

The Effect of Self Directed Learning Tasks on Attitude towards Science

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Abstract

Guangyang Primary School (GYPS) embarked on a school-based curriculum innovation (SCI) which aimed to develop students to be self-directed learners (SDL) in Science. The SCI was carried out on one class of Primary 3 (Grade 3) and one class of Primary 4 (Grade 4) high-ability students. It involved students working independently towards an enrichment project which comprised a series of tasks. The project focus was shaped by the curiosity of the students and the questions they posed in class. Through structured consultation sessions, the teachers acting as facilitators and resource persons encouraged students to construct their answers. During these sessions, the teachers guided students through the different stages of the project, namely, selection of a research area/ topic, decision on deliverables, crafting of the assessment criteria and the agreement on the presentation format and sharing of the new knowledge. Using the standardised mean difference, a large effect was observed for the scales, namely, confidence in the subject and usefulness of Science, in favour of the post-SCI results. The positive effect is likely to be attributed to good questioning techniques and effective use of feedback.

Introduction

Guangyang Primary School (GYPS) believes that learners of Science will develop skills, habits of mind and attitudes necessary to understand themselves and the world around them if they are given opportunities to build on their interest and have their curiosity aroused.

The I Discover Science (i-DiSc) programme was the school's curriculum innovation to develop students to be self-directed learners. The i-DiSc programme was first piloted among the high-ability learners as research suggested that the curriculum must be modified to meet the needs of this group. The curriculum modification with the intent of enriching students' learning, took on a process-product approach. (Van Tassel-Baska, 1986).

Literature Review

Studies have shown that one of the differences between high achieving and low achieving children is the degree to which they become self regulators of their learning. High achieving students engage in a number of strategic skills including goal setting, planning, self-interrogating, self-monitoring and asking for help (Zimmerman & Schunk 1989). Self-directed learning involves learner-initiated and regulated activities such as autonomous learning activities, metacognitive activities, self-regulated learning, intentional learning and learning strategies (Thomas, Strage & Curley 1988). It does suggest that high ability learners would benefit from self-directed learning which involved them in activities requiring self-regulation.

Paris and Paris (2001), in their review, suggested that teacher support in the form of open-ended tasks and scaffolding assistance for inquiry, enabled students to be more self-regulated. The use of projects, portfolio assessment and performance tasks, has a motivating effect for self-regulation and creative expressions. Teachers' modeling of the strategies to process information and organizing information is also another form of support. The use of projects could assess students' level of self-directed learning by examining how they : (a) select a topic; (b) make connection to

prior knowledge; (c) collection information; (d) draw conclusion; (e) reflect and self assess; and (f) share knowledge (Birenbaum, 2002).

A study by Corno and Rohrkemper (1985) provided evidence of students, who after undergoing self-directed learning, experienced enhanced feelings of efficacy, increased motivation to learn and increased effort expended on the tasks. In another study cited by Helen and Crick (2003), Perry (1998) examined the effect of self-regulated learning (SRL) on young children's effort and control over learning in the classrooms. Three high SRL classes were conducted by teachers who offered complex activities, students' choices, enabled students to control the amount of challenge, collaboration with peers and evaluation of their work. In contrast, in the low SRL classrooms, teachers were more controlling, offering few choices and their assessments of students' work were limited to mechanical features. The students in the high SRL classes possessed a task focus when choosing topics or collaborators for their writing. They were able to focus on what they had learned about a topic and how their writing had improved when they evaluated their writing products. On the other hand, students in the low SRL classes were more concerned with teachers' feedback.

Guided by the above literature review, this study examined the impact of self-directed tasks on learners' attitude towards Science. It uses a pre-post single group design.

Method

Participants

This study involved 38 Primary 3 and 30 Primary 4 students. The participants were high-ability students. The average age of the students in Primary 3 and Primary 4 was nine years old and ten years old respectively.

Measures

The study used the modified Fennema-Sherman Attitude Scales to measure the students' attitude towards Science. The original instrument was developed by Elizabeth Fennema and Julia Sherman in the early 1970s to study students' attitudes towards Mathematics. Of the four scales, the following three scales were used in this study: a) confidence in learning scale; (b) the usefulness of Science scale; and (c)

students' perceptions of their teacher's attitude scale. The subject perceived as a male domain scale was not administered as it was not relevant to this study.

The researcher split the test into two parts; the first part comprising 23 items and the second part comprising 24 items, to reduce student fatigue in having to respond to too many items in one test. The positive and negative items for each scale were roughly even in number. They were administered as two separate pre-tests and two separate post-tests for each class. The researcher checked for language appropriateness of the items in the instrument with five students each from the Primary 3 and Primary 4. The students had no difficulty in understanding the items.

Towards the end of the study, the two teachers who taught the P3 and P4 class and ten students, five from each class, were interviewed to gather their perceptions on the impact of the intervention on students' engagement level. The researcher conducted one-on-one interviews with the two teachers. The students participated in two separate group interviews and they provided input on: (a) the level of the autonomy given in deciding on the subject matter of the SDL task; (b) the performance tasks which included oral presentations; (c) involvement in drawing up the assessment criteria; and (d) the impact of the SDL activity on their engagement. During the SDL sessions, the researcher used non-participatory observations to understand the dynamics and interactions in the classroom which helped the researcher to interpret and triangulate the data gathered from the interviews.

Procedure

The Head-of-Science Department developed a teaching package based on the Science syllabus framework of the identified topic to be taught. The package contained enrichment tasks to develop self-directed learning among the high-ability students. The same teachers serving as facilitators and resource persons, encouraged their students to construct answers through structured consultation sessions. These sessions allowed both teacher and students to: (a) discuss the focus of the task; (b) set expectations of the tasks; (c) provide guidance in research; and (d) identify platforms for sharing of the newfound knowledge with their peers.

The Science teachers separately carried out the tasks with their students in their respective classes over five weekly lessons. The duration of each lesson was 45

minutes. During these lessons, the teachers guided students through the different stages of the project, namely, selection of a research area/ topic, decision on deliverables, crafting of the assessment criteria and the agreement on the presentation format and sharing of the new knowledge. Students were given a choice of three presentation formats, namely, PowerPoint slide presentations, oral presentations, model-making and poster-making. As the curriculum time of 3¾ contact hours was not sufficient for students to complete their tasks, students were allowed to work on their tasks during non-curriculum time. The administration of the pre-tests and post-tests is shown in the figure below.

		Intervention			
Pre-test 1 4 weeks before the first task	Pre-test 2 2 weeks before the first task	First task	Last Task	Post-test 1 2 weeks after the last task	Post -test 2 4 weeks after the last task

Figure 1. Administration of Pre- and Post-tests

Results and Discussion

Data from the Primary Three and Primary Four students were aggregated. Table 1 shows the reliability indices of the scales of the modified instrument. The items in each scale are found to be internally consistent.

Table 1: Reliability Indices of the modified Fennema-Sherman Attitude Scales

Scales	Number of Items	Cronbach Alpha
Personal Confidence in Science	16	0.99
Usefulness of Science Content	16	0.98
Perception of Teacher's Attitudes	15	0.98

Table 2 contains the means and standard deviation scores from the modified Fennema-Sherman Attitude scales for both the pre-tests and post-tests. The effect size values for the scales were included.

Table 2. Pre- and Post-test Scores from the Modified Fennema-Sherman Attitude Scales

Scales	Pre-Test (N=68) Mean(SD)	Post-Test (N=69) Mean(SD)	Effect size	Remarks
Personal Confidence in Science	3.41 (0.48)	4.63 (1.79)	2.54	Large Effect
Usefulness of Science Content	3.86 (0.45)	4.83 (1.83)	2.16	Large Effect
Perception of Teacher's Attitudes	3.46 (0.33)	4.78 (1.88)	4.00	Large Effect

The effect sizes indicated that the intervention had a large effect on the Primary Three and Primary Four students with respect to each scale shown above. These findings suggest that there has been an increase in the students' confidence in Science, positive perceptions of their teacher's attitudes and perception of the usefulness of Science.

