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<tr>
<td>Author(s)</td>
<td>Jessie Ee and Phillip J. Moore</td>
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<td>Organised by</td>
<td>Educational Research Association of Singapore (ERAS)</td>
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Strategy-based Instruction of Primary Six Teachers

Jessie Ee
NIE/Nanyang Technological University
Singapore
&
Phillip J. Moore
University of Newcastle
Australia

Abstract
In this paper, strategy-based instruction is instruction that promotes students' cognitive self-appraisal and self-management of cognition. By cognitive self-appraisal, students are taught cognitive and self-management strategies that will make them cognitively aware of the demands of the task in relation to their own capabilities and range of strategies. The teaching of cognitive self-management involves assisting students to plan, set goals and use a variety of strategies to monitor and regulate their performance. The central intention is to promote student understanding of the content as well as to teach students cognitive and self-regulated learning strategies that they will find useful in learning and thinking in the classroom. The study involved a sample size of 311 Primary Six teachers in 53 Singapore schools. Of these 311 teachers who participated in the study, 32 taught EM1 classes, 194 taught EM2 classes and 85 taught EM3 classes. One-Way ANOVA was used to examine the differences in teachers' strategy-based instruction. Subsequently, a teacher interview was also carried out to further understand the kinds of strategies that teachers used in the three streams. Great variability in strategy-based instruction among the three streams was observed. However, even in this inconsistency, there is consistency in that many teachers have limited understanding of what the current literature might say about effective strategy-based instruction, particularly at the meta-cognitive end of the scale. Further implications will be discussed.

Introduction
In this paper, strategy-based instruction is instruction that will promote students' cognitive self-appraisal and self-management of cognition. By cognitive self-appraisal, students are taught cognitive and self-management strategies that will make them cognitively aware of the demands of the task in relation to their own capabilities and range of strategies. The teaching of cognitive self-management involves assisting students to plan, set goals and use a variety of strategies to monitor and regulate their performance. In the process, students are taught effective learning strategies to equip them to be metacognitively, motivationally, and behaviourally active participants of their own learning. Research findings indicate that strategy-based instruction is capable of enhancing students' usage of effective strategies when engaging in a task resulting in higher quality of learning outcomes (Biggs, 1991; Pintrich & DeGroot, 1990). Thus, the key assumption of strategy-based instruction is process-based, that is, it encourages students to think and act when planning, executing and regulating their own performance on a task (Lenz, Clark, Deshler & Schmaker, 1988). The central intention is to provide students with a repertoire of strategies that they can flexibly employ to assist them in academic learning. Hence, the instruction is to promote student understanding of the content as well as to teach students cognitive and self-regulated learning strategies that they will find useful in learning and thinking in the classroom.

Research on student perceptions of classroom instruction (e.g. Knight, 1992; Knight, Waxman & Padron, 1989) revealed teachers' generic classroom instruction affected the students' subsequent strategy use. In a study by Pramling (1988), metacognitive dialogue between the teacher and the students was found to enhance the metacognitive awareness of 56 preschoolers. Furthermore, Schneider et al. (1986) study using 91 grade 4 Americans and 102 grade 4
Germans showed that pretraining of metamemory and task-related strategy knowledge were likely to enhance superior recall of students. Studies on reading comprehension (Loranger, 1997; Scevak & Moore, 1997; Block, 1993) showed that students were likely to obtain greater knowledge of reading comprehension (Loranger, 1997; Block, 1993) and awareness about reading strategies (Paris, Cross & Lipson, 1984). Among the above studies, the longitudinal study and intervention of Paris et al. (1984) showed that students can be taught reading strategies in regular classrooms and yet perform significantly on cloze and error detection tasks. Furthermore, these students as young as Grades 3 to 5 can make inferences and monitor their own reading comprehension. Schunk (1997; 1994) and Billingsley and Wildman (1990) looked at specific strategies such as, self-monitoring, self-evaluating and goal-setting in enhancing other aspects of learning. The above three self-regulated learning strategies were found to perpetuate students’ self-regulated learning. It also appears that self-regulated learning strategies has further enhance performance in subject areas such as, even spelling (Fulk & Stormont-Spurgin, 1995) and mathematics (Cardelle-Elawar, 1995; Schunk, 1996).

In this study, teachers’ classroom teaching practices related to cognitive self-management strategies (e.g. planning, monitoring, evaluating) were examined and seven items were developed in draft form with the assistance of three experts. Modifications were made to ensure that the intent of each item was apparent. The items encourage the need for task analyses, planning and reflectivity in decisions to select strategies and be able to monitor their effectiveness. Thus, teachers need to encourage students to set goals, plan and use a variety of strategies and be able to monitor and revise their on-going performance (e.g. Baker & Brown, 1984). According to Ellis (1993a, 1993b) and Moore (1991), students need to develop the ability to plan even before they begin on a task and make adjustments and revisions as they go along. Thus, the first item “After I have assigned pupils tasks, I require them to make a plan of what strategies they would use and how they intend to complete the task and why they choose those strategies” focused on encouraging students to task analyse and plan their choice of strategies for problem-solving. The metacognitive literature (see Zimmerman, 1986) indicates that planning is one of the critical component of self-regulated learning.

This study sought to examine if there were significant differences in the reported strategy-based instruction of teachers in the three streams (EM1, EM2 and EM3) as well as to examine teachers’ knowledge and understanding of the concept of strategy and the reasons for teaching the way they did in the different streams. This was to explore teachers’ knowledge and understanding of the influence of strategy use on learning outcomes, particularly for students’ self-regulated learning and achievement.

Subjects
Of the 311 teachers (91 males and 220 females) who participated in the study, 32 (10.3%) taught EM1 classes, 194 (62.4%) taught EM2 classes, and 85 (27.3%) taught EM3 classes. Teachers in EM1 classes teach pupils in the top 10% of the total primary six population whereas teachers in the EM3 classes teach students comprising of the bottom 20% of the total primary six population.

In examining the first research question, a questionnaire on strategy-based instruction was administered to the 311 teachers in the 53 schools. In examining the second question, a teacher interview was carried out with 38 teachers (15 males and 23 females) from the 311 sample size in the main study. The interview questions are:

1. Most teachers say they frequently teach their students to use different strategies and discuss with them why, how and when they should use these strategies. What does the word “strategies” mean to you?
2. Do you teach your students to use different strategies? Could you give me some examples of strategies that you would teach your students?
3. Why do you teach students to use these strategies? What benefits do you think students will gain from learning these strategies?

Strategy-Based Instruction Questionnaire
This scale focuses on teachers' strategy-based instruction that promotes the cognitive self-management of students. Thus, students will be able to evaluate, plan and regulate as they learn. For each item, the respondents, the sample of 311 teachers were asked to respond on a four-point scale ranging from "Rarely" to "Almost Always". For each statement, the teachers were required to circle what they perceive as best in describing their classroom. Scoring involves averaging the ratings across the items on the scale. A high score on the strategy-based instruction scale indicates that teachers reported teaching more strategy-based instruction to the students. Prelis and Lisrel7 were used to obtain the one factor congeneric analysis of the strategy-based instruction scale. The reliability coefficient is 0.868 (Table 1). The full details of the items in the strategy-based scale are shown in Table 1.

Data Analysis
On completion of the data collection, the data were collated and analyzed using both descriptive and inferential statistical methods. Means, standard deviations and one-way analyses of variance (ANOVA) were used for analysing the differences among the teacher variables in the three streams using SPSS Release 7.5.

In order to address the issues related to teachers' knowledge of strategies and the types that they practised besides the reasons and benefits behind their practice of such strategies, teachers' responses to the interview questions were analyzed using the qualitative interview data of the teachers. Descriptive statistics (e.g. frequencies, percentages) and relevant verbatim responses were subsequently used.

Table 1
Fitted One-Factor Congeneric Model for Teachers' Strategy-Based Instruction (STPRAC) Scale: Parameter Estimates, Item Score Regressions, Scale Reliability and Goodness-of-Fit Measure

<table>
<thead>
<tr>
<th>Strategy-Based Instruction Scale</th>
<th>B1</th>
<th>B3</th>
<th>B5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item B1 - After I have assigned pupils tasks, I require them to make a plan of what strategies they would use and how they intend to complete the task and why they choose those strategies.</td>
<td>0.513</td>
<td>0.737</td>
<td>0.263</td>
</tr>
<tr>
<td>Item B3 - I teach my pupils to use different strategies and discuss with them why, when and how they should use these strategies.</td>
<td>0.727</td>
<td>0.471</td>
<td>0.529</td>
</tr>
<tr>
<td>Item B5 - I take time to help each of my pupils to set realistic and attainable goals in their learning at the beginning of each semester.</td>
<td>0.658</td>
<td>0.567</td>
<td>0.433</td>
</tr>
</tbody>
</table>
Item B7 - I brainstorm with my pupils different possible ways of solving a problem and then guide them to find out the most effective strategy.

Item B9 - When pupils fail to obtain a solution to a problem, I guide them to monitor and evaluate their strategy and help them to work out another possible solution.

Item B11 - When my pupils are working on a task, I encourage them to stop from time to time and think if the strategy they are using will help them to achieve their goal.

Item B14 - After each lesson, I ask my pupils to summarize the main points they have learned in that lesson.

Scale reliability (• • X)

Goodness-of-fit measures

<table>
<thead>
<tr>
<th>Measure</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi-square (• )</td>
<td>12.62</td>
</tr>
<tr>
<td>Degrees of Freedom (df)</td>
<td>13</td>
</tr>
<tr>
<td>Probability (p)</td>
<td>0.477</td>
</tr>
<tr>
<td>Goodness of fit index (GFI)</td>
<td>0.994</td>
</tr>
<tr>
<td>Adjusted Goodness of fit index (AGFI)</td>
<td>0.986</td>
</tr>
<tr>
<td>Root mean square residual (RMR)</td>
<td>0.036</td>
</tr>
</tbody>
</table>

Note

a. Proportionally weighted factor score regressions.

Results

Comparison of EM1, EM2 and EM3 Teachers

Data on strategy-based instruction were analysed using a one-way ANOVA. The results revealed significant differences in teachers' strategy-based instruction in the three streams, F(2, 308) = 7.93, p < .001. Post-hoc Scheffe tests showed significant differences between all three streams. An examination of the means in Table 2 revealed that strategy-based instruction was reported more frequently in EM1 classes as compared to EM2 classes, and more frequently reported in EM2 classes as compared to EM3 classes. While teachers reported that they promote strategy-based instruction “frequently” in EM1 classes, strategy-based instruction was reported being promoted only from “sometimes” to “frequently” in EM2 classes and even less frequently reported encouraged in EM3 classes. Teachers of EM1 classes reported that they frequently promoted their students' strategy-based instruction by teaching their students different strategies and discussing with them why, how and when they should use these strategies; and brainstorming the possible ways of solving problems to guide them to find out the most effective strategy than teachers of EM2 or EM3 classes.

Table 2: Means and Standard Deviations of Strategy-Based Instruction in EM1, EM2 and EM3 Classes

<table>
<thead>
<tr>
<th></th>
<th>EM1 Class (N=32)</th>
<th>EM2 Class (N=194)</th>
<th>EM3 Class (N=85)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategy-Based Instruction</td>
<td>M=3.07</td>
<td>M=2.86</td>
<td>M=2.67</td>
</tr>
<tr>
<td>SD</td>
<td>0.49</td>
<td>0.48</td>
<td>0.54</td>
</tr>
</tbody>
</table>

Note: Maximum possible score for all variables = 4
Teachers' Knowledge and Understanding of Strategy Use on Learning Outcome

Teachers' knowledge and understanding of the concept of strategy differs in terms of what they meant and what they practised. Two (25%) EM1 teachers, 4 (20%) EM2 teachers and 1 (10%) EM3 teacher provided meanings for “strategies” in terms of teaching methods. For example:

T79 (EM1): “how teacher varies her style to help students understand concepts”
T160 (EM2): “methods of teaching”
T340 (EM3): “Ways of teaching ... the way how to make the pupils understand the lesson”.

However, over 75% of the teachers in the different streams were able to provide appropriate meanings of learning strategies. For example:

T212 (EM2): “different ways of approaching a problem”
T172 (EM1): “methods ... strategies for learning”
T216 (EM3): “different methods of learning”

Table 3: Frequencies and Percentages of What Teachers Meant by Strategies

<table>
<thead>
<tr>
<th></th>
<th>EM1 Teachers</th>
<th>EM2 Teachers</th>
<th>EM3 Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. (%)</td>
<td>No. (%)</td>
<td>No. (%)</td>
</tr>
<tr>
<td>Meaning Respond to Teaching Strategy</td>
<td>2 (25%)</td>
<td>4 (20%)</td>
<td>1 (10%)</td>
</tr>
<tr>
<td>Meaning Respond to Learning Strategy</td>
<td>6 (75%)</td>
<td>16 (80%)</td>
<td>9 (90%)</td>
</tr>
</tbody>
</table>

However, when they were required to provide examples of strategies that they would teach their students, only 1 (12.5%) EM1 teacher, 4 (20%) EM2 teachers and 1 (10%) EM3 teacher were able to differentiate between teaching and learning strategies. The majority of the teachers in all three streams especially EM3 teachers, tended to identify both teaching and learning strategies, demonstrating that they were not too clear regarding what learning strategies actually meant. T180, an EM3 teacher, had no examples for any learning strategies at all.

Table 4: Clarity of Types of Strategies reported practised by EM1, EM2 and EM3 teachers

<table>
<thead>
<tr>
<th>Type of Strategies</th>
<th>EM1 No. (%)</th>
<th>EM2 No. (%)</th>
<th>EM3 No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive Self-Management</td>
<td>1 (12.5%)</td>
<td>4 (20%)</td>
<td>2 (20%)</td>
</tr>
<tr>
<td>Cognitive Strategies</td>
<td>7 (87.5%)</td>
<td>20 (100%)</td>
<td>7 (70%)</td>
</tr>
<tr>
<td>Instructional Strategies</td>
<td>5 (62.5%)</td>
<td>13 (65%)</td>
<td>7 (70%)</td>
</tr>
<tr>
<td>Motivational Strategies</td>
<td>3 (37.5%)</td>
<td>8 (40%)</td>
<td>6 (60%)</td>
</tr>
</tbody>
</table>

Note: Clarity of Responses based on types of strategies provided by teachers from Table 4

Table 4 provides an illustration of the kinds of strategies practised by teachers in the three streams. EM1 teachers reported providing more concept mapping, recording, memory strategies and brainstorming, whilst EM2 teachers reported practicing more cognitive (e.g. memory strategies, recording, reviewing, revising, concept mapping) and cognitive self-management
strategies (e.g. planning, regulating) in assisting their students to prepare for their examination. EM3 teachers were more interested in motivating their students towards learning through group activities and brainstorming, and teaching EM3 students cognitive strategies such as memory strategies and seeking information. Only one teacher in EM3 reported providing all the four cognitive self-management strategies to assist their students in self-regulating their learning. In general, the emphasis on all three streams is the provision of memory strategies, recording (e.g. taking down notes), revising and reviewing their notes, exam questions and tests in preparation for the exam.

**Teachers' Knowledge on the relationship between strategies and learning outcomes, particularly for self-regulated learning**

Some teachers had more than one reason for teaching learning strategies. Furthermore, teachers in different streams had different reasons for teaching their students learning strategies. Fifty-five percent of EM2 and 30% of EM3 teachers reported that it would assist their students’ learning and achievement. Furthermore, 60% of EM3 teachers reported their intentions were to assist students in their problem-solving. Yet, from the types of self-regulated learning strategies provided, these same EM3 teachers did not identify some of the strategies used for problem-solving. This may suggest that some teachers may have the knowledge but fail to practise it. Indirectly, this may imply that they might say one thing and do another. It may also imply that most of the teachers were lacking in their knowledge base of enhancing strategies for self-regulation.

In general, 60% of EM2 teachers recognise the importance of strategies for achievement than teachers in EM1 and EM3 streams. Furthermore, only EM2 teachers also perceived strategy instruction as assisting students in applying to their daily living. Only 38% of EM1 teachers recognised the importance of enhancing self-regulated learning through the use of strategies whereas, 25% of EM3 teachers perceived the benefits of strategies in assisting problem-solving. Again, teachers in all three streams perceived the benefits derived from the use of strategies differently.

**Discussion**

Strategy-based instruction of teachers differ in quantity and quality in the three streams. EM1 teachers were reported providing more strategy-based instruction as compared to EM2 teachers, whereas EM2 teachers reported providing more strategy-based instruction as compared to EM3 classes. From the results of the questionnaire, EM3 teachers were less likely to provide explicit strategy-based instruction, or expose their students to the effectiveness of one strategy over another or brainstorming the possible usage of these strategies. According to Borkowski et al. (1990), Duffy (1993b) and Jones (1986), explicit strategy explanations are essential especially for students with learning difficulties if they are to understand and be self-regulated learners. It is not merely exposing students with effective strategy-based instruction but to immerse the students with explanations about how to be self-regulated while simultaneously providing the explanations. According to Duffy (1993b), on most occasions, teachers tend to get students to use the language of strategies without developing students' conceptions of what it means to be self-regulated learners.

On further probing to understand the extent of teachers' knowledge of the usefulness of strategies for students in the respective streams, EM2 teachers seemed to have a clearer understanding of teaching learning strategies. In discussing their reasons for teaching such learning strategies, teachers clearly indicated a diversity in opinions. Many teachers (especially EM2 teachers) perceived a relationship between teaching learning strategies and achievement. In general, all the teachers in the three streams seem lacking in their knowledge base on self-regulated learning strategies. This is consistent to the findings of Kurtz, Schneider, Carr, Borkowski & Rellinger.
This may imply that teachers' knowledge base of strategies may need attention if they are to make a positive contribution to students' learning and achievement. Furthermore, EM3 teachers reported problem-solving as one of the benefits for teaching learning strategies. These EM3 teachers seemed to centre on the teaching of tactics, rather than self-regulated learning strategies, especially for mathematical problems. It seems that the application of set routines for particular types of mathematical problem could lay the basis for longer term, more metacognitive approaches to problem solving (Montague, 1992; 1993).

While there was consistency in this dimension, on the strategy-based instruction side, there was greater variability. For example, EM2 teachers showed greater understanding of strategy-based instruction. Even in this inconsistency, there is consistency in that many of the teachers have limited understanding of what the current literature might say about effective strategy-based instruction, particularly, at the metacognitive end of the scale.

Teachers' knowledge of strategy-based instruction seems limited, focusing on cognitive strategies especially memory strategies. While memory strategies may be important in themselves, if ultimately the goal is independent learning.

Implications for Classroom Practice
As teachers in different streams have different reasons for providing strategy-based instruction for their students, strategy-based instruction for the high-achievers may need to focus on challenging activities to allow these students to manage and organize their environment to meet their individual needs and interests as well as require them to assess, record or report real life context (Stein & Poole, 1997) with the provision of higher-order thinking skills (van der Westhuizen & Rautenbach, 1997).

In the case of EM2 teachers, strategy-based instruction needs to be more explicit and elaborate and to include cognitive self-management strategies to ensure that EM2 students' knowledge and usage of strategies will predict achievement. Activities that provide opportunities for transfer and generalization must also be provided to assist students to relate their learning to real life situations. EM2 teachers should not only be trained on strategy-based instruction to ensure that their students are aware and able to apply strategies that would regulate their learning but should continuously update their knowledge base through reading the latest journals and books and being in touch with other professionals on the latest effective teaching strategy.

The strategies used by EM3 teachers may be more focused on revising and reviewing exam papers and memory strategies for recall and drills (refer interview data). However, it is essential that these students be exposed to explicit strategy instruction if they are to understand and be self-regulated learners eventually. It is not merely exposing students with effective strategy-based instruction but to immerse the students with explanations about how to be self-regulated while simultaneously providing the explanations.

General Implications for Instruction
While the previous discussion has centred on the implications for each of the streams, there are a number of more general observations that can be made regarding implications for teaching. Teachers need to teach strategies for general learning tasks (e.g. goal-setting, planning, monitoring, regulating, note-taking, reviewing, revising, recording, time-management) and for learning specific content areas (e.g. self-questioning, clarifying, summarizing and question generation for reading comprehension strategies), provide models for exercising these cognitive strategies and ensure that guided practice with feedback allow students sufficient practise in the use of these strategies in their assignments and homework. The practice exercise can be in the form of interesting, relevant activities, games, quizzes and projects.
In the classroom, teachers' strategy-based instruction must be aligned with students' actual learning strategies (e.g. with cognitively self-management strategies to assist students in regulating their performance). Paris and Winograd (1990) talk about utility that is, it is no use teaching unless student knowledge of strategies will make a difference to the ultimate outcomes.

**Implications for Teacher Educators**

For both pre-service and in-service teacher education courses, specific courses on self-regulated learning or strategy-based instruction could be organised to reach the masses of trainee teachers as well as teachers in the schools. Other courses could also be pitched for the Masters of Education course related to such topics.

Exemplary-based teachers can also act as consultants within schools to assist teachers. They work together with other teachers to build up teacher competencies. Teachers must be given exposure to appropriate types of strategies relevant to assisting them to teach their students to self-regulate. Opportunities for observing and emulating the practices of outstanding teacher models and for practicing under the supervision of skilled teachers would provide the kinds of experience that all good professionals need.

**Implications for Policy-Makers**

Implications have already been discussed for classrooms and for teacher education but clearly these are nested within an education system. What are the implications at the policy level?

There is a need to develop instruments that can be used by teachers to self-assess their teaching performance in their knowledge and usage of self-regulated learning and classroom practices. This means that school principals or heads of departments in the various subject areas could conduct relevant courses pertaining to these aspects of teacher development. Teacher educators may also be invited to provide advice or relevant workshops related to the school's needs.

The Ministry of Education may also need to ensure that the curriculum is more metacognitively-based. Knowledgeable teachers, principals and teacher educators in strategy-based instruction should be deployed to write curriculum materials and more project-based activities that would harness students' thinking and learning. Furthermore, a resource centre may also be established to provide and support high quality teaching, research and consultancy in strategy-based instruction. Collaborative research with other international institutions may be necessary to ensure that the centre is internationally up-to-date and well-established.

**Future Research**

The data for this study was obtained mainly through questionnaires and interviews. To understand how teachers' strategy-based instruction are translated into classroom lessons, it is also necessary that future research examines the classroom practices of teachers through actual classroom observations and even through videotapes so that what is perceived as routine to some teachers may be translated more effectively by the researcher through the actual observations and videotapes to ensure a degree of consistency and predictability in the various teaching behaviours.

It would be interesting to find out if different streams use similar strategies for different subject domains e.g. strategies for Mathematics will not be the same as strategies for Science or English. Idol (1987) and Scruggs and Mastropieri (1992) have done similar research in this area. Therefore, another future research could be to examine if different ability groups use similar strategies for different subject domains.
References


