Presentation Title	**Using Arts-Based Curriculum (Drama & Visual Arts) to Engage and Motivate Pupils in the Learning of Primary Three Mathematics**
Format	**Paper Session [2.05]**
Sub-theme	**Curriculum Development and Innovation by Schools and Teachers**

Using Arts-Based Curriculum (Drama & Visual Arts) to Engage and Motivate Pupils in the Learning of Primary Three Mathematics

Muhammad Huzaifah HARIS
Teacher and Research Activist, Evergreen Primary School

Veronica, L.S. TAN
Teacher and Research Activist, Greenwood Primary School

Vanitha PARADA RAJU
Teacher and Research Activist, Huamin Primary School

Abstract

This study is based on the Learning Through The Arts (LTTA) programme in Calgary, Canada. LTTA components are curriculum infusion across subject disciplines, teacher development and in-class sessions with artists and teachers. Entitled 'Arts-Based Curriculum' (ABC), this study was designed to use arts-based lessons and resources to teach key concepts in Mathematics. This study enabled the schools to determine if there is enhanced engagement and motivation in pupils, and if there is a positive impact on academic achievement in Mathematics using drama and visual arts forms. In all, 232 Primary Three mixed ability pupils from the three schools were involved in this study. The results generally show that using drama and visual arts as pedagogical tools has the potential to promote achievement and increase pupils' motivational and engagement levels in the learning of Primary Three Mathematics.

Keywords: Visual and Performance Arts, Arts Education, Mathematics Education

Introduction

Mathematics continues to be perceived as a difficult subject by the pupils of Evergreen Primary School, Greenwood Primary School and Huamin Primary School. There are many factors that attribute to the lack of interest in Mathematics. Many pupils find Mathematics a challenge but what can educators do to make pupils want to take up the challenge? Mathematics lessons need to be engaging in order for pupils' interest to be aroused. Engagement refers to the involvement of the sensorimotor or physical, emotional, cognitive and social dimensions (Noddings, 1992; Csikszentmihalyi, 1997). Only then will they be motivated to learn the subject and this in turn will result in higher Mathematics achievement among pupils.

Pupils in the three schools have difficulty grasping mathematical concepts through conventional teaching methods. There must be a paradigmatic shift in practices. Restricting the definition of education to acquisition only reduces education to a passive process of obtaining information rather than an engaged process of creating new forms of knowledge and ways of knowing (Chaiklin & Lave, 1993; Varenne & McDermott, 1999). Change in practices is of paramount importance as pupils today can no longer be engaged in lessons by merely being passive learners in a typical classroom where boredom is a disease of epidemic proportion, as defined by Goodlad (1984). Global marketing executive Elissa Moses (2000) also noted that global teens have been brought up to experience and expect sensory stimulation.

Gardner (1995) proposed that education works most effectively for most individuals if differences in mental activities and strengths are taken into account rather than denied or ignored. Given that pupils learn in different ways, the sole adoption of the conventional method of teacher-centred learning is not appropriate in today's school context. The current practice emphasizes linguistic and logical-mathematical intelligences but often overlooks bodily-kinesthetic, visual, spatial and interpersonal intelligences. Consequently, kinesthetic and visual learners end up not being engaged in lessons and are left feeling unmotivated, resulting in poor performance in examinations.

The introduction of Arts-Based Curriculum (ABC) in the three schools aims to motivate and promote engagement, and achievement in the learning of Primary Three Mathematics using drama and visual arts as pedagogy. ABC is based on the Learning Through The Arts (LTTA) programme in Calgary, Canada. One of the components of the LTTA model is collaboration with practicing artists to design and develop lesson plans and teaching and learning resources. The findings of a study conducted by LTTA from 1999 to 2002 noted that involvement in the arts contributed to engagement in learning, motivation and achievement, particularly in Mathematics (Upitis & Smithrim, 2003).

The benefits of using the arts as pedagogy are aplenty. Many studies had been conducted to document them. In "Champions of Change: The Impact of the Arts on Learning", the contributors highlighted some of the "take-home" messages about the arts (Fiske, 1999):

- It changes the environment to one of discovery. This can re-ignite the love of learning in pupils tired of being filled up with facts; and
- Pupils learn to become sustained, self-directed learners, not a repository of facts from direct instruction for the next high-stakes test.

Social opportunities affect motivation (Bransford et al., 2000) and ABC presents pupils with a lot of social opportunities, be it working together to study an artwork or solve a problem in roles. Learners of all ages are more motivated when they can see the usefulness of what they are learning and when they can use that information to do something that has an impact on others (McCombs, 1996; Pintrich & Schunk, 1996). Most importantly, using the arts as pedagogy works because drama, for example, develops the brain by facilitating the maturation of its cortical systems. This is especially important for enhancing pupil learning. Reading, counting, speaking and problem-solving are all maturation correlated (Jensen, 2001).

