

1. Abstract

This paper examines the effectiveness of the Thinking Programme in developing critical thinking and creativity among the Secondary One students (13 year-old, first year) in The Chinese High School. This study utilises qualitative and quantitative methodologies to evaluate students' perceptions on the teaching and learning of the Thinking Programme. Students are asked to reflect on their actual learning experience and comment on whether the explicit teaching of thinking skills has helped to develop their critical and creative thinking ability. This retrospective reflection done by the students helps the writer to identify certain characteristic, behaviours and learning attitudes of better thinkers, thereby reinforcing the belief that the Thinking Programme does have an impact on the critical thinking and creativity of the individual.

In addition, this study examines the extent to which thinking skills are applied in the daily lives of the students, be it in school or beyond the institutional boundaries. Also, it shows how certain conducive environmental factors that help promote and inculcate critical and creative thinking and learning that surface consequentially because of this study.

2. Introduction

The vision of creating "THINKING SCHOOLS, LEARNING NATION" is formed in the hope of building a workforce that will be able to cope with the changes of a transient economy. The need to develop critical and creative thinking skills is deemed crucial for increasing Singapore's economic competitiveness especially in the knowledge-based economy. Singapore's Prime Minister, Mr. Goh Chok Tong, in his opening speech at the opening of the 7th International Conference on Thinking, reiterated that:

the future wealth will depend on their capacity of learning... their ability to seek out new technologies and ideas, and to apply them in everything they do will be the key source of economic growth (1997) .

Thus, the concept of Thinking Schools introduced by the Ministry of Education is central to heeding the government's call to realise this national vision. Schools are entrusted with the responsibility to develop future generations of thinking and committed citizens, capable of making good decisions to keep Singapore vibrant and successful in future. Individual creativity, the originality of thought and inventiveness are therefore deemed important to retain and increase Singapore's competitiveness in a knowledge-based economy. There is a need for Singapore to re-look and improve the educational system. Amongst other things, the curriculum needs to be changed in order to meet present and future demands to encourage creativity, innovation and independent thinking and life-long learning .

Hence, the Thinking Unit in the Ministry of Education was set up in 1997 as a vehicle of change in the educational system. Through its Thinking Programme, it aims at helping Singapore students become better thinkers and learners. The Thinking Programme, which is developed and endorsed by the Ministry, is packaged into an educational thinking syllabus and then given to schools, including independent ones like The Chinese High School, who are then entrusted with the responsibility to develop future generations of creative, innovative and resourceful citizens.

A major feature of the programme concerns helping pupils to develop critical, creative and self-regulated thinking dispositions. The eight core thinking skills are generic thinking skills essential for creative problem solving and decision making (Marzano et al., 1988). They include the following skills of focusing, information-gathering, remembering, organizing,

analyzing, generating, integrating and evaluating. These eight core thinking skills were selected and packaged by the Thinking Unit in the Ministry of Education on the basis that they were essential for investigation, problem solving, and decision making (Appendix 1).

2.1 Research Context

The pedagogical approach adopted by The Chinese High School is to teach these eight core thinking skills explicitly for one period a week for ten months (an academic year) to the Secondary One pupils who are to be imbued with the relevant explicit thinking techniques when they join the school in the first year. Subsequently, it is hoped that the students would be able to infuse these thinking techniques to their respective subject areas.

In alignment with the Ministry of Education's goals for the Thinking Programme, the school shares the same objective of developing students to become more critical and creative learners. The school is now into its fourth year of teaching the Thinking Programme and no comprehensive study has yet been done to determine if the above objective has been met. The paradox is that while there is much scope for research, there are very few evaluation of thinking literature in the local scene that the present researcher could refer to for guidance.

In view of this, the obvious starting point for this pioneer project is to put up a commonly asked question, 'What is the effect of the explicit teaching of the thinking skills through the Thinking Programme on the thinking ability of Secondary One students in The Chinese High School for a period of 10 months?'. It is imperative to evaluate how the Thinking Programme has impacted the students' creative and critical thinking. From here, two specific questions arose: firstly, how does one measure improvement in student thinking? If thinking is measurable, then, it does mean that there are some indicators or observable signs and traits exhibited in better thinkers for us to determine that. Conversely, it also means that in the absence of these visible signs, then the attempt to teach thinking has failed. We also need to know how consciously the students apply the thinking skills. This leads us to the second specific question: In what ways do they apply these thinking skills in academic learning as well as to real-life situations in problem-solving and decision making?

3. Conceptual Framework and Design Strategy

As this is an evaluative study of the effectiveness of the Thinking Programme on students' creative and critical thinking, the independent variable in question would be the aspects of the Thinking Programme, e.g. the lessons and activities conducted in the Thinking Programme. The dependent variable would be the students' thinking as evident from their verbal and written responses.

The general qualitative data are analysed using the Miles and Huberman framework of reducