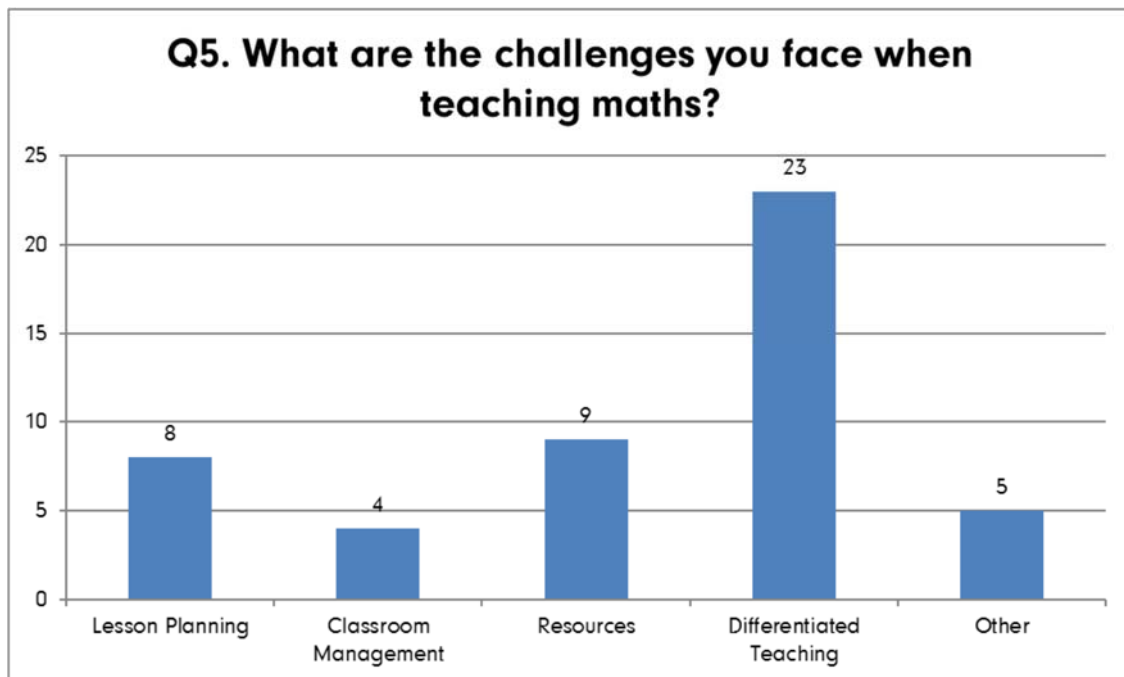


Figure 5 What are the challenges you face when teaching maths?

Q5. What are the challenges you face when teaching maths?

This question was very helpful in pointing to the problems of differentiation when teaching even in small groups of students.

Finding resources and lesson planning are also important but do have the same priority as how to differentiate. This might be a focus for further training.

Q6. If you answered "other" in Q5, please state what other challenges you face when teaching maths.

Insufficient Time

Most of the participants responded that they had insufficient time to conduct the lessons as the students pass was slow and that 1 hour was insufficient and suggested 2 hours instead.

Lesson Planning

Some participants wanted to have more support in lesson planning.

"What to include or what not to include in each component of the lesson plan"

Differentiated Instruction

Teaching the students strategies and differentiated instruction, in catering to the different learning styles and needs of their students was another theme.

Language of Maths

"How to teach the language aspect of Maths especially for the lower primary"

"The teaching problem sums featured several times and model drawing"

Background to Teacher Training

Maths Practicum

Selected DAS Educational Therapists are required to attend the Certificate in Dyscalculia and Numeracy which is delivered by the DAS Academy and the Maths Practicum and Mentoring which is lead by the Maths Core team which spans for 5 weeks.

The current criteria to be a Maths Dual Specialist are to have at least one year experience in teaching the DAS Main

Literacy Programme. The Maths practicum aims to equip the Educational Therapists with practical hands-on skills to plan and teach essential maths concepts to students with numeracy difficulties integrating the Gillingham principles (Gillingham and Stillman, 1997) with the CRA approach and Polya’s four step processes (Polya, 1945) in supporting students with Maths learning difficulties.

As at December 2015 the DAS has trained 34 Educational therapists. We currently have 27 teachers who are practising.

Table 1. Training Pathways for DAS Maths Dual Specialists

Dual Specialist Teacher Training Pathway	
Certificate in Numeracy & Dyscalculia by DAS Academy for all Maths Dual Specialist ✓ Start Teaching	<ul style="list-style-type: none"> ◆ PCC run by the Maths Core Team (5 weeks of mentoring) ◆ Compulsory Insets · ◆ Annual Testing · ◆ Quality Assurance Audits
Enhanced Training Pathway: 2016	
Certificate in Numeracy & Dyscalculia by DAS Academy ✓ Start Teaching	<ul style="list-style-type: none"> ◆ PCC run by the Maths Core Team (5 weeks of mentoring) · ◆ Compulsory Insets · ◆ Annual Testing · ◆ Quality Assurance Audits
Certificate in Mathematics Teaching (Primary) by Marshall Cavendish Run: (April 2016 March 2017)	<ul style="list-style-type: none"> ◆ 120 hours / 1 year of training. (Max 40 participants)
Specialist Certificate in Mathematics Teaching (Primary) for Core Team Members & selected Dual specialists by Marshall Cavendish April 2017	<ul style="list-style-type: none"> ◆ ·60 hours of training

Quality Assurance Audits: Essential Maths 2014 & 2015

Objective:

To ensure that teaching follows the scope and sequence and teaching approaches as outlined in the DAS Maths Curriculum and meets the standards as defined by the Quality Assurance Marking Rubric, there are observations which are conducted once a year.

In 2014, Quality Assurance observations were conducted for the Maths Dual Specialists. The observers comprised of at least two Maths Core Team members so as to have inter-rater reliability. This is to ensure consistent ratings and to minimise any bias that may be present.

The DAS Maths programme which is very much a curriculum based programme, supports DAS students with Dyslexia with persistent Maths difficulties who are attending Ministry of Education schools. Our current programme is well received and has shown improvement rates by our students who attend classes of a minimum of 6 months (Yeo et al, 2015; Bunn et al., 2014).

Programme Evaluation:

Analysis of the information derived from the recent Maths Programme Evaluation reports at the DAS conducted by Bunn et al., 2014 and published in the DAS Handbook 2014 and Yeo et al., 2015a, in the DAS Handbook 2015, aimed at evaluating the student progress results of

