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Empowering Teachers with Thinking Skills

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Abstract

Research by Ee (1998) and Ee, Lee & Potter (2004) showed that although teachers perceived the importance of strategy-based instruction, they were found lacking in not only understanding the effects of strategy-based instruction but also the strategies and teaching approaches that govern thinking and self-regulation. Over 40 Postgraduate Diploma in Education (PGDE) Secondary teacher trainees were administered both a pre- and post-test using a teacher questionnaire designed by Ee, Lee & Potter (2004) besides attending a 26 hour course on Strategies for Teaching Thinking and Learning. Both quantitative and qualitative data analysis will be used to investigate these teachers' strategies and teaching approaches. The findings and implications will be discussed.

Introduction

In this current era with the many Ministry of Education (MOE) initiatives such as, "Thinking Schools, Learning Nation", "Innovation & Enterprise" and "Teach Less, Learn More" teachers need to be effective, reflective thinkers and learners who are flexible, resilient, adaptive and self-directed to keep up with the constant changes in time. Teachers must themselves have a clear understanding of the thinking skills in teaching and learning; and in nurturing a thoughtful environment conducive for thinking before they can empower their students to be independent, self-regulated learners.

According to Ee & Moore (2004), teachers' ability to empower their students with relevant learning strategies can assist in their students' learning. Researchers (e.g. Ee & Moore, 2004; Mayer, 1996; McCormick & Pressley, 1997 & Zimmerman 2002) have also found that the use of effective thinking and learning strategies play an important role in enhancing student academic development. According to Pressley et al. (1990), teachers need to identify relevant strategies that will address the cognitive demands of the task to benefit students' achievement. In the selection of these strategies, teachers need to have knowledge of what the strategy is for, be able to describe critical attributes of the strategies to the students, provide reasons for learning that strategy and relate the kind of benefits that can be derived for using it besides informing the students how, when and where that is, under what circumstances the strategy should be used. Feedback on how to evaluate and tell whether the strategy helps in that given task should also be explained. Hence, teachers' knowledge base is important in ensuring success of strategy-based instruction.

According to Ee's (1998) study involving 311 teachers in 53 Singapore schools, teachers' strategy-based instruction differ in quantity and quality. Although many teachers perceived a relationship between teaching learning strategies and achievement, many were found lacking in their knowledge base on strategies for enhancing thinking and learning for achievement or self-regulation.

As such, this study hoped to train some Postgraduate Diploma in Education (PGDE) Secondary teacher trainees on strategies for empowering students' thinking and learning through a pre- and post-test using a teacher questionnaire designed by Ee, Lee & Potter (2004). These PGDE teacher trainees were also exposed to 26 hour course on Strategies for Teaching Thinking and Learning.

Subjects

Forty-two (26 males, 16 females) trainee teachers participated in the study. However, only 35 (20 males, 15 female) trainee teachers participated in the post-test. Fifty-seven percent of these trainees

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are in their early twenties whilst 40% are in their late twenties. They are all degree holders with 6% having Masters (see Table 1).

Methodology

A 50 item questionnaire on classroom practices designed by Ee, Lee & Potter (2004) was used to examine these trainees' understanding of strategies. The questionnaire consisted of two parts. Part 1 consisted of their bio-data whilst Part 2 consists of 36 four-point Likert-type items that measure teachers' perceptions of importance as well as their frequency of using such classroom strategies.

Table 1
Trainee Teachers' Bio-Data

	Gender		Age				Qualifications			
	Male	**Female**	**20-25**	**26-30**	**31-40**	**41-50**	**Degree**	**Grad Dip**	**Masters**	**Phd**
Pre-Test										
T1-T21 (21)	12	9	12	7	1	1	18		2	1
E22-E42 (21)	14	7	14	7			20		1	
Total	26	16	26	14	1	1	38		3	1
Post-Test										
T43-T56 (14)	8	6	8	5	1	0	12	1	1	
E57-E77 (21)	12	9	12	9			20		1	
Total	20	15	20	14	1	0	32	1	2	

Quantitative Data Analysis

The data consisting of responses of 77 teachers on 35 items for both the variables "perception of importance (IMPT)" of strategy-based instruction (SBI) and "frequency of use (FREQ)" of SBI were analysed using Rasch analysis in order to calibrate the items on the instruments and to obtain the person-measures on both variables. The analysis will result in items-calibrations in "logits" and person-measure also in "logits" and both will be on the same scale so that they are comparable to each other.

However, the analyses for the variables IMPT and FREQ were done separately, which means that each logit on the IMPT scale is not equal in length to the logit on the FREQ scale, and the outputs of analyses should be interpreted as such.

Results of Analyses

Two classes of trainee teachers took the pre-test on the perception of importance of the SBI and the frequency of use in their teaching practice, before undergoing a training session on strategy-based instruction. At the end of the training programme, both classes took the post-test. One of the classes had an attrition of five teachers.

Rasch analysis on the pre-test responses results in items being calibrated. At the same time, the respondents were measured on their perceptions of the importance of SBI and their frequency of use of the strategies during their teaching practice or during their earlier experiences in teaching before undergoing training at the National Institute of Education (NIE). When analyzing the responses to the post-test, the item calibrations from the pre-test are used as anchor. This will put the person measures for both the post-test and the pre-test on to a common scale and they can be directly compared and tested for any significant difference.

Tables 2 (a) and (b) show the summary statistics for the pre-test analysis. The tables show that this instrument has an item separation reliability of 0.93 on the "perception of importance" (IMPT) of SBI scale and 0.90 on the frequency of use scale. What these two values show are that the instrument has items that cover a wide range of aspects for the measure of each of the two

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variables, meaning that the items are well separated in their variations of the construct under study. This makes the instrument reliable in telling apart differences between the respondents if such differences exist in their perceptions of importance of SBI and in their frequencies of use of the strategies.

Tables 2 (a) and (b) also show that of the 42 respondents participated in this survey, one was "extreme", meaning that he scored either the maximum possible or minimum possible score. Such a respondent is automatically dropped from the analysis by the Rasch analysis programme because extreme scores do not add useful information to the calibration of the items on the instrument. The same is observed for the variable "frequency of use" (FREQ). We note from these two tables, that the person separation reliabilities are 0.89 and 0.91 for IMPT and FREQ respectively. These high reliabilities show that the respondents are well separated from each other on the two variables, meaning that they have a large variance on both variables.

The instrument has 36 items on each of the two variables IMPT and FREQ. However, item 22 was omitted by most participants and has been excluded in this analysis. There are therefore 35 items analysed.

Table 2(a)
Summary Statistics For Pre-measures of SBI Perception Of Importance (IMPT)

INPUT: 42 PERSONS, 35 ITEMS MEASURED: 42 PERSONS, 35 ITEMS, 4 CATS

SUMMARY OF 41 MEASURED (NON-EXTREME) PERSONS

	RAW SCORE	COUNT	MEASURE	MODEL ERROR	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	102.0	34.9	1.08	.29	1.02	-.3	1.01	-.3
S.D.	12.0	.5	1.01	.02	.64	2.6	.62	2.6
MAX.	130.0	35.0	3.80	.40	2.89	5.4	2.89	5.3
MIN.	67.0	32.0	-1.62	.27	.10	-6.5	.10	-6.4

REAL RMSE	.33	ADJ.SD	.96	SEPARATION 2.92	PERSON RELIABILITY	.89
MODEL RMSE	.29	ADJ.SD	.97	SEPARATION 3.31	PERSON RELIABILITY	.92

SUMMARY OF 35 MEASURED (NON-EXTREME) ITEMS

	RAW SCORE	COUNT	MEASURE	MODEL ERROR	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	119.5	40.8	.00	.27	.99	-.1	1.01	-.1
S.D.	16.4	.4	1.07	.01	.39	1.7	.42	1.8
MAX.	140.0	41.0	3.26	.29	1.86	3.5	2.20	4.2
MIN.	69.0	39.0	-1.47	.24	.50	-2.7	.48	-2.9

REAL RMSE	.29	ADJ.SD	1.03	SEPARATION 3.58	ITEM RELIABILITY	.93
MODEL RMSE	.27	ADJ.SD	1.03	SEPARATION 3.84	ITEM RELIABILITY	.94

UMEAN=.000 USCALE=1.000

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Table 2(b)
Summary Statistics For Pre-measures of SBI Frequency Of Use (FREQ)

```
INPUT: 42 PERSONS, 35 ITEMS  MEASURED: 42 PERSONS, 35 ITEMS, 4 CATS
-------------------------------------------------------------------------------
      SUMMARY OF 41 MEASURED (NON-EXTREME) PERSONS
+-------------------------------------------------------------------------------+
|           RAW                          MODEL         INFIT        OUTFIT     |
|          SCORE     COUNT     MEASURE   ERROR      MNSQ   ZSTD   MNSQ   ZSTD  |
|-------------------------------------------------------------------------------|
| MEAN      87.0      34.8         .04     .27       .99    -.5   1.01    -.4  |
| S.D.      13.8        .8         .98     .01       .65    2.7    .65    2.6  |
| MAX.     113.0      35.0        1.81     .31      3.18    6.4   3.17    6.4  |
| MIN.      55.0      31.0       -2.44     .26       .26   -5.0    .27   -4.8  |
|-------------------------------------------------------------------------------|
| REAL RMSE    .30  ADJ.SD     .94  SEPARATION  3.13  PERSON RELIABILITY  .91  |
|MODEL RMSE    .27  ADJ.SD     .95  SEPARATION  3.54  PERSON RELIABILITY  .93  |
+-------------------------------------------------------------------------------+
     SUMMARY OF 35 MEASURED (NON-EXTREME) ITEMS
+-------------------------------------------------------------------------------+
|           RAW                          MODEL         INFIT        OUTFIT     |
|          SCORE     COUNT     MEASURE   ERROR      MNSQ   ZSTD   MNSQ   ZSTD  |
|-------------------------------------------------------------------------------|
| MEAN     101.9      40.7         .00     .25      1.00    -.1   1.01    -.1  |
| S.D.      13.9        .5         .86     .01       .37    1.7    .39    1.7  |
| MAX.     129.0      41.0        2.89     .30      2.02    3.8   2.13    4.1  |
| MIN.      60.0      39.0       -1.58     .24       .45   -3.3    .45   -3.3  |
|-------------------------------------------------------------------------------|
| REAL RMSE    .27  ADJ.SD     .82  SEPARATION  3.07  ITEM   RELIABILITY  .90  |
|MODEL RMSE    .25  ADJ.SD     .82  SEPARATION  3.32  ITEM   RELIABILITY  .92  |
+-------------------------------------------------------------------------------+
```

Checking for Misfitting Persons

Misfitting persons are to be removed from such analysis because irregular and inconsistent responses can cause items and persons to be wrongly calibrated. Table 3 (a) shows that the output of the analyses picked out Respondent 9 (T09) as the "most misfitting" person for the variable IMPT, with an infit mean square of 2.9 and an outfit mean square of 2.9. By observing the residuals, it is safe to conclude that there is no evidence to show that Respondent 9 selected his or her responses randomly. It is completely possible that the unexpected responses of "4" for items 7, 31, and 32 and the response "1" for items 8, 9, 25, an 26 are genuinely felt by the respondent and are therefore valid. This is especially so when variations in strategies can indeed be or not be a teacher's preference although statistically it may or may not be expected. We therefore conclude that there are not misfitting persons. The same explanation can be given for Respondent 18 on the variable FREQ (Table 3b).

Table 3(a)
Poorly Fitting Persons (Items In Entry Order) for IMPT

```
TABLE 7.1 SBI PERCEPTION OF IMPORTANCE (PRE)
INPUT: 42 PERSONS, 35 ITEMS  MEASURED: 42 PERSONS, 35 ITEMS, 4 CATS
-------------------------------------------------------------------
NUMBER - NAME -- POSITION ------ MEASURE - INFIT (MNSQ) OUTFIT

     9  T0912446                    .13     2.9   A    2.9
  RESPONSE:      1:   3   4   4   4   3    3   4   1   1   2
Z-RESIDUAL:                                   2  -2  -2

  RESPONSE:     11:   2   3   2   3   2    3   2   2   2   2
Z-RESIDUAL:

  RESPONSE:     21:   4   3   2   2   1    1   3   2   4   2
Z-RESIDUAL:                           -3   -3

  RESPONSE:     31:   4   4   3   2   2
Z-RESIDUAL:           3   3   2
-------------------------------------------------------------------
```

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Table 3(b)
Poorly Fitting Persons (Items In Entry Order) for FREQ

```
INPUT: 42 PERSONS, 35 ITEMS  MEASURED: 42 PERSONS, 35 ITEMS, 4 CATS
-------------------------------------------------------------------------
NUMBER - NAME -- POSITION ------ MEASURE - INFIT (MNSQ) OUTFIT

    18  T1812446                      .60     3.2   A    3.2
  RESPONSE:      1:   2   2   1   1   1    1   1   4   3   4
Z-RESIDUAL:                  -2  -2  -2   -2  -2           2

  RESPONSE:     11:   3   M   3   2   2    4   3   4   2   3
Z-RESIDUAL:

  RESPONSE:     21:   4   1   1   4   3    4   3   3   4   4
Z-RESIDUAL:              -2  -2

  RESPONSE:     31:   4   4   3   4   1
Z-RESIDUAL:           2   2       2
-------------------------------------------------------------------------
```

Misfitting Items

In a similar way as for persons, we now look at the table of misfitting items. It is clear from both Tables 4(a) and (b), that none of the items can be considered misfitting. For IMPT, the analysis highlighted item 36 (entry 35, since item 22 was not responded to) to be most misfitting. Its infit and outfit mean squares however, are 1.8 and 2.2 respective, and considering that the variable IMPT has a varied number of different strategies, these mean square values can be considered small and does not warrant the dropping of Item 36. Similarly, item 32 highlighted as misfitting for the variable FREQ has infit and outfit mean squares of 2.0 and 2.1 respectively and an examination of the residuals does not warrant removal of this item. All items on both variables are therefore retained.

Table 4(a)
Poorly Fitting Items (Persons In Entry Order) for IMPT

```
INPUT: 42 PERSONS, 35 ITEMS  MEASURED: 42 PERSONS, 35 ITEMS, 4 CATS
-------------------------------------------------------------------------
NUMBER - NAME -- POSITION ------ MEASURE - INFIT (MNSQ) OUTFIT

    35  Q36                        3.26     1.8   A    2.2
  RESPONSE:      1:   1   2   2   1   3    1   2   1   2   2
Z-RESIDUAL:                          3

  RESPONSE:     11:   1   1   2   1   2    1   1   1   1   2
Z-RESIDUAL:                          3

  RESPONSE:     21:   2   4   1   3   2    1   2   1   3   2
Z-RESIDUAL:               X       3                   3

  RESPONSE:     31:   2   2   2   1   1    3   1   2   1   1
Z-RESIDUAL:

  RESPONSE:     41:   3   3
Z-RESIDUAL:           2
-------------------------------------------------------------------------
```

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Table 4(b) Poorly Fitting Items (Persons In Entry Order) for FREQ

```
INPUT: 42 PERSONS, 35 ITEMS  MEASURED: 42 PERSONS, 35 ITEMS, 4 CATS
-------------------------------------------------------------------------
NUMBER - NAME -- POSITION ------ MEASURE - INFIT (MNSQ) OUTFIT

    31  Q32                          1.05     2.0   A    2.1
  RESPONSE:      1:   2   2   2   2   2    3   2   2   4   2
Z-RESIDUAL:                              3           3

  RESPONSE:     11:   2   2   2   3   2    1   2   4   1   2
Z-RESIDUAL:                          2               2  -2

  RESPONSE:     21:   2   4   1   3   2    4   3   1   3   1
Z-RESIDUAL:             X               2      -2

  RESPONSE:     31:   1   2   1   1   3    2   2   2   2   1
Z-RESIDUAL:          -2

  RESPONSE:     41:   2   2
Z-RESIDUAL:
-------------------------------------------------------------------------
```

Item Calibrations

In calibrating the items on both variables, we should note that the higher the calibration the more difficult it is for respondents to perceive the item as important in the case of the IMPT variable and the more difficult it is for respondents to say that they use the strategy more frequently, in the case of FREQ variable.

Consider first the variable IMPT. Table 5(a) shows that the respondents regard item 1 as most important followed by items 21, 30, 25, 27, and so on. The five items that they regard as least important are items 36, 34, 35, 33, 32. The rest of the items in order of importance are as shown in the table.

As for FREQ, Table 5(b) shows that the strategy indicated by the items that respondents report as being most frequently used are those of items 21, 25, 27, 26 and 30 while those that they least frequently use are for strategies indicated by items 36, 34, 35, 33 and 32. The rest of the items in order of frequency of use, are as shown in the table.

Table 5(a) Calibrations of Items on IMPT In Descending Order of Importance

NAME	MEASURE	COUNT	SCORE	ERROR	IN.MSQ	IN.ZSTD	OUT.MS	OUT.ZSTD
Q1	-1.47	41	140	0.29	0.58	-2.34	0.60	-2.03
Q21	-1.30	41	138	0.29	1.22	1.05	1.10	0.53
Q30	-1.14	41	136	0.28	0.82	-0.86	0.79	-0.95
Q25	-1.14	41	136	0.28	0.84	-0.74	0.91	-0.36
Q27	-0.98	41	134	0.28	1.11	0.55	1.06	0.33
Q14	-0.98	41	134	0.28	0.74	-1.29	0.70	-1.46
Q3	-0.98	41	134	0.28	0.57	-2.36	0.65	-1.79
Q2	-0.90	41	133	0.28	0.80	-0.96	0.81	-0.86
Q4	-0.67	41	130	0.27	0.59	-2.12	0.58	-2.18
Q28	-0.60	41	129	0.27	0.82	-0.80	0.82	-0.78
Q26	-0.60	41	129	0.27	1.64	2.54	1.64	2.54
Q8	-0.45	41	127	0.27	0.97	-0.06	0.95	-0.15
Q18	-0.38	41	126	0.27	0.67	-1.61	0.67	-1.60

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Q12	-0.32	40	122	0.27	0.56	-2.28	0.57	-2.20
Q10	-0.23	41	124	0.27	0.70	-1.40	0.70	-1.42
Q23	-0.16	40	120	0.27	0.98	0.00	1.00	0.07
Q16	-0.16	41	123	0.27	0.75	-1.13	0.76	-1.11
Q11	-0.16	41	123	0.27	0.80	-0.91	0.77	-1.05
Q20	-0.09	41	122	0.27	0.50	-2.70	0.48	-2.86
Q15	-0.09	41	122	0.27	0.76	-1.08	0.78	-0.99
Q24	-0.02	41	121	0.26	0.93	-0.23	0.96	-0.10
Q31	0.05	41	120	0.26	1.21	0.96	1.25	1.11
Q29	0.05	40	117	0.27	0.90	-0.37	0.92	-0.28
Q19	0.05	41	120	0.26	0.67	-1.59	0.68	-1.54
Q7	0.05	41	120	0.26	1.32	1.37	1.34	1.44
Q6	0.12	41	119	0.26	1.06	0.34	1.06	0.32
Q13	0.19	41	118	0.26	0.72	-1.31	0.73	-1.28
Q9	0.19	41	118	0.26	0.98	-0.03	0.94	-0.18
Q5	0.32	41	116	0.26	1.12	0.58	1.15	0.72
Q17	0.48	39	108	0.26	0.73	-1.23	0.71	-1.33
Q32	1.46	41	98	0.25	1.63	2.64	1.70	2.86
Q33	2.00	41	89	0.24	1.84	3.42	1.88	3.55
Q35	2.04	40	86	0.25	1.65	2.74	1.66	2.75
Q34	2.55	41	80	0.25	1.86	3.54	1.89	3.57
Q36	3.26	41	69	0.26	1.76	3.11	2.20	4.15

Table 5(b) Calibrations of Items on FREQ In Descending Order of Frequency

NAME	MEASURE	COUNT	SCORE	ERROR	IN.MSQ	IN.ZSTD	OUT.MS	OUT.ZSTD
Q21	-1.58	41	129	0.25	1.03	0.22	1.00	0.06
Q25	-1.21	41	123	0.25	0.66	-1.88	0.68	-1.71
Q27	-1.15	41	122	0.25	1.11	0.59	1.08	0.47
Q26	-1.03	41	120	0.24	1.01	0.10	0.99	0.03
Q30	-0.98	41	119	0.24	0.67	-1.77	0.68	-1.75
Q28	-0.68	41	114	0.24	0.75	-1.28	0.77	-1.17
Q29	-0.57	40	109	0.24	0.61	-2.12	0.62	-2.06
Q14	-0.45	41	110	0.24	0.74	-1.34	0.73	-1.40
Q1	-0.39	41	109	0.24	0.93	-0.28	0.92	-0.31
Q23	-0.34	40	105	0.24	0.87	-0.58	0.90	-0.41
Q24	-0.28	41	107	0.24	0.82	-0.86	0.83	-0.82
Q3	-0.22	41	106	0.24	0.99	0.03	0.98	-0.01
Q15	-0.22	41	106	0.24	0.76	-1.18	0.76	-1.19
Q31	-0.22	41	106	0.24	1.67	2.74	1.74	2.97
Q8	-0.16	41	105	0.24	1.25	1.17	1.25	1.16
Q16	-0.16	41	105	0.24	0.73	-1.38	0.72	-1.42
Q18	-0.16	41	105	0.24	0.58	-2.29	0.59	-2.27
Q6	-0.11	40	102	0.24	1.26	1.20	1.24	1.13
Q2	-0.10	41	104	0.24	0.89	-0.47	0.89	-0.47
Q20	-0.10	41	104	0.24	0.45	-3.31	0.45	-3.29
Q4	-0.04	41	103	0.24	0.84	-0.71	0.83	-0.79
Q17	-0.04	39	97	0.25	0.56	-2.38	0.56	-2.35
Q9	0.07	41	101	0.24	0.90	-0.40	0.91	-0.36

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Q10	0.14	40	97	0.25	0.94	-0.22	0.91	-0.38
Q7	0.19	40	97	0.25	1.55	2.28	1.55	2.27
Q19	0.19	41	99	0.24	0.68	-1.63	0.68	-1.65
Q13	0.25	41	98	0.24	0.89	-0.49	0.88	-0.53
Q12	0.27	40	95	0.25	0.70	-1.50	0.69	-1.58
Q11	0.31	41	97	0.24	1.00	0.06	1.01	0.10
Q5	0.37	40	94	0.25	1.19	0.91	1.19	0.91
Q32	1.05	41	85	0.25	2.02	3.78	2.13	4.13
Q33	1.17	41	83	0.25	1.87	3.32	2.03	3.85
Q35	1.35	40	78	0.26	1.51	2.13	1.49	2.06
Q34	1.92	41	72	0.27	1.28	1.29	1.23	1.07
Q36	2.89	41	60	0.30	1.26	1.19	1.40	1.48

Testing for Significant Differences Between Mean Measures

The mean measures of persons for pre- and post-training, were tested for significant difference using the t-test. This was carried out using both classes as a single group and also the individual classes separately.

A. Using both classes as one group:

The two classes combined has 42 subjects for the pre-training session, and due to attrition (seven subjects were lost from class T), the total number of subjects for the post test was to 14.

Table 6 Independent Samples t-test for Whole Group

Group Statistics

	CODE1	N	Mean	Std. Deviation	Std. Error Mean
IMPT MEAS	1 Pre	42	1.2462	1.48719	.22948
	2 Post	35	1.4097	1.30945	.22134
FREQ MEAS	1 Pre	42	.2183	1.51120	.23318
	2 Post	35	.2811	1.70402	.28803

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Diff	Std. Error Diff	95% Confidence Interval of the Diff	
									Lower	Upper
IMPT MEAS	Equal variances assumed	.090	.764	-.507	75	.614	-.1635	.32257	-.80611	.47906
	Equal variances not assumed			-.513	74.753	.610	-.1635	.31883	-.79869	.47164
FREQ MEAS	Equal variances assumed	.220	.640	-.171	75	.864	-.0628	.36653	-.79298	.66736
	Equal variances not assumed			-.169	68.700	.866	-.0628	.37059	-.80217	.67656

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As the teachers are not fully practising at this point in time, we do not expect any significant increase in their reported frequency of use, which may come from their reflections of their earlier experiences in teaching before attending their programmes at NIE. Any significant increase would be expected to be in their perception of the importance of SBI as specific training was given in this area. The increase in the mean measure of their perception of the importance of SBI however, is from 1.25 to 1.41 logits. As shown by the t-test, this increase is not significant. The likely reason why this increase is not significant is that the training period is too short before the post-measure was taken. The increase, however is encouraging and is itself a reason to believe that with a longer period of training, the increase should become significant. This of course, is left to be seen.

B. Analyzed by class – separate groups by class

A similar t-test is done for both IMPT and FREQ by class. The results are as shown in Tables 7 and 8. From these two tables, we see that the larger increase was for class T while there was hardly any change in the mean of IMPT for Class E. This change however, is again not significant and the possible and likely reason is as explained in the case for the whole-group t-test of difference between means.

Table 7
Independent Samples t-test for Class T

Group Statistics

	CODE2	N	Mean	Std. Deviation	Std. Error Mean
IMPT MEAS	1-Pre	21	.8119	.88246	.19257
	3-Post	14	1.0014	.96219	.25716
FREQ MEAS	1-Pre	21	.0176	1.03699	.22629
	3-Post	14	-.2179	2.07039	.55333

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
IMPMEAS	Equal variances assumed	.201	.657	-.601	33	.552	-.1895	.31560	-.83162	.45257
	Equal variances not assumed			-.590	26.293	.560	-.1895	.32127	-.84954	.47049
FREMEAS	Equal variances assumed	.444	.510	.446	33	.658	.2355	.52784	-.83842	1.30937
	Equal variances not assumed			.394	17.396	.698	.2355	.59782	-1.02362	1.49458

Table 8

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Independent Samples t-test for Class E

Group Statistics

	CODE2	N	Mean	Std. Deviation	Std. Error Mean
IMPMEAS	2-Pre	21	1.6805	1.83282	.39995
	4-Post	21	1.6819	1.45556	.31763
FREMEAS	2-Pre	21	.4190	1.87662	.40951
	4-Post	21	.6138	1.36365	.29757

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Diff	Std. Error Diff	95% Confidence Interval of the Diff	
									Lower	Upper
IMPT MEAS	Equal variances assumed	.143	.708	-.003	40	.998	-.0014	.51074	-1.03366	1.03081
	Equal variances not assumed			-.003	38.049	.998	-.0014	.51074	-1.03532	1.03246
FREQ MEAS	Equal variances assumed	.059	.809	-.385	40	.702	-.1948	.50621	-1.21785	.82833
	Equal variances not assumed			-.385	36.516	.703	-.1948	.50621	-1.22090	.83138

Qualitative Data Analysis of Teachers' Understanding and Perceptions of Strategy-Based Instruction

Meaning of Strategy-Based Instruction

The course has helped to empower trainee teachers with their understanding of strategy-based instruction (SBI). Although not many of them were aware of what SBI was about, the posttest showed a clearer understanding of what they thought it meant.

E60: *"strategies to guide students in their learning – in a way training them to be independent learners".*

E65: *"use of selective strategies to support and guide students in their thinking and learning process".*

E66: *"strategies for learning and teaching. One of the ways is via self-regulation in which goals are established, followed by execution and evaluation".*

Table 9
Trainee Teachers' Knowledge of Strategy-Based Instruction

	Pretest			Posttest		
	T1	**E2**	**Total**	**T2**	**E2**	**Total**
Has Knowledge	8 (38.1)	4 (19.0)	12 (28.6)	11 (78.6)	19 (90.5)	30 (85.7)
Not sure	10 (47.6)	16 (76.2)	26 (61.9)	1 (7.1)	1 (4.8)	2 (5.7)
Blank	3 (14.3)	1 (4.8)	4 (9.5)	2 (14.3)	1 (4.8)	3 (8.6)

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In attempting to address teachers' knowledge of the behaviour that are truly necessary in enhancing self-regulation, five behaviours (shown shaded in Table 10) were considered necessary, that is, goal setting, planning and organising, self-monitoring and self-evaluation. Although the trainee teachers were aware that goal setting, self-evaluation and self-monitoring may be necessary behaviours for self-regulation, they don't perceive the importance of planning and organising to reach their goals. However, the posttest showed that after attending the course they were more conscious of the importance of the necessary five behaviours for self-regulation.

Table 10.

Trainee Teachers' Responses to the words that best describe students' self regulatory behaviour in frequency and percentages

	Pre-Test			Post-Test		
	T1 (n=21)	E1 (n=21)	Total (n=42)	T2 (n=14)	E2 (n=21)	Total (n=35)
competitive	2 (9.5)	5 (23.8)	7 (16.7)	2 (14.3)	2 (9.5)	4 (11.4)
high achievement	5 (23.8)	3 (14.3)	8 (19.0)	4 (28.6)	2 (9.5)	6 (17.1)
personal goal setting	15 (71.4)	14 (66.7)	29 (69.0)	11 (78.6)	17 (71.4)	28 (80.0)
seeking guidance	5 (23.8)	10 (47.6)	15 (35.7)	5 (35.7)	9 (42.9)	14 (40.0)
working collaboratively for support	5 (23.8)	8 (38.1)	13 (31.0)	6 (42.9)	10 (47.6)	16 (45.7)
self-directed	17 (81.0)	13 (61.9)	30 (71.4)	11 (78.6)	17 (71.4)	28 (80.0)
self-evaluative	15 (71.4)	15 (71.4)	30 (71.4)	12 (85.7)	18 (85.7)	30 (85.7)
self-monitoring	14 (66.7)	15 (71.4)	29 (69.0)	12 (85.7)	18 (85.7)	30 (85.7)
aiming for perfection	2 (9.5)	4 (19.0)	6 (14.3)	0 (0)	2 (9.5)	2 (5.7)
risk taking	2 (9.5)	4 (19.0)	6 (14.3)	2 (14.3)	11 (52.4)	13 (37.1)
confident	7 (33.3)	9 (42.9)	16 (38.1)	7 (50.0)	5 (23.8)	12 (34.3)
anxious	0 (0)	2 (9.5)	2 (4.8)	0 (0)	1 (4.8)	1 (2.9)
task-oriented	9 (42.9)	9 (42.9)	18 (42.9)	7 (50.0)	10 (47.6)	17 (48.6)
co-operative	4 (19.0)	8 (38.1)	12 (28.6)	5 (35.7)	11 (52.4)	16 (45.7)
indicating leadership	4 (19.0)	5 (23.8)	9 (21.4)	2 (14.3)	4 (19.0)	6 (17.1)
seeking affirmation	4 (19.0)	5 (23.8)	9 (21.4)	1 (7.1)	4 (19.0)	5 (14.3)
independent	11 (52.4)	13 (61.9)	24 (57.1)	9 (64.3)	12 (57.1)	21 (60.0)
autonomous	4 (19.0)	9 (42.9)	13 (31.0)	7 (50.0)	10 (47.6)	17 (48.6)
intrinsically motivated	14 (66.7)	10 (47.6)	24 (57.1)	14 (100)	15 (71.4)	29 (82.9)
extrinsically motivated	5 (23.8)	2 (9.5)	7 (16.7)	5 (35.7)	1 (4.8)	6 (17.1)
organising	10 (47.6)	9 (42.9)	19 (45.2)	11 (78.6)	16 (76.1)	27 (77.1)
planning	8 (38.1)	9 (42.9)	17 (40.5)	13 (92.9)	16 (76.1)	29 (82.9)

Trainee Teachers' Strategies for Enhancing Self-Regulatory Behaviour

In general, over 78.6% of the trainee teachers indicated that they teach self-regulatory behaviours to their students. They are provided relevant strategies for self-regulatory (Table 11: shaded area). Class E showed less awareness of these self-regulatory strategies during pretest. But, after the course, Class E seemed to suggest more of these strategies than Class T.

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Table 11.
Trainee Teachers' strategies for enhancing self-regulatory behaviour

	Pre-Test			Post-Test		
	T1 (n=21)	E1 (n=21)	Total (n=42)	T2 (n=14)	E2 (n=21)	Total (n=35)
Yes	16 (76.2)	17 (81.0)	33 (78.6)	12 (85.7)	18 (85.7)	30 (85.7)
No	2 (9.5)	3 (14.3)	5 (11.9)	2 (14.3)	3 (14.3)	5 (14.3)
Set Goals	5 (23.8)	3 (14.3)	8 (19.0)			
Planning				1 (7.1)	3 (14.3)	4 (11.4)
Organise		1 (4.8)	1 (2.4)		2 (9.5)	2 (5.7)
Monitor	3 (14.3)		3 (7.1)	1 (7.1)	4 (19.0)	5 (14.3)
Self-Evaluate	1 (4.8)	1 (4.8)	2 (4.8)	1 (7.1)	4 (19.0)	5 (14.3)
Self-question	2 (9.5)		2 (4.8)	1 (7.1)	2 (9.5)	3 (8.6)
Total SRL	11 (52.4)	5 (23.8)	16 (76.1)	4 (28.6)	15 (71.4)	19 (54.3)
Task-oriented	1 (4.8)		1 (2.4)			
Time-management				1 (7.1)		1 (2.9)
Emphasize importance		1 (4.8)	1 (2.4)			
Mindmap		1 (4.8)	1 (2.4)			
Scaffolding		1 (4.8)	1 (2.4)			
Checklist		1 (4.8)	1 (2.4)			
Portfolio / Thinking logs		1 (4.8)	1 (2.4)		2 (9.5)	2 (5.7)
Memorising strategies					2 (9.5)	2 (5.7)
Think aloud					1 (4.8)	1 (2.9)

Trainee Teachers' Preference on the Use of Self-Regulatory Skills

Although self-regulatory skills can be imparted in any of the five given manner, it is hoped that teachers would

(need to discuss with you)

Table 12
Trainee Teachers' Preference on the Use of Self-Regulatory Skills

	Pre-Test			Post-Test		
	T1 (n=21)	E1 (n=21)	Total (n=42)	T2 (n=14)	E2 (n=21)	Total (n=35)
1.Just before you want them to undertake a special task	7 (33.3)	2 (9.5)	9 (42.9)	7 (50.0)	4 (19.0)	11 (31.4)
2. In specially designed lessons just for this purpose	2 (9.5)	3 (14.3)	5 (11.9)	4 (28.6)	4 (19.0)	8 (22.9)
3. In preparation for project work	9 (42.9)	3 (14.3)	12 (28.6)	7 (50.0)	7 (33.3)	14 (40.0)
4. Constantly, within the day to day curriculum	11 (52.4)	8 (38.1)	19 (45.2)	8 (57.1)	12 (57.1)	20 (57.1)
5. You don't do it explicitly but expect it and consistently reinforce students' efforts in self-regulation through immediate feedback	12 (57.1)	7 (33.3)	19 (45.2)	6 (57.1)	5 (23.8)	11 (31.4)

Trainee Teachers' views on best practices for enhancing students' learning

In Ee, Lee & Potter's (2004) study, 114 Singapore teachers tended to identify more instructional strategies (53%) than cognitive strategies (18%) or motivational strategies (23%). In the pretest of this study, the trainee teachers' responses for instructional strategies and cognitive strategies (Table 13) were similar in percentages to Ee, Lee & Potter's (2004) study. However, the trainee teachers in this study were more aware of the need to provide just as much self-regulated learning strategies (60.0%) as well as instructional strategies (68.6%) in the posttest. The E Class also seems to

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perform better than the T Class in the posttest of this study. This may account for the teacher factor for the two classes.

Trainee teachers irrespective of class in the pre or posttest tended to perceive cooperative learning or group work (25.7%) as an instructional support that will enhance student learning (Table 13). They also recognised the need for authentic tasks and a student-centred approach. Project work was cited as an authentic task activity. Besides authentic tasks, they also indicated the need for a non-threatening environment if students' learning are to be enhanced.

Class E provided much cognitive and thinking strategies that will empower students to be self-regulated learning. In general, 17.1% of the students are aware of the need to provide self-regulated learning strategies to assist students in their learning (Table 13).

Table 13. Frequency and Percentages of Trainee Teachers' qualitative responses on best practices for enhancing learning

		T1	E1	Total	T2	E2	Total
Instructional Strategies							
1	Group work, collaborative learning	5 (23.8)	5 (23.8)	10 (23.8)	2 (14.3)	7 (33.3)	9 (25.7)
2	Drill	1 (4.8)		1 (2.4)			
3	Practise	3 (14.3)	2 (9.5)	5 (11.9)		1 (4.8)	1 (2.9)
4	Multi-sensory approach		1 (4.8)	1 (2.4)			
5	Process-oriented teaching		1 (4.8)	1 (2.4)			
6	Student-centred approach				2 (14.3)	1 (4.8)	3 (8.6)
7	Relate learning to something significant in their lifes		1 (4.8)	1 (2.4)		1 (4.8)	1 (2.9)
8	Direct Teaching				1 (7.1)		1 (2.9)
9	Provide authentic tasks e.g. project work		1 (4.8)	1 (2.4)	2 (14.3)	1 (4.8)	3 (8.6)
10	modeling					2 (9.5)	2 (5.7)
11	scaffolding					2 (9.5)	2 (5.7)
12	questioning		2 (9.5)	2 (4.8)		2 (9.5)	2 (5.7)
	Total	9 (42.9)	13 (61.9)	22 (52.4)	7 (50.0)	17 (81.0)	24 (68.6)
Self-Regulated Learning Strategies							
13	planning					2 (9.5)	2 (5.7)
14	organising					2 (9.5)	2 (5.7)
15	Setting goals		1 (4.8)	1 (2.4)			
16	Self-questioning		1 (4.8)	1 (2.4)			
17	Self-regulated learning strategies	1 (4.8)	1 (4.8)	2 (4.8)	1 (7.1)	5 (23.8)	6 (17.1)
18	Self-evaluation					1 (4.8)	1 (2.9)
19	Critical thinking				1 (7.1)		1 (2.9)
20	Thinking skills	2 (9.5)	2 (9.5)	4 (9.5)		3 (14.3)	3 (8.6)
21	Learning skills	1 (4.8)					1 (2.9)
22	Keypoints	1 (4.8)					1 (2.9)
23	Graphic organisers					2 (9.5)	2 (5.7)
24	Checking results					2 (9.5)	2 (5.7)
	Total	5 (23.8)	5 (23.8)	8 (19.0)	2 (14.3)	17 (81.0)	21 (60.0)
Motivational Strategies							
25	Encourage feedback	3 (14.3)		3 (7.1)			
26	Non-fearful classroom environment		1 (4.8)	1 (2.4)		1 (4.8)	1 (2.9)
	Total	3 (14.3)	1 (4.8)	4 (9.5)		1 (4.8)	1 (2.9)

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Conclusion

Although the course has been successful in empowering trainee teachers to be reflective and self-regulatory, the findings also indicate that the teacher factor may reinforce better learning outcome in the class. An increase is observed in the teachers' perception of the importance of strategy-based instruction, but the increase is not significant at the 0.5 level of significance. The very likely reason for this is that the duration of the SBI training was not adequate. The increase over the short training period however, is encouraging as it shows that a longer period of training is likely to bring about a significant change.

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