Measuring the Impact of SAIL on Students' Beliefs and Teacher Classroom Practices[1]

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Abstract: Strategies for Active and Independent Learning (SAIL) was introduced into Singapore schools in 2004 to create a classroom culture that supports dynamic interaction among learners. The pedagogy uses an integrated approach of tasks, rubrics, explicit statements of expectation and exemplary students' work to nurture open expression of learning expectations, learner-centred processes and emphasis on formative assessment. The study seeks to examine the impact of using SAIL on students' mathematical beliefs and their perceptions of teachers' behaviours in the mathematics classroom. The sample consists of a group of Grade 7 & 8 students who have been exposed to teaching and learning using the SAIL approach for 2 years. The study measures changes in students' beliefs about mathematics and mathematics learning using the Indiana Mathematics Beliefs Scale and the Fennema-Sherman Attitudes Scales. As SAIL leverages on the dynamic interaction between learners and teacher, the teacher is a strong source of influence in shaping students' beliefs and efforts towards mathematics. The Teacher Classroom Leadership Questionnaire is used to measure students' perceptions of this influence as demonstrated by the teacher in the classroom. Examples of how SAIL tasks and the accompanying rubric can develop students' learning are detailed. Implications for teachers' evolving roles in helping students acquire mathematics skills and knowledge in learner-centered approaches are highlighted.
Keywords: classroom culture, rubrics, assessment, teacher classroom leadership, influence

Introduction

In 1997, the Ministry of Education was given the mandate to develop Thinking Schools Learning Nation. As part of the journey towards this vision, a study trip to Vermont, USA, in 1999 gave impetus to a curriculum innovation in the Curriculum Planning and Development Division (CPDD). It aimed to develop a pedagogic framework that nurtures a learning environment where students are clear about the learning outcomes and assessment criteria, and are comfortable with discussing the learning expectations with their teachers and parents. The instructional approach would enhance existing teaching and learning practices. This approach is called Strategies for Active and Independent Learning or SAIL. The SAIL framework contains tools to create opportunities for students to engage in a range of learning processes and to provide the scope to self assess their own performance for further learning.

The SAIL approach as a teaching strategy for the mathematics classroom was introduced to a government school between July 2004 and December 2005 to provide opportunities for the following (SAIL, 2004):

1. Nurturing Independent, Reflective Learners through open communication of learning targets and expectations,
2. Promoting Dynamic Classroom Talk through the provision of a common language and vocabulary for classroom conversations. This helps to focus and enrich classroom talk with stimulating questions and meaningful discussion about learning.
3. Enabling Differentiated Learning. The tasks and rubrics within the SAIL approach provide scope to engage students of different abilities.

[1] The author would like to thank Peicai Secondary School for assisting in the data collection of this study.

4. Shaping Positive Attitudes towards Learning as a journey with signposts that show the way for progress.
5. Growing a Culture that Embraces Diversity to bring forth variation in ability, thinking, response and achievement.

Schools interested to use SAIL were supported by the provision of SAIL resources. They consisted of workshops, mentorship and material packages which contained suggested lesson plans on how the included SAIL tasks could be integrated into classroom lessons. To support implementation, sample solutions and scoring rubrics for giving feedback to student works were also included. The essence of the SAIL approach was not in presenting the knowledge about the subject content to be learned but in the provision of opportunities for students to learn "actively [so that] they think for themselves, and how they [should] interact with their teachers and peers' in solving the problem (New teaching method puts the 'how' before 'what', 2004). SAIL tasks which contained novel elements were crafted to support active learning and allow students to work with their peers (Helme & Clarke, 2001). The suggested activities in the lesson plans sought to connect students to an experience-flow of problem solving thrills and 'ahas' (Csikszenmihalyi, 1990). An example of a SAIL task is found in Figure 1. The open-ended nature of the task provided opportunities for multiple approaches to solving it. The contexts were carefully chosen so that students could relate to them. When students found the task meaningful, it encouraged dynamic classroom talk among students. Recent studies have observed that students exposed to real world mathematics applications attained more conceptual understanding than groups that were taught by direct teaching methods (Fuson, Carroll & Drueck, 2000; Huntley, Rasmussen, Villarubi, Sangtong, & Fey, 2000; Bevil, 2003). Problem solving that involves the use of authentic situations connects students to the real world and allows teachers to place value on the cognitive complexity and the dynamic process of working at a mathematics task. Such cognitive demands are opportunities for students to make connections among different concepts (Newmann, Marks & Gamoran, 1995).

WHICH ONE SHOULD SALLY BUY?

Task

Sally decides to buy popcorn before going for a movie. She has a choice to have the popcorn packed in one of the two different types of cylinders. The curved surfaces of these cylinders are each formed from a rectangular sheet of paper of the same size. Which one should Sally choose if both the cylinders of popcorn cost the same price?

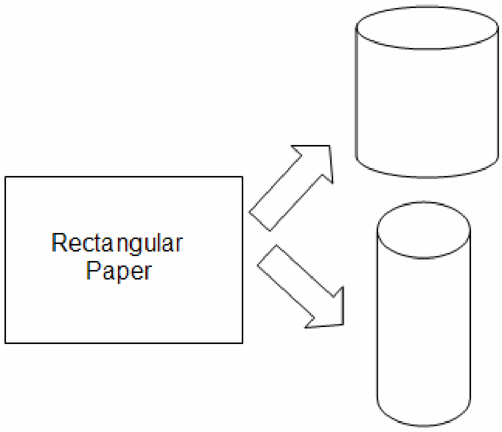

Figure 1: *An example of a SAIL*

In addition, rubrics were a key feature of the SAIL approach which gave feedback to the learners' level of performance. The rubrics when used as a form of self assessment increased students' responsibility for their own learning (Klenowski, 1995). Using SAIL, teachers graded student work on five criteria: Approach, Solution, Connection, Communication and Layout. Each of these criteria has a 4-point scale. Figure 2 contains part of a sample rubrics that students used to self or peer evaluate their work on the approaches they use.

Task Specific Scoring Guide: WHICH ONE SHOULD SALLY BUY?			
Reasoning and Problem Solving			
Approach & Reasoning: The strategies and skills used to solve the problem and the reasoning that supports the approach **(AR)**			
Level 1	**Level 2**	**Level 3**	**Level 4**
Approach and reasoning do not work e.g. surface area is being considered instead of volume	Approach and reasoning leads to solving only part of the problem e.g. using numerals to find the volume of either the tall or short cylinder with no comparison of volumes made [B1]	Obtains a solution using numerals to show that volume of the shorter cylinder will contain more popcorns than the taller one. **[B1]**	• Uses algebraic approach to show that the volume of the shorter cylinder is greater than volume of the taller cylinder **[B3]** **or** • Uses algebraic approach to find volumes and then make comparisons with numerical examples [B3]

Figure 2: *Sample Scoring Rubric*

The SAIL approach encouraged students to discuss and share their approaches and mathematics solutions. Such dynamic interactions that occur in the classroom helped students to develop knowledge from practice *(*Hiebert, Gallimore & Stigler,2002). Emphasis on self- or peer- evaluation encouraged students to hypothesise possible misconceptions that their friends might have about mathematics and they could better appreciate how certain mathematics errors could be avoided. The explicit levels of the rubrics helped the teachers to attune to the different levels of competencies reflected in the student sample scripts and give emphasis to other qualities of mathematical thinking besides a single-solution outcome. The diagnosis of the incomplete or incorrect solutions emphasised the learning process and gave focus to the formative value of assessment. The use of SAIL moved the teachers from the preoccupation of marks-awarding to how they could help students 'shoot for a higher level of competence – on their own' (Lee, 2005).

Purpose

This study investigates the impact of using SAIL in the classroom on students' beliefs in the learning of mathematics and their perception of teacher practices in the classroom.

This study sought to examine the extent to which the use of SAIL could support and inform the teachers in (a) building rapport and using strategies to allow students to identify with the teachers' goals; (b) motivating their students intrinsically; (c) demonstrating consideration for the individual's learning needs; (d) challenging students' mental models through questioning the assumptions they bring to the lesson; and (e) rewarding agreed levels of performances. In particular, the study also investigated the extent SAIL could influence beliefs students hold about the learning of mathematics

Methodology

Sample

A total of 552 students (grades seven and eight) from one neighborhood school comprised the overall student sample of this study, among which there were 357 7^{th} graders and 195 8^{th} graders. Most of these students had been exposed to SAIL over a 2-year period. Student-data were collected by the corresponding instruments between 2004 and 2005 which the study will refer to as Year 1 and Year 2, respectively.

Table 1 shows how the sample would be studied using four separate groupings.

Group A is made up of four classes – two G7 and two G8 classes. Group B (04G7B, 04G7C, 04G7D, 04G7G) comprising of four Grade 7 classes was the comparison group. In the data collection exercises using two instruments, survey responses were returned by 291 and 279 students, respectively. Preliminary data coming from Groups A and B comprises 291 students from eight classes of 7^{th} and 8^{th} graders. There were 140 males (52%) and 133 females (48%), no information on gender was provided by 18 students.

In Year 2, teachers taught using SAIL in both Group A and the comparison Group B. In addition, five other classes were also included in the study. They were labelled Group C. The objective was to provide a bigger sample size with Group B.

Table 1: *Distribution of the classes.*

Group	Class	No. of students	Year 1	Year 2	Remarks
A1	04G8A	23	SAIL	Dropped out of study	4 classes had SAIL for Year 1
	04G8B	34	SAIL	Dropped out of study	

Group	Class	No. of students	Year 1	Year 2	Remarks
A2	04G7E,	31	SAIL	SAIL	Two classes 04G7E 04G7F had SAIL for Year 1 & Year 2
	04G7F	34	SAIL	SAIL	
B	04G7B	17	Non SAIL	SAIL	Four classes 04G7B 04G7C 04G7D 04G7G had SAIL only in Year 2
	04G7C	35			
	04G7D	29			
	04G7G	31			
C	05G7A	18		SAIL	Six classes were introduced to SAIL in Year 2
	05G7 B	24			
	05G7C	19			
	05G7E	23			
	05G7F	31			
	05G7G	16			

Measures

The study which spanned 18 months was interested to investigate how SAIL as a strategy about opportunities for student-student and student-teacher interactions shaped students' beliefs about maths and their perceptions about classroom practices.

Two instruments were employed to measure students' perception. The Teacher Classroom Leadership Questionnaire (TCLQ) (Lee, 2002), an instrument developed to understand the influence of the teachers' classroom practices on the students, was used to collect students' perceptions of the teachers' classroom practices during SAIL lessons. The idea behind the work is that teachers exhibiting practices of transformational leadership have an extraordinary, positive impact on the motivation, morale and performance of their students with whom they worked closely. Five practices are assessed by the TCLQ include perceptions of teachers demonstrating Learner Centredness (C), Engaging Dispositions (F), and behaviours that use Intrinsic Motivation (M), Extrinsic Reinforcement (R) and Student Active Inquiry (S). The instrument was field tested on 825 school students (Lee, 2005).

The second instrument is the *Indiana Mathematics Belief Scales* (IMBS) (Kloosterman & Stage, 1992), a self-reporting questionnaire. The instrument measures six beliefs dimensions. (Mason & Scrivani, 2004):

- Effort can increase mathematical ability. (coded as EFFORT)
- Understanding concept is important in mathematics. (coded as CONCEPTS)
- Word problems are important in mathematics (coded as WORDPROB)
- There are word problems that cannot be solved with simple, step-by-step procedures. (coded as PROCEDUR)
- I can solve time-consuming mathematics problems. (coded as PERSERV)
- Mathematics is useful in daily life[2] (coded as UTILITY)

Students were asked to rate to what extent they agree with given statements on a 5-point Likert scale of 1 - Strongly Disagree; 2 – Disagree; 3 - Not sure; 4 – Agree; and 5 - Strongly Agree. Some of the items have reverse coding to strengthen the reliability of the instrument.

[2] The *Usefulness Scale was extracted from Fennema-Sherman Mathematics Attitude Scales*

Procedures

As the teachers were immersed into the use of the new strategy SAIL, the study had the opportunity to examine the effect on the classes as a result of different exposure to SAIL. Over the two years of the study, fourteen classes with different exposure to SAIL lessons were examined.

Table 1 show how the 12 classes are categorised into three groups:

(1) Group A consisted of Grade 7 and 8 students who have 6 months of SAIL;
(2) Group B consisted of Grade 8 students who have 12 months of SAIL; and
(3) Group C consisted of Grade 7 students who have 12 months of SAIL.

Data Analysis

The administration of the two instruments which measured students' maths beliefs and students' perception of teacher classroom practices, respectively, was conducted on separate days within a week at the end of the school terms. As a result, the number of responses to the two questionnaires collected was different.

Descriptive statistics such as means, standard deviations, and percentages were used to present the survey data. Inferential techniques such as independent samples t tests, and analysis of variance were used to investigate students' pre-post achievement gains in the targeted construct dimensions.

Findings and Discussion

Part 1

Independent-samples t tests were performed to examine changes in students' beliefs about maths learning and their perceptions about classroom practices. One belief dimension was identified by t-test with significant differences between Group A and Group B: Word Problems (p<.05). Students who have been exposed to learning maths using SAIL were more ready to believe that word problems are important in mathematics instead of just routine drill exercises. The same pattern of scores is observed in Group A for the other belief dimensions, although the differences between the two groups are not quite so large. This is not surprising as the SAIL tasks were different from the routine textbook problems. SAIL tasks were less structured to provide scope for students to analyse the problem in different ways, and to compare and contrast the strategies used in solving the given problem.

Table 2: *IMBS Comparison of Group A and Group B after 6 months of SAIL*

	t-test	SAIL N=143			NON SAIL N=148	
	Sig. (2-tailed)	Mean	SD[3]		Mean	SD
Concepts Understanding	0.78	3.8	0.7		3.7	0.7
Procedures	0.71	2.6	0.5		2.5	0.5
Perseverance	0.11.	3.3	0.7		3.2	0.4
Utility	0.79.	3.8	0.8		3.8	0.7
Word Problems	0.02*	3.1	0.5		2.9	0.5
Effort	0.53.	3.7	0.8		3.6	0.7

***** p < 0.01**
**** p< 0.05**
*** p < 0.10**

[3] Std. Deviation

At the end of six months, students' perceptions of teachers' classroom practices were measured. Table 3 shows the results of the t-tests which indicate significant difference between the 2 groups for the subscales: Intrinsic Motivation and Learner- Centeredness. Both subscales approach significance at 0.10.

Table 3 *TCLQ Comparison of Group A and Group B*

TCLQ	t-tests	SAIL N=132			NON SAIL N=147	
	Sig. (2-tailed)	Mean	SD		Mean	SD
Learner Centredess	0.10*	3.22	0.79		3.06	0.84
Engaging Vision/Value	0.64	3.10	0.83		3.05	0.91
Intrinsic motivation	0.09*	3.24	0.79		3.08	0.80
Extrinsic Motivation	0.85	2.92	0.76		2.91	0.84
Student Inquiry	0.33	3.28	0.75		3.19	0.86

***** p < 0.01**
**** p< 0.05**
*** p < 0.10**

The use of a scoring guide, a key feature of the SAIL approach provided opportunities for open communication of learning targets and expectations. The rubric was a tool to provide qualitative feedback on the students' effort at solving the SAIL tasks. Both students and teachers used the given criteria contained in the rubrics to describe to one another the different performance levels for a given piece of work. The specific guidance allowed students to be more focused in their learning. The continuous and regular feedback deepened students' understanding of what they were good at, what they needed to improve and how they can improve.

Being exposed only to the use of SAIL for a short period of time, it was not surprising that students in Group A score only marginally higher on the other subscales (Engaging vision, extrinsic motivation, student inquiry). Nevertheless, the teacher's conscious effort to value habits of independent and reflective learning motivated students to be more responsible for their own learning (Engaging Vision subscale scores: 3.10 vs. 3.05). The rubric criteria for formative assessment went beyond the attainment of a correct solution to emphasise alternative approaches adopted, connection among concepts, mathematical communication skills and overall layout of the solution. During SAIL lessons, students reported teachers' emphasis away from just attaining correct answer. This practice played a strong part in developing independent learning and reflective thinking (Student Inquiry: 3.28 vs. 3.19).

Part 2

At the end of the first 6 months of the SAIL intervention, two classes 04G8A and 04G8B dropped out of Group A. The remaining 2 classes formed a new group: Group A2. The classes in Group A2 continued to use SAIL for another 12 months during Year 2. At the end of Year 2, the IMBS and the TCLQ were administered and their scores obtained were compared to Year 1.

Table 4 and **Table 5** show the results of the t-tests. Results indicated a significant difference in the Utility belief dimension. Extended use of SAIL seemed to increase students' belief about the benefits of learning of mathematics and its usefulness in daily life.

As the sample size was relatively small, no significant difference on the TCLQ was noted between Group A2 and Group B.

Table 4 *IMBS Comparison of two classes (1E 1F) in Year 1 & 2*

Maths Beliefs	t-tests	Year 1 N=78			Year 2 N =65	
	Sig. (2-tailed)	Mean	Std. Deviation		Mean	Std. Deviation
Concepts Understanding	0.227	3.9	0.8		4.0	0.6
Procedures	0.520	2.6	0.5		2.6	0.5
Perseverance	0.049	3.4	0.6		3.2	0.5
Utility	0.000**	3.0	0.5		3.2	0.5
Word Problems	0.307	3.1	0.5		3.0	0.4
Effort	0.333	3.8	0.8		3.7	0.7

***** p < 0.01**
**** p< 0.05**
*** p < 0.10**

Table 5 *TCLQ Comparison of two classes (1E 1F) in Year 1 and 2*

TCLQ	t-tests	SAIL N=78			NON SAIL N=64	
	Sig. (2-tailed)	Mean	Std. Deviation		Mean	Std. Deviation
Learner Centredess	0.137	3.29	0.79		3.10	0.74
Vision/Value	0.284	3.18	0.81		3.04	0.78
Intrinsic motivation	0.971	3.11	0.71		3.11	0.71
Extrinsic Motivation	0.121	2.95	0.74		2.76	0.68
Student Inquiry	0.467	3.32	0.71		3.23	0.71

Part 3

t-tests was performed on a larger SAIL sample comprising classes from Group B. The sample consisted of Grade 7 students from Year 1, who were exposed to SAIL in Year 2. Year 1 and Year 2 scores obtained on IMBS and TCLQ were compared.

Table 6 contains t-tests which indicate a significant difference in their perception levels. It seemed that SAIL teaching increased students' perception of math learning as involving word problems that cannot be solved with simple step-by-step procedures.

SAIL tasks were crafted such that maths concepts were nested in real life context. The non-routine task was less structured compared to textbook problems. The task required the students to identify the maths in the problem and to devise strategies to solve the problem posed. Emphasis was not given to a single-correct answer. Instead, a scoring rubric awarded credit to approaches explored, connections made, and communication skills exhibited in addition to the ability to arrive at a correct solutions.

Table 6 *IMBS Comparisons between Year 1 and Year 2*

		Year 1 N=147			Year 2 N=108	
Maths Beliefs	Sig. (2-tailed)	Mean	Std. Deviation		Mean	Std. Deviation
Concepts Understanding	0.281	3.7	0.7		3.8	0.7
Procedures	0.002**	2.5	0.5		2.7	0.5
Perseverance	0.990	3.2	0.4		3.2	0.5

Utility	0.324	3.8	0.7		3.9	0.7
Word Problems	0.214	2.9	0.5		3.0	0.4
Effort	0.252	3.6	0.7		3.7	0.7

***** p < 0.01**
**** p< 0.05**
*** p < 0.10**

Table 7 contained results of the t-tests, displaying significant differences in favour of teachers employing SAIL in their teaching on four subscales. TCLQ results as shown in Table 7 register strong differences in three subscales: Engaging vision ($p < 0.01$), intrinsic motivation ($p < 0.00$) and Student Inquiry ($p < 0.00$). Students in the SAIL classes felt that their teacher had an engaging vision of a desired future that inspired them. One of these strong values that students perceived was that their teachers believed that one should learn maths for intrinsic reasons. The SAIL approach lends itself very well to providing opportunities for students to explore different problem solving strategies and to justify the formulae or rules used to solve the problem.

The SAIL approach gave the scope for students to relate mathematics to a real life and to extend and explain the mathematically relevant observation made or pattern identified which went beyond solving the problem, and situation (Student Inquiry subscale scores: 2.90 vs 2.94).

Table 7 TCLQ Comparison between Year 1 and Year 2

TCLQ		NON SAIL N=147			SAIL N=108	
	Sig. (2-tailed)	Mean	Std. Deviation		Mean	Std. Deviation
Learner Centredess	0.025	3.06	0.84		3.35	1.10
Engaging Vision/Value	0.003***	305	0.91		3.39	0.86
Intrinsic motivation	0.000***	3.08	0.80		3.44	0.79
Extrinsic Motivation	0.742	2.90	0.84		2.94	0.80
Student Inquiry	0.000***	3.19	0.86		3.56	0.81

***** p < 0.01**
**** p< 0.05**
*** p < 0.10**

Part 4

In Part 3, the study examined impact on four Grade 7 classes who were taught in the conventional way in Year 1 and were given the SAIL intervention in Year 2. These classes form Group B. In the same year, Year 2, another group, Group C comprising 7th graders was exposed to the SAIL lessons for 12 months. Group C with 131 students. 51 are boys and 37 are girls (19 students did not provide information on gender).

A one-way ANOVA was carried out to examine association of maths beliefs and perception of teacher practices with different levels of SAIL usage. Table 8 shows the results of the ANOVA analysis with four scales registering significant differences among the three groups.

Table 8 *Analysis of Variance of IMBS Scores by SAIL Usage levels*

IBMS		Sum of Squares	df	Mean Square	F	Sig.
Concepts	Between Groups	10.24	2	5.12	12.30	0.00***
	Within Groups	126.92	305	0.42		

IBMS		Sum of Squares	df	Mean Square	F	Sig.
Understanding	Total	137.15	307			
Procedures	Between Groups	2.49	2	1.25	5.12	0.01**
	Within Groups	74.21	305	0.24		
	Total	76.70	307			
Perseverance	Between Groups	1.29	2	0.64	2.42	0.09
	Within Groups	81.41	305	0.27		
	Total	82.69	307			
Utility	Between Groups	3.22	2	1.61	3.45	0.03*
	Within Groups	142.14	305	0.47		
	Total	145.36	307			
Word Problems	Between Groups	0.12	2	0.06	0.32	0.73
	Within Groups	59.84	305	0.20		
	Total	59.97	307			
Effort	Between Groups	0.33	2	0.17	0.23	0.80
	Within Groups	222.56	305	0.73		
	Total	222.89	307			

***** p < 0.01**
**** p< 0.05**
*** p < 0.10**

Post-hoc analysis is used to hunt through the data for any significant differences. Turkey's honesty significance difference test was used to perform every possible comparison since there is no theoretical basis to expect any direction. Table 9 indicates that there are significant differences between Group B with (1) Group A and C for Concepts Understanding; (2) with group C for the Procedures dimension; (3) with group C for the Utility dimension;

Table 9 *Multiple Comparisons among the Three Groups*

Multiple Comparisons			Math Beleifs		
Tukey HSD					
Dependent Variable	(I) CATEGORY	(J) CATEGORY	Mean Difference (I-J)	Std. Error	Sig.
Concepts Understanding	Group A	Group B	0.23	0.10	0.05
		Group C	0.47	0.10	0.00
	Group B	Group A	-0.23	0.10	0.05
		Group C	0.24	0.08	0.01
	Group C	Group A	-0.47	0.10	0.00
		Group B	-0.24	0.08	0.01
Procedures	Group A	Group B	-0.18	0.08	0.06
		Group C	0.01	0.07	0.98
	Group B	Group A	0.18	0.08	0.06
		Group C	0.19	0.06	0.01
	Group C	Group A	-0.01	0.07	0.98
		Group B	-0.19	0.06	0.01
Perseverance	Group A	Group B	0.03	0.08	0.91
		Group C	0.15	0.08	0.14
	Group B	Group A	-0.03	0.08	0.91
		Group C	0.12	0.07	0.19
	Group C	Group A	-0.15	0.08	0.14
		Group B	-0.12	0.07	0.19

Multiple Comparisons			Math Beleifs		
Tukey HSD					
Dependent Variable	(I) CATEGORY	(J) CATEGORY	Mean Difference (I-J)	Std. Error	Sig.
Utility	Group A	Group B	-0.03	0.11	0.94
		Group C	0.18	0.10	0.18
	Group B	Group A	0.03	0.11	0.94
		Group C	0.22	0.09	0.04
	Group C	Group A	-0.18	0.10	0.18
		Group B	-0.22	0.09	0.04
Word Problems	Group A	Group B	0.03	0.07	0.90
		Group C	-0.01	0.07	0.97
	Group B	Group A	-0.03	0.07	0.90
		Group C	-0.05	0.06	0.71
	Group C	Group A	0.01	0.07	0.97
		Group B	0.05	0.06	0.71
Effort	Group A	Group B	-0.09	0.13	0.78
		Group C	-0.05	0.13	0.93
	Group B	Group A	0.09	0.13	0.78
		Group C	0.04	0.11	0.92
	Group C	Group A	0.05	0.13	0.93
		Group B	-0.04	0.11	0.92

***** $p < 0.01$ ** $p< 0.05$ * $p < 0.10$**

Paired-group comparisons as shown in Table 9 indicated significant differences in Concept Understanding, Procedures, perseverance and utility. While the gain is largest for Group A in Concepts Understanding and Perseverance, Group B exhibited significant differences in both comparisons with Group A and Group C. Results seem to suggest that students who were more exposed to SAIL usage believes that concepts understanding is important, learning mathematics involved more than simple step by step procedures, there is usefulness in learning mathematics and that perseverance at mathematics problem solving would be productively.

Table 10 shows that Grade 8 students (Group B) benefited most from the use of SAIL. When the students were given opportunities to work on unstructured problems, the experience deepened their concepts understanding. Compared to Grade 7 students, their benefits were not as large. It seems to suggest that the older students who had more exposure to learning maths became more aware that understanding concepts was important in mathematics. In addition, it increased their confidence in being able to solve time-consuming mathematics problems.

On the other hand, the G8 students who only had SAIL introduced to them in Year 2 for 12 months scored highest in two belief constructs, Procedures and Utility. These students realised that maths problems could not always be solved by simple routine step-by-step procedures. Real world problems required them to think through the concepts and to apply them in relevant places. Through the experience of working with real world problems, students increased their awareness of the use of maths in daily events.

Table 10 *IMBS Mean Scores Comparisons*

CATEGORY	Group A2 N = 65	Group B N = 112	Group C N = 131	Total 308

SAIL Exposure	18 months (G8)		12 months (G8)		12 months (G7)			
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Concepts Understanding	**4.04**	0.55	3.80	0.65	3.56	0.68	3.75	0.67
Procedures	2.56	0.48	**2.74**	0.47	2.55	0.52	2.62	0.50
Perseverance	**3.20**	0.54	3.17	0.53	3.05	0.49	3.12	0.52
Utility	3.81	0.55	**3.85**	0.72	3.63	0.71	3.75	0.69
Word Problems	3.04	0.37	3.01	0.42	3.05	0.49	3.03	0.44
Effort	3.65	0.68	3.74	0.69	3.70	1.04	3.70	0.85

Similar observations were noted in the TCLQ scores in Table 11. Group C seemed to register the highest TCLQ scores. When ANOVA was conducted to test if the mean scores on the TCLQ from the three groups were equal, results displayed in Table 12 indicated significant interaction between the grade level of the students and SAIL usage, in all five dimensions. Post-hoc analysis was followed up to surface from the data any significant difference in perceptions of teacher practices across the three groups.
teacher also balanced the use of intrinsic motivation with tangible tokens of rewards for students' effort and hard work.

Table 11 *TCLQ Mean Scores Comparisons*

CATEGORY	**Group A N= 64**		**Group B N=108**		**Group C N=107**		**Total N=279**	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Learner centredness	3.1	0.74	3.35	1.1	**3.43**	0.73	3.32	0.9
Engaging Vision/Values	3.04	0.78	3.39	0.86	**3.45**	0.74	3.33	0.81
Intrinsic motivation	3.11	0.71	3.44	0.79	**3.46**	0.71	3.37	0.75
Extrinsic Motivation	2.76	0.68	2.94	0.8	**3.18**	0.64	2.99	0.73
Student Inquiry	3.23	0.71	**3.56**	0.81	3.5	0.67	3.46	0.74

Table 13 shows the scores of the eleven Year 2 SAIL classes in their 3 categories of the classes. Interestingly, the highest scores reside in Group C, the group comprising Grade 7 students. The students could identify with the strong vision that the teacher had for them, in desiring them to learn maths beyond marks and extrinsic rewards. At the same time, the

Table 12 *Analysis of Variance of TCQ Scores by SAIL Usage levels*

		Sum of Squares	df	Mean Square	F	Sig.
Learner centredness	Between Groups	4.513	2	2.256	2.817	0.062*
	Within Groups	221.097	276	.801		
	Total	225.610	278			
Engaging Vision/Values	Between Groups	7.435	2	3.718	5.845	0.003***
	Within Groups	175.534	276	.636		

	Total	182.969	278			
Intrinsic motivation	Between Groups	5.670	2	2.835	5.165	0.006**
	Within Groups	151.468	276	.549		
	Total	157.138	278			
Extrinsic motivation	Between Groups	7.320	2	3.660	7.149	0.001**
	Within Groups	141.310	276	.512		
	Total	148.631	278			
Student Inquiry	Between Groups	4.710	2	2.355	4.366	0.014*
	Within Groups	148.880	276	.539		
	Total	153.590	278			

***** p < 0.01**
**** p< 0.05**
*** p < 0.10**

Conclusion

Grade 7 and Grade 8 students' maths beliefs were enhanced at significant and important levels through the use of the SAIL in their maths lessons. In addition, students felt their teachers practised learner-centred behaviours when integrating SAIL in their teaching. SAIL tasks were non-structured and offered opportunities for classroom discourse. At the same time, SAIL tasks requiring the application of different maths concepts emphasised the importance of learning maths in more connected ways. These mental stimuli for making and testing conjectures encouraged the practice of higher order thinking skills. As a result, students using SAIL to learn maths, over time, felt that there was more student inquiry in the classroom. The conducive learning environment that supported the use of stronger reasoning skills and deeper metacognitive abilities among students developed positive maths beliefs in students.

Table 13 *Post Hoc Comparison of TCLQ Scores*

Tukey HSD					
Dependent Variable	(I) CATEGORY	(J) CATEGORY	Mean Difference (I-J)	Std. Error	Sig.
LEARNER	Group A	Group B	-0.25	0.14	0.18
		Group C	-0.33	0.14	0.05*
	Group B	Group A	0.25	0.14	0.18
		Group C	-0.08	0.12	0.79
	Group C	Group A	0.33	0.14	0.05
		Group B	0.08	0.12	0.79
ENGAGING	Group A	Group B	-0.35	0.13	0.01**
		Group C	-0.41	0.13	0.00***
	Group B	Group A	0.35	0.13	0.01
		Group C	-0.06	0.11	0.85
	Group C	Group A	0.41	0.13	0.00
		Group B	0.06	0.11	0.85
INSTRINS	Group A	Group B	-0.33	0.12	0.01**
		Group C	-0.35	0.12	0.01**

	Group B	Group A	0.33	0.12	0.01
		Group C	-0.02	0.10	0.98
	Group C	Group A	0.35	0.12	0.01
		Group B	0.02	0.10	0.98
EXTRINSI	Group A	Group B	-0.18	0.11	0.26
		Group C	-0.41	0.11	0.00***
	Group B	Group A	0.18	0.11	0.26
		Group C	-0.24	0.10	0.04**
	Group C	Group A	0.41	0.11	0.00
		Group B	0.24	0.10	0.04
INQUIRY	Group A	Group B	-0.33	0.12	0.01**
		Group C	-0.27	0.12	0.05**
	Group B	Group A	0.33	0.12	0.01**
		Group C	0.06	0.10	0.81
	Group C	Group A	0.27	0.12	0.05
		Group B	-0.06	0.10	0.81

***** p < 0.01 ** p< 0.05 * p < 0.10**

In sketching the impact of SAIL on students' beliefs about maths learning and their perception of teacher practices in the classroom, we still need to know to what extent these experiences would directly enhance understanding and the quality of students' problem solving skills in mathematics. There were different factors contributing to the outcomes of the intended goals of SAIL, of which teacher-students interactions seemed vital. Further work would be needed to ascertain the extent of the linkages between the integration of SAIL and mathematics thinking and learning within a classroom culture that supports dynamic interaction among learners.

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