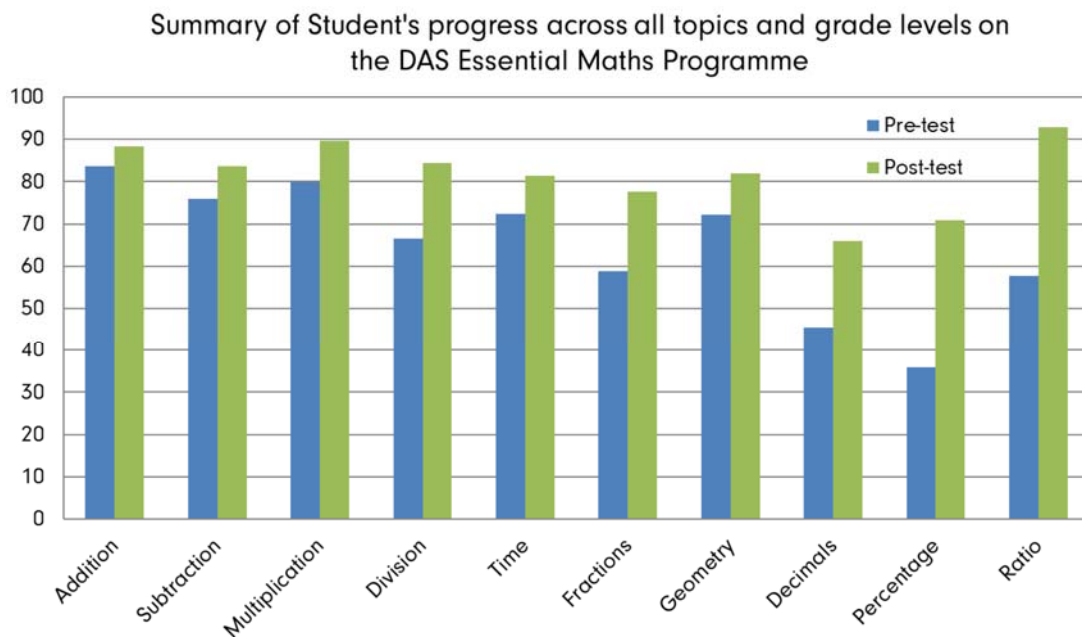


Figure 6: Summary of Student's progress across all the topics and grade levels on the DAS Essential Maths Programme

which were encouraging and demonstrated that student made gains across all levels (Yeo et al., 2015a).

The purpose of the study was to evaluate our students' progress by measuring how much learning had taken place topic by topic on a small group mathematics intervention and to 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). The students had to be receiving intervention for at least six months with the DAS Maths Programme.

Through the DAS Maths Programme annual evaluation reports we are able to do programme needs analysis to better understand the training and professional development needs of our Maths teachers as well as curriculum development. (Yeo et al., 2015a)

It was felt however, that enhancements toward the Maths Dual Specialists Professional Development needed to be made for the benefit of our dyslexic students and our teachers as the programme developed.

Maths Teacher's Training

Key areas for teacher training that have been identified through the Quality Assurance following the DAS Maths Evaluation reports in the 2014 and 2015 DAS Handbook. (Bunn et al., 2014, Yeo et al., 2015a)

A customised training programme and pathway to meet the needs of Maths Dual Specialists teachers, from the Dyslexia Association of Singapore (DAS) was then identified as a key initiative in order to level up all the teacher's Maths teaching skills and knowledge of the syllabus.

Teacher Training: 2015

At the end of 2015 we had 27 trained and practicing Maths Dual Specialists who would have attended the Certificate in Dyscalculia and Numeracy from the DAS Academy as well as the Professional Certificate in Numeracy Support conducted by the Maths Core Team.

Rationale of the Professional Certificate in Numeracy Support

1. To train the selected, confirmed Educational Therapists with at least one year experience in teaching MAP to become Maths Dual Specialists to facilitate the increasing number of students who had been enrolled to be placed into classes and to be provided with the right teaching instruction on Maths procedures so as to effectively the students from our remediation programme.
2. To equip the Educational Therapists with practical hands-on skills to plan and teach essential maths concepts to students with numeracy difficulties integrating the Essential Literacy Approach (ELA) principles and the CRA approach.

3. Each Trainee Educational Therapist is assigned to an experienced Maths Supervisor Educational Therapist preferably at the same centre. Training is for a period of 5 weeks after which the trained Educational Therapist is ready to teach Maths classes.

Findings from the annual Quality Assurance Audits 2014 / 2015

It is our intention with Quality Assurance (QA) to ensure that all our Maths Dual Specialists have the background teaching pedagogy and are enabled to support our DAS Maths students attending MOE schools.

The following were some of the findings which the Maths team noted during the annual QA Audit.

1. Teaching was not consistent across levels.
2. Teaching methodologies / concepts taught were inconsistent.
3. Mathematics terminology used was different.
4. There is therefore inconsistent delivery amongst the current 25 actively teaching Maths Dual Specialists.

Main training targets which were identified for Maths Teachers

1. Training that enhances their teaching practice and up-grade their content knowledge in primary Mathematics so that they can help students to improve their learning.
2. The approach should be based on the teaching approaches and

methodologies adopted and practised widely in Singapore public schools.

3. To ensure the consistency and continuous improvement of content delivery and development.
4. To provide continuous long-term support for our Educational Therapists in the area of lesson planning, delivery and classroom management

Timeline:

The Maths team then identified that training should be provided by leading Maths Training & Maths Publisher, Marshall Cavendish who have the resources and knowledge of the Ministry of Education (MOE) curriculum and teaching pedagogy.

All of our Maths Educational therapists are to be trained by Marshall Cavendish for the 120 hour credit course. The Educational therapists will receive the **Professional Certificate in Mathematics Teaching (Primary)**. The certification which commenced on the 14 April 2016 will be completed by 1 March 2017.

Rationale for the enhancement to the Maths Training Pathway

The Professional Certificate in Mathematics Teacher (Primary) aims to fill in the gap to their current curriculum content knowledge and level up the knowledge for all our Maths Dual Specialists. The Marshall Cavendish Certificate in Mathematics Teaching (Primary) will also better prepare the teachers to teach our students on the upcoming **Advanced Maths Programme**

which will be launched in Term 4, 2016. The Advanced Maths Programme is a programme catered to address the learning needs of the Primary 5 and Primary 6 Standard Maths students who are struggling with the more complex word problems by teaching them appropriate problem-solving heuristics.

Improve teacher competency and competence.

Maths Dual Specialists through the certification are to be trained to deliver / Primary 1 – Primary 6 topics based on the current syllabus / requirements by Ministry of Education (MOE). Maths teachers through applying these new post training teaching approaches and strategies which are aligned to the current mainstream curriculum will allow for the better teaching of the DAS Maths teaching Model and Framework. It is our aim therefore, through enhancements of the DAS Maths teacher training pathway we endeavour to bridge the gap between mainstream mathematics classrooms and small group Maths remediation at the DAS.

In summary and Future directions

For 2016, the Maths Core team have identified a comprehensive training programme for our maths teachers. The Maths teachers training pathway is in line with the DAS commitment to provide continued teachers' professional development.

In summary, the **Certificate in Mathematics Teaching (Primary)** by Marshall Cavendish will be the highlight for the 2016 teacher training that will

enable our teachers who support students on our DAS Maths programme to deliver a higher quality of teaching and adopting the teaching practice aligned with MOE Maths curriculum.

Through the enhanced training provided for our Maths teachers it is our intention that through the research based teaching of the CRA approach and Polya's four step processes adopted at DAS Essential Maths, we will strengthen our student's foundation for confidence in higher-level maths, and thereby bridge the gap between the student's maths abilities and the demands of the school mathematics syllabus so that all Dyslexic students may have the opportunity to achieve in both Literacy and Numeracy. Through our Programme Evaluation we will continue to work on further enhancements that will meet the needs of our ever changing population.

We would like to thank Muhamad et al.; (2016), for the invaluable feedback on the support required by teachers, especially those who may not be trained school teachers. This allows for us to take a closer look at the Professional development of our teachers and share our enhancements to the training pathway.

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Appendix 1: Survey and Interview with the DAS Math teachers

SURVEY ON MATH TEACHING AT DAS

1) How sufficient is your training in equipping you to teach your learners? *

- Sufficient Can be improved Insufficient

2) What additional training do you think would help you become more competent in teaching Maths? *

3) How do you think Mathematics should be taught? (Give a specific example to illustrate) *

4) Do you believe your students' difficulties in maths have any impact on their confidence in doing maths? *

- Yes No Unsure

5) What are the challenges you face when teaching maths? (You can tick more than one) *

- | | |
|---|--|
| <input type="checkbox"/> Lesson planning | <input type="checkbox"/> Differentiated teaching |
| <input type="checkbox"/> Classroom management | <input type="checkbox"/> Differentiated teaching |
| <input type="checkbox"/> Resources (e.g. manipulatives) | <input type="checkbox"/> Other |

6) If you answered "other" in Q 5, please state what other challenges you face when teaching maths.