Using the arts as pedagogy is a strategy that is relatively new in Singapore. However, it has been tried and tested in Canada and the benefits that it brings with it are testament to the fact that arts infusion in the curriculum can motivate pupils to learn and succeed. The three schools believe that through ABC, the integration of the arts in the curriculum will motivate pupils to learn Mathematics as mathematical concepts are conveyed in an experiential way, making them clearer. In the zeal to upgrade education for all pupils, to neglect the arts would be disadvantageous. Far from taking away from more serious learning, the arts make a compelling contribution to pupils' education (Diket, 2003).

Research Questions

The purpose of this study is to assess the effectiveness of drama and visual arts as pedagogical tools to motivate and promote engagement and achievement in the learning of Primary Three Mathematics. Specifically, the following questions guided the study:

- Does the use of drama have an impact on pupils' achievement in Bar Graphs?
- Does the use of visual arts (paper cut) have an impact on pupils' achievement in Angles?
- Does the use of visual arts (lines) have an impact on pupils' achievement in Perpendicular and Parallel Lines?
- Does the use of drama and visual arts motivate pupils' learning?
- Does the use of drama and visual arts engage pupils?

Hypotheses

The hypotheses of this study are as follows:

- The use of drama has an impact on pupils' achievement in Bar Graphs.
- The use of visual arts (paper cut) has an impact on pupils' achievement in Angles.
- The use of visual arts (lines) has an impact on pupils' achievement in Perpendicular and Parallel Lines.
- The use of drama and visual arts motivates pupils' learning.
- The use of drama and visual arts engages the pupils.

Method

Subjects

232 Primary Three pupils were involved in this study. Table 1 shows the breakdown. The socio- economic status of the pupils from the three schools is similar.

Table 1. Breakdown of pupils from Evergreen Primary, Greenwood Primary and Huamin Primary

School	N	Project Group	Comparison Group
Evergreen Primary	72	36	36
Greenwood Primary	80	40	40
Huamin Primary	80	40	40

The Primary Three level was selected for this study because the present Primary Three Mathematics topics consist of basic concepts that are built on progressively at the upper primary levels.

For the study, each school identified a class of project group and a class of comparison group comprising mixed ability pupils. The pupils were assigned to their classes at the beginning of the year based on their previous year's end-of-year examination results.

A pre-test for the pupils involved in this study was conducted to ensure that the project and comparison groups were equivalent.

Measures

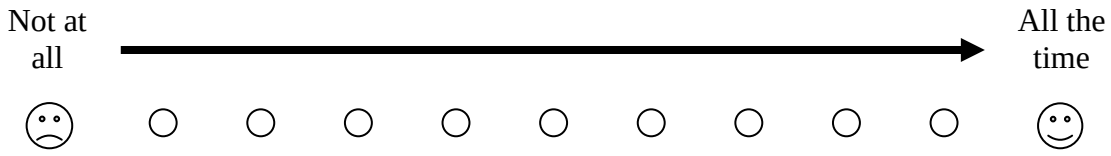
Topical post-tests, pupil's motivational survey and PETALS^{TM} engagement survey were used to assess the outcomes of this study.

The three topics selected for this study are Bar Graphs, Angles, and Perpendicular and Parallel Lines. Three topical post-tests were used as a measure for pupils' achievement on each topic. The total score for each test is 30. The questions are based on knowledge, comprehension and application components.

A Modified Fennema-Sherman Attitude Scale (Fennema & Sherman, 1986) for Mathematics was used to assess pupils' motivation (refer to Appendix 1). The language in the items was modified to suit the understanding of Primary Three pupils. The pupil's motivational survey comprises 12 close-ended items. Pupils had to choose one of the 6 options (strongly agree, agree, somewhat agree, somewhat disagree, disagree and strongly disagree) given. This survey was administered after all the lessons were carried out.

Pupils' engagement in learning was measured using the PETALS^{TM} Engagement Indicator (PEI) Questionnaire which has six scales, namely Pedagogy (P), Experience of Learning (E), Tone of Environment (T), Assessment (A), Learning Content (L) and Engagement (G). The PETALS^{TM} Engagement Indicator Questionnaire was developed by teachers on a research project attachment to the Ministry of Education (MOE) based on a comprehensive framework comprising five principles for engaged learning (The PETALS™ Primer, 2007).

The P, E, T, A and L scales each contains six items. There are 30 items in the engagement scale. The engagement scale comprises three subscales, Affective Engagement (F), Behavioural Engagement (B) and Cognitive Engagement (C). Each of the engagement subscales contains 10 items. The respondents were required to rate the extent to which each statement describes the respective lessons that they had been given. The respondents were asked to read the items carefully and shade the bubble beneath each statement to show the extent they agree with the statement based on the following 11-point Likert-type scale:



Procedure

Using drama to teach Bar Graphs

The team selected Bar Graphs to assess the effectiveness of drama as a pedagogical tool to enhance the learning of Primary Three Mathematics. During the selection process for each of the topics, the team found that drama conventions could be used to deliver the objectives in the Bar Graphs lessons. For instance, using the freeze frame technique, pupils could form a human bar graph. Being part of a bar graph, the pupils could understand better how a bar graph works.

The processes involved in the design and development of the Bar Graphs lesson plans are as follows:

a. Artists from Singapore Drama Educators Association (SDEA) were identified to work with the team in this study based on their experience.

b. During the planning meetings, the team discussed with the artists the concept and skills to be taught for the topic. The team and artists then designed and developed the lessons, deciding on the storyline, roles and drama conventions to be employed. Both parties also came up with drama games that are appropriate to the teaching and learning of Bar Graphs.

c. Curriculum officers from MOE and a lecturer from the National Institute of Education (NIE) gave important inputs for this study.

d. There was a sharing session for all the Mathematics teachers of the project classes. During the session, the teachers were briefed on this study and the roles they had to play. The lessons were also shared in detail.

e. The team sourced for teaching resources needed to conduct the lessons. The team and artists also used this time to fine-tune the lessons and make changes if necessary.

Using visual arts i.e. paper cut and lines to teach Angles and Perpendicular and Parallel Lines respectively

For the topic on Angles, the team used paper fold and paper cut as a strategy to teach the concept of angles. Since mathematical terms such as 'angles' and 'right angle' are used in the teaching of paper fold and paper cut, the team selected this art form to teach angles. The Mathematics teachers used the paper cut-outs and paper fold items that the pupils had created in their Art lessons as a tool to deliver the concept of angles.

As one of the elements of Art is lines, the team felt that it would be appropriate to use it to teach the concept of perpendicular and parallel lines. The pupils were exposed to artworks on lines and through these artworks, the concept of perpendicular and parallel lines was presented visually. After which, the pupils had to create their own artworks using perpendicular and parallel lines.

The processes involved in the design and development of the Angles and Perpendicular and Parallel Lines lesson plans are as follows:

a. The Heads of Greenwood Primary's and Huamin Primary's Art departments are trained in Art and specialize in the teaching of Art in their schools. The team worked with the Heads to design and develop the Art and Mathematics lesson plans.

b. Curriculum officers from MOE and a lecturer from NIE gave important inputs for this study.

c. There was a sharing session for all the Art and Mathematics teachers of the project classes. During the session, the teachers were briefed on this study and the roles they had to play. The lessons were shared in detail and the teachers had a chance to try out the Art lessons.

d. The team sourced for appropriate Art and Mathematics teaching resources for the lessons.

This study was carried out in Term three over a period of eight weeks in all three schools.

Results

As Table 2 shows, for the pre-test in Evergreen Primary, the Project group obtained a mean of 15.1 (6.06) and the Comparison group 15.1 (5.82). The corresponding effect size of -0.01 is of negligible magnitude by Cohen's Criteria. For the pre-test in Greenwood Primary, the Project group obtained a mean of 13.4 (5.98) and the Comparison group 14.7 (5.53). The corresponding effect size of -0.23 is of small magnitude by Cohen's Criteria. For the pre-test in Huamin Primary, the Project group obtained a mean of 21.8 (7.61) and the Comparison group 22.5 (7.68). The corresponding effect size of -0.08 is of negligible magnitude by Cohen's Criteria.

Table 2. Means (Standard Deviations) and Effect sizes of pupils' pre-test results

School	N	Project Group (SD)	Comparison Group (SD)	Effect Size	Remarks
Evergreen Primary	72	15.1 (6.06)	15.1 (5.82)	-0.01	Negligible effect
Greenwood Primary	80	13.4 (5.98)	14.7 (5.53)	-0.23	Small effect
Huamin Primary	80	21.8 (7.61)	22.5 (7.68)	-0.08	Negligible effect

The results from the pre-test showed that the means for the project and comparison groups were close enough for the groups to be taken as equivalent for achievement in the three schools.

As Table 3 shows, for the Bar Graphs post-test in Evergreen Primary, the Project group obtained a mean of 16.7 (5.20) and the Comparison group 15.3 (5.68). The corresponding effect size of 0.24 is of small magnitude by Cohen's Criteria. For the Bar Graphs post-test in Greenwood Primary, the Project group obtained a mean of 14.2 (5.73) and the Comparison group 14.1 (5.54). The corresponding effect size of 0.02 is of negligible magnitude by Cohen's Criteria. For the Bar Graphs post-test in Huamin Primary, the Project group obtained a mean of 22.6 (6.93) and the Comparison group 17.9 (7.26). The corresponding effect size of 0.64 is of medium magnitude by Cohen's Criteria.

For the Angles post-test in Evergreen Primary, the Project group obtained a mean of 17.1 (3.98) and the Comparison group 16.8 (5.74). The corresponding effect size of 0.06 is of negligible magnitude by Cohen's Criteria. For the Angles post-test in Greenwood Primary, the Project group obtained a mean of 17.4 (4.73) and the Comparison group 13.5 (5.12). The corresponding effect size of 0.77 is of medium magnitude by Cohen's Criteria. For the Angles post-test in Huamin Primary, the Project group obtained a mean of 20.3 (7.26) and the Comparison group 18.3 (6.21). The corresponding effect size of 0.33 is of small magnitude by Cohen's Criteria.

For the Perpendicular and Parallel Lines post-test in Evergreen Primary, the Project group obtained a mean of 18.8 (7.58) and the Comparison group 13.6 (6.58). The corresponding effect size of 0.79 is of medium magnitude by Cohen's Criteria. For the Perpendicular and Parallel Lines post-test in Greenwood Primary, the Project group obtained a mean of 20.8 (7.13) and the Comparison group 17.1 (7.43). The corresponding effect size of 0.50 is of medium magnitude by Cohen's Criteria. For the Perpendicular and Parallel Lines post-test in Huamin Primary, the Project group obtained a mean of 21.8 (7.61) and the Comparison group 22.5 (7.68). The corresponding effect size of -0.08 is of negligible magnitude by Cohen's Criteria.

Table 3. Means (Standard Deviations) and Effect sizes of pupils' post-tests results

Measure	School	N	Project Group (SD)	Comparison Group (SD)	Effect size	Remarks
Bar Graphs (drama)	Evergreen Primary	72	16.7 (5.20)	15.3 (5.68)	0.24	Small effect
	Greenwood Primary	80	14.2 (5.73)	14.1 (5.54)	0.02	Negligible effect
	Huamin Primary	80	22.6 (6.93)	17.9 (7.26)	0.64	Medium effect
Angles (visual arts)	Evergreen Primary	72	17.1 (3.98)	16.8 (5.74)	0.06	Negligible effect
	Greenwood Primary	80	17.4 (4.73)	13.5 (5.12)	0.77	Medium effect
	Huamin Primary	80	20.3 (7.26)	18.3 (6.21)	0.33	Small effect
Perpendicular & Parallel Lines (visual arts)	Evergreen Primary	72	18.8 (7.58)	13.6 (6.58)	0.79	Medium effect
	Greenwood Primary	80	20.8 (7.13)	17.1 (7.43)	0.50	Medium effect
	Huamin Primary	80	21.8 (7.61)	22.5 (7.68)	-0.08	Negligible effect

As Table 4 shows, for the motivation survey conducted in Evergreen Primary, the Project group obtained a mean of 3.7 (1.00) and the Comparison group 3.6 (1.12). The corresponding effect size of 0.07 is of negligible magnitude by Cohen's Criteria. For the motivation survey conducted in Greenwood Primary, the Project group obtained a mean of 5.0 (0.77) and the Comparison group 4.3 (0.95). The corresponding effect size of 0.75 is of medium magnitude by Cohen's Criteria. For the motivation survey conducted in Huamin Primary, the Project group obtained a mean of 4.9 (0.97) and the Comparison group 4.8 (0.92). The corresponding effect size of 0.09 is of negligible magnitude by Cohen's Criteria.

For the engagement survey conducted in Evergreen Primary, the Project group obtained a mean of 64.3 (14.60) and the Comparison group 61.6 (17.51). The corresponding effect size of 0.15 is of negligible magnitude by Cohen's Criteria. For the engagement survey conducted in Greenwood Primary, the Project group obtained a mean of 80.2 (12.57) and the Comparison group 71.5 (20.14). The corresponding effect size of 0.43 is of small magnitude by Cohen's Criteria. For the engagement survey conducted in Huamin Primary, the Project group obtained a mean of 75.6 (22.33) and the Comparison group 69.4 (15.05). The corresponding effect size of 0.41 is of small magnitude by Cohen's Criteria.

Table 4. Means (Standard Deviations) and Effect sizes of pupils' responses to the motivation and engagement surveys

Measure	School	N	Project Group (SD)	Comparison Group (SD)	Effect size	Remarks
Motivation	Evergreen Primary	72	3.7 (1.00)	3.6 (1.12)	0.07	Negligible effect
	Greenwood Primary	80	5.0 (0.77)	4.3 (0.95)	0.75	Medium effect
	Huamin Primary	80	4.9 (0.97)	4.8 (0.92)	0.09	Negligible effect
Engagement	Evergreen Primary	72	64.3 (14.60)	61.6 (17.51)	0.15	Negligible effect
	Greenwood Primary	80	80.2 (12.57)	71.5 (20.14)	0.43	Small effect
	Huamin Primary	80	75.6 (22.33)	69.4 (15.05)	0.41	Small effect

As Table 5 shows, the overall engagement is most highly correlated with learning content for the three schools.

Table 5. Correlation between pupils' engagement and PETALS^{TM} framework

Measure	School	**P**edagogy	**E**xperiences of Learning	**T**one of Environment	**A**ssessment	**L**earning Content
Overall Engagement	Evergreen Primary	0.52	0.59	0.60	0.70	0.73
	Greenwood Primary	0.45	0.55	0.61	0.66	0.73
	Huamin Primary	0.61	0.71	0.73	0.72	0.80

Discussion

This study aimed to look at how using visual arts and performing arts led to an increase in pupils' performance and engagement and motivational levels. As shown by the data obtained, using drama to teach Bar Graphs and visual arts to teach Angles and Perpendicular and Parallel Lines has the potential to promote achievement and increase pupils' motivational and engagement levels in the learning of Primary Three Mathematics.

Pupils' language ability plays a part in drama lessons as drama is a language based approach. Pupils with a better command of the English Language tend to benefit more from drama lessons than those who do not have a good command of the language. A number of pupils from the mixed ability classes do not come from English speaking homes. Given that the language ability of mixed ability pupils usually ranges from middle to low, there may be a tendency to think that drama would not have any, or worse still, would have a negative impact on mixed ability pupils' achievement in the learning of Bar Graphs. There is also the tendency to think that the role-playing that comes with drama would detract from the mathematical objectives of the lessons. The reason why using drama as a pedagogical tool has a positive impact on the mixed ability pupils' achievement in the learning of Bar Graphs is most probably due to the fact that the interaction and communication aspects of drama provided the pupils from the project group with more opportunities to talk about bar graphs with one another. This leads to a better retention of the Bar Graphs lessons they had than pupils from the comparison group as they are more able to recall what they learnt in those lessons. Since drama involves a lot of movements and role-play, pupils were also receptive to the lessons and thus better engaged. Drama involves play and play speeds up the process of learning and problem solving.

The interaction and communication aspects of drama played an integral role in enhancing pupils' understanding of the Bar Graphs lessons. The impact of using drama as a pedagogical tool on Greenwood Primary's mixed ability pupils' achievement in the learning of Bar Graphs is negligible due to the fact that there were only a few kinesthetic pupils in the project group. The rest of the pupils were not very expressive and interactive. They found the teaching strategy unfamiliar as drama lessons involve a lot of movements and interactions. The impact of using drama as a pedagogical tool on the mixed ability pupils' achievement in the learning of Bar Graphs may range from negligible to moderate but the higher scores that the pupils from the project group achieved are certainly encouraging.

Pupils today live in a highly visual environment, surrounded by images from the media. This could explain why the pupils' response to learning Angles and Perpendicular and Parallel Lines through visual arts is generally positive. The Angles and Perpendicular and Parallel Lines post-tests' mean scores of the project groups for each school were all higher than the comparison groups'. This shows that the study had some impact on the pupils' achievement in Angles and Perpendicular and Parallel Lines though the impact differs from one school to another.

For the topic on Angles, the reason why the effect size for Evergreen Primary is negligible could be due to the fact that the learning of mathematical concepts has to be progressive, from concrete to pictorial to abstract. Since Angles is a topic that Primary Three pupils are learning for the very first time, the concept of angles has to be made concrete in order for effective teaching and learning to take place. However, quite a number of pupils from the project group felt that the use of paper cut in the teaching and learning of Angles made the concept of angles abstract. In paper cut, the concept of angles was taught by highlighting and discussing the angles found in the design of the paper cut. The angles were in the form of holes due to the cutting and pupils from the project group found it challenging to visualise the angles through the emptiness created by the holes. The difficulty they experienced in grasping the concept of angles is most probably the primary cause that leads to this art form having a negligible impact on Evergreen Primary's mixed ability pupils' achievement in the learning of Angles. Greenwood Primary's and Huamin Primary's mixed ability pupils on the other hand, did not experience the same difficulty because they have attended paper cut exhibitions and therefore are more exposed to paper cut.