The students having assumed a decision-making role at the various stages of the task, from selection of topics through to the formulation of rubrics, could have improved their personal confidence. Students were given opportunities to exercise their decision- making skills by choosing the focus and content of their tasks. In the interviews with students, they expressed that they liked having a choice on the type of performance tasks to undertake as it enabled them to select the task for which they have the requisite skills or flair. Teachers observed that students chose their performance tasks based on their ability to deliver quality results through that task, drawing on their prior experience. Teachers and students also jointly constructed the assessment criteria and standards in the rubrics on content and presentation for the performance tasks.

The consultation sessions with their teachers could also have boosted the confidence levels of the students. The Primary Three Science teacher observed that the younger students in Primary 3, initially had difficulty completing the decision-making matrix as they were not familiar with the task and concept. With appropriate choice of examples

and scaffolding, the teacher was able to help her students to complete the task. In some of the sessions, teachers gave feedback on their students' work based on the co-designed rubrics and challenged them to perform at a higher standard. The criteria for improvement was communicated clearly to students and such feedback was aligned with good assessment practices (Stiggins, 2002). Students were also given opportunities to self-evaluate. According to Kitsantas, Reiser and Doster (2004), such opportunities for students to evaluate their own work build greater student confidence. As a result, the teachers observed that students were intrinsically motivated to perform better than before. The teachers also observed that students were more open to feedback as they were able to use the feedback to improve their work. In addition, the peers' feedback on how to improve on one another's projects could also explained the increased confidence of the students.

The increase in the scores for the items in the Usefulness of Science Content scale could be explained by the design of the performance task and the choice given to students. The tasks provided opportunities for the students see the relevance of Science to the real world. Given the autonomy to select their topics, it was noted that most students chose: (a) to investigate issues that appealed to them; or (b) to examine phenomena commonly encountered in their daily lives. For example, when carrying out a project on life cycle, the Primary 3 students chose animals which they have encountered.

The increased students' positive perception of their teacher's attitudes towards Science could have resulted from their teachers' active involvement in the tasks with them. In the conduct of the tasks, the teachers' keen interest in guiding the students motivated them towards better performance. In guiding them to examine information sources, teachers demonstrated to students how they have carried out the inquiry process.

The findings have surfaced some key enablers which might have resulted in the improvement of these students' attitude, namely, confidence, usefulness of Science and perception of teachers. These enablers include the higher level of student-teacher interaction and the predominantly facilitative style adopted by the teachers. The observed learning environment was conducive and emotionally safe for students

to ask questions and share their ideas. There was a free flow of ideas within the classroom. Teachers took the stance of learners alongside with their students, using questioning techniques to steer their students to a higher level of understanding. Teachers were observed to be able to ask useful questions which elicited answers from the students and challenged them to investigate further or work towards better quality of work. In addition, the teachers' ability to facilitate discussions was especially important when assisting their students in crafting the learning content and the task rubrics.

Conclusion

This study investigated the impact of self-directed learning tasks on the learning needs of high ability students, facilitated by the teachers. Findings indicated that having students assume an expanded role in decision making and with facilitated teacher support would contribute to students' higher level of confidence in the learning of Science. Teacher's support in the form of structured scaffolding was seen to be especially critical among younger students.

While the study has recorded a higher positive effect, a more extensive study involving a larger sample would be useful in establishing the impact of self-directed learning among high ability students. A more detailed analysis of the data could yield information on the relative impact on the different age group of students in this study. Further studies could be carried out to examine the sustainability and scalability of the benefits, namely the confidence in learning Science and perception of usefulness in learning Science. Other possible follow-ups of this study could be to explore the impact of self- and peer-assessment practices on learning and the pedagogical practices in developing students of other abilities on self-directed learning.

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