Using visual arts (lines) as a pedagogical tool in the learning of Perpendicular and Parallel Lines has a medium impact on both Evergreen Primary's and Greenwood Primary's mixed ability pupils' achievement. Almost all the Perpendicular and Parallel Lines lessons required pupils from the project group to identify perpendicular and parallel lines in the various artworks they were provided with. The lessons also consistently gave the pupils many opportunities to draw their own perpendicular and parallel lines – on pieces of grid paper and in the creation of their own artworks through line drawing and printing. The repetitive nature of the lessons reinforced the pupils' understanding of the concept of perpendicular and parallel lines. On top of that, pupils from Evergreen Primary and Greenwood Primary have been exposed to famous foreign artists and their artworks since Primary One. They have been brought to art exhibitions to look at art pieces or attended art appreciation lessons. This could have been an advantage to them as they were able to appreciate the artworks used in the lessons.

The impact of using visual arts to teach Perpendicular and Parallel Lines on the mixed ability pupils' achievement is on the other hand, negligible for Huamin Primary. One of the reasons could be that the art pieces used as tools to teach the concept of Perpendicular and Parallel Lines were too complex for the pupils to relate to and appreciate. The art pieces were from Picasso's collections and some art books. The pupils had to use these art pieces to carry out the activities. The pupils were probably not enticed by the artworks and so they did not enhance the pupils' interest to perform better. Pupils from Huamin Primary are exposed to only local artists and their artworks since Primary One. This could also explain why they were unable to relate to the art pieces given. Thus it is important to select artworks that pupils can relate to or are familiar with.

The motivation survey results show that the pupils were generally more motivated to learn Mathematics through drama and visual arts. According to Bransford et al. (2000), social opportunities affect motivation. Since the arts-based lessons provided the pupils with a lot of opportunities to interact and communicate with one another, the increase in the pupils' motivational level could have resulted from the many social opportunities that the lessons provided the pupils with. All the three schools are either existing or emerging centres of excellence in the visual or performing arts so pupils are exposed to many forms of art and highly involved in art making using different art forms and media. However, the incorporation of drama and visual arts into Mathematics was a novelty to them and that created a greater interest in the subject. Using drama and visual arts as pedagogical tools excited the pupils and therefore made a positive impact in the form of helping them grasp mathematical concepts better thus causing them to be more motivated.

In Evergreen Primary and Huamin Primary, the motivation survey results show that there was not much difference in the motivational level between the project and comparison groups. In the case of Huamin Primary, it was probably due to the fact that the motivation survey was conducted immediately after the delivery of the third topic, Perpendicular and Parallel Lines. Since Huamin Primary's project group was already not enticed by the artworks provided, conducting the motivation survey immediately after the Perpendicular and Parallel Lines lessons could have affected the results of the survey as the pupils' lack of interest in the artworks might have influenced the choices they made when responding to the items in the survey.

Disruptive pupils prove to have an effect on the results of both the motivation and engagement surveys. Although Evergreen Primary's project and comparison groups were equivalent in terms of achievement, the project group had more pupils with behavioural

problems. They were not motivated and engaged learners and therefore were disruptive in class. Their responses to the motivation and PETALS^{TM} engagement surveys could have lowered the mean of the surveys thus causing using drama and visual arts as pedagogy to have a negligible impact on Evergreen Primary's mixed ability pupils' motivation and engagement. It cannot be denied that using drama and visual arts as pedagogy has not been successful in making the disruptive pupils more motivated and engaged. However, on a more positive note, the fact that the project group has a higher mean for both the motivation and PETALS^{TM} engagement surveys shows that using drama and visual arts as pedagogy does have the potential to motivate and engage pupils. Given time, using drama and visual arts as pedagogy would not only be able to motivate and engage pupils in general at a higher level, but also motivate and engage disruptive pupils.

The results of the engagement survey for Greenwood Primary and Huamin Primary may show that the impact of using drama and visual arts as pedagogical tools to engage the pupils in the learning of Primary Three Mathematics is small but it still indicates that the pupils in the project group were more engaged in their learning than those in the comparison group. A few reasons could have contributed to this. The structure and activities of the drama lessons, and the learning station activities in the Angles lessons were able to naturally engage the pupils. Pupils were required to move about to identify lines in some of the Perpendicular and Parallel Lines lessons. This, together with having to come up with their own line designs by drawing and printing, could have caused them to be engaged in the lessons too. Generally, the lessons were stimulating and catered to the needs of pupils with different learning styles. They also provided opportunities to stretch pupils' thinking and enabled pupils to see meaning in what they had learnt as many of the activities required them to identify, visualise, compare and classify. For instance, in one of the Angles lessons, pupils had to analyse the data they had gathered from an investigative station game.

The PETALS^{TM} engagement survey indicates that engagement is most highly correlated to learning content which means that the pupils found the lessons they went through relevant to them and therefore saw meaning in the activities they did. This highlights the benefits that drama and visual arts as pedagogy brings with it. Therefore in future, when planning engaging lessons for mixed ability pupils, teachers should make the lessons authentic and relevant to these pupils' real lives.

From all the data obtained, it can be concluded that involvement in the arts does promote engagement in learning, motivation and achievement in Mathematics, in line with the findings of the study conducted by LTTA from 1999 to 2002 (Upitis & Smithrim, 2003). The results are also congruent with what Diket (2003) had found, that the arts make a compelling contribution to pupils' education. Using drama and visual arts as pedagogy requires time before substantial improvements can be made but coupled with the pedagogy's potential to motivate and promote engagement and achievement in the learning of Primary Three Mathematics, there is a good reason to continue using this approach. Given time, the impact of using drama and visual arts as pedagogy on pupils' achievement, engagement and motivation would be greater.

Limitations

For this study, only one motivation survey was administered after all the lessons were carried out. As such, it was not possible to determine which of the two art forms, drama or visual arts, that contributed to the increase in the motivational level. Therefore two motivation

surveys should have been administered – one after the drama lessons and another after the visual arts lessons.

The items in the motivation survey were too general. For example, the item "Solving Math questions is boring" should have been phrased as "Solving Bar Graphs questions is boring". The items in the motivation survey should have also been crafted such that the responses given were based on the pedagogy used in carrying out the lessons. For example, the item "Math is enjoyable and interesting to me" should have been phrased as "Learning Bar Graphs through drama is enjoyable and interesting to me".

In terms of implementation, using drama and visual arts as pedagogical tools is more time consuming as compared to the conventional method of teaching and learning. The teachers were not able to carry out more in-depth discussions of the pupils' artworks and did not have sufficient time to help the weaker pupils grasp the mathematical concepts better.

Conclusion & Recommendations

This study shows that using drama and visual arts as pedagogical tools has the potential to promote achievement in the learning of Primary Three Mathematics in the three schools. In general, the results of the surveys show that ABC was able to increase Primary Three pupils' motivational and engagement levels in learning Mathematics.

Using drama and visual arts as pedagogy may not show a vast improvement in a short period of time. Further studies could be done to determine if the effect size would be larger should the project period be longer. To ensure sustainability in using drama and visual arts as pedagogical tools, this approach should continue to be carried out with the pupils that were involved in this study.

It was the first time that the teachers involved in this study carried out arts-based lessons. Sharing sessions were conducted to share the lesson plans in detail with the teachers but it would have been more effective if the teachers had seen the lessons in action. The mere sharing of the lesson plans could have attributed to the small increase in the results. With the recording of the lessons compiled into highlights, new teachers carrying out the lessons will be able to have a better idea of how the lessons are to be executed.

According to Carini et al. (2006), low ability pupils benefited more from engagement than their high ability counterparts. A study could be done to find out if low ability pupils would benefit more from using drama and visual arts as pedagogy as compared to their high ability and middle ability counterparts.

Apart from using the arts as pedagogy in the teaching and learning of Mathematics, the LTTA programme has also used this approach with other subject disciplines. Similar studies using ABC could be conducted to assess the effectiveness of using the arts as pedagogy in the teaching and learning of other subject disciplines such as the English and Mother Tongue Languages, and Science.

Though the results of the findings show some positive impact, through the process of planning and implementing the lessons, the team realised that it is not possible to use drama and visual arts as pedagogical tools to teach all Mathematics topics. The same applies to the use of arts as pedagogy in the teaching and learning of other subject disciplines. It is important not to force fit as there may not be an impact in the study on topics that are not

suitable. Thus proper selection of the topics and matching of the topics to the appropriate art forms are very important.

References

Bransford, J. D., Brown, A. L., Cocking, R. R., Donovan, M. S. & Pellegrino, J. W. (Eds.). Committee on Developments in the Science of Learning, Committee on Learning Research and Educational Practice, Commission on Behavioural and Social Sciences and Education, and National Research Council. – Expanded ed. (2000). *How People Learn: Brain, Mind, Experience and School.* Washington, D. C.

Carini, R. M., Kuh, G. D. & Klein, S. P. (2006). Student engagement and student learning: Testing and linkages. *Research in Higher Education, 47*(1), 1-32.

Chaiklin, S. & J. Lave. (1993). *Understanding practice: Perspectives on activity and context.* Cambridge, England: Cambridge University Press.

Csikszentmihalyi, M. (1997). Assessing aesthetic education. *Grantmakers in the Arts, 8*(1), 22-26.

Curriculum Policy and Pedagogy Unit, Curriculum Planning and Development Division, Ministry of Education & Asociation for Supervision and Curriculum Development (Singapore). *The PETALS™ Primer* (2007).

Diket, R. M. 'The Arts Contribution to Adolescent Learning,' *Kappa Delta Pi Record* (Summer 2003)

Fennema, E. & Sherman, J. (1986). *Fennema-Sherman Mathematics Attitudes Scales: Instruments designed to measure attitudes toward the learning of mathematics by females and males.* Madison, WI: Wisconsin Centre for Education Research

Fiske, E. (Ed.). (1999). *Champions of change: The impact of the arts on learning.* [Online report]. Washington, DC: The Arts Education Partnership and the President's Committee on the Arts and the Humanities. Available:

http://www.artsedge.kennedy-center.org/champions/

Gardner, H (1995). 'Reflections on Multiple Intelligences: Myths and Messages,' *Phil Delta Kappan*.

Goodlad, J. (1984). *A place called school: Prospects for the future.* New York: McGraw-Hill.

Jensen, E. (2001). *Arts with the brain in mind.* ASCD, Alexandria, Virginia USA.

McCombs, B. L. (1996). Alternative perspectives for motivation. Pp. 67-87 in *Developing Engaged Readers in School and Home Communities,* Baker, L., Afflerback, P. & Reinking, D. (Eds.). Mahwah, NJ: Erlbaum.

Moses, E. (2000). *The $100 billion allowance: Accessing the global teen market.* New York: Wiley.

Noddings, N. (1992). *The challenge to care in schools: An alternative approach to education.* New York: Teacher's College Press.

Pintrich, P. R. & Schunk, D. (1996). *Motivation in Education: Theory, Research and Application.* Columbus, OH: Merrill Prentice-Hall.

Upitis, R. & Smithrim, K. (2003). *Learning Through the Arts™: National Assessment 1999 – 2002; Final Report to The Royal Conservatory of Music.* Canada.

Varenne, H. & McDermott, R. (1999). *Successful failure: The school America builds.* Boulder, Colo.: Westview Press.

Appendix 1

Mathematics Motivational Survey

School : _____Primary School Class : P3 ( )
Date : _____2008 Register Number: ( )

Purpose:

This survey is designed to help the school understand your motivational level in Mathematics. Your truthful responses will be useful for the school.

Instructions:

- There is no need for you to write your name on this survey.
- Please shade **ONE** of the bubbles for **EACH** question.
- You need to complete all 12 questions.

No.	Statements	Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree
1.	I like to solve Math questions.	O	O	O	O	O	O
2.	Math is enjoyable and interesting to me.	O	O	O	O	O	O
3.	I am not interested in solving Math questions.	O	O	O	O	O	O
4.	The challenge in solving Math questions does not interest me.	O	O	O	O	O	O
5.	Solving Math questions is boring.	O	O	O	O	O	O
6.	When I can't solve a Math question, I keep trying until I am able to solve it.	O	O	O	O	O	O
7.	I don't understand	O	O	O	O	O	O

No.	Statements	Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree
	how some people can enjoy spending so much time solving Math questions.						
8.	I would rather have someone give me the solution to a difficult Math question than to solve it by myself.	O	O	O	O	O	O
9.	Once I start trying to solve a Math question, it makes me want to solve more Math questions.	O	O	O	O	O	O
10.	When a question is left unanswered in a Math lesson, I continue to think about it after the lesson.	O	O	O	O	O	O
11.	I do as few Math questions as possible.	O	O	O	O	O	O
12.	I enjoy solving challenging Math questions.	O	O	O	O	O	O

Authors

Muhammad Huzaifah HARIS
Teacher / Research Activist
Evergreen Primary School
31, Woodlands Circle, Singapore 738908
Telephone Number: 6368 7705
Fax Number: 6368 8084
Email: muhammad_huzaifah_haris@moe.edu.sg

Veronica, L.S. TAN
Teacher / Research Activist
Greenwood Primary School
11, Woodlands Drive 62, Singapore 737942
Telephone Number: 6366 6158
Fax Number: 6366 6159
Email: tan_liew_siang_veronica@moe.edu.sg

Vanitha PARADA RAJU
Teacher / Research Activist
Huamin Primary School
21, Yishun Avenue 11, Singapore 768857
Telephone Number: 6752 9004
Fax Number: 6755 2455
Email: vanitha_parada_raju@moe.edu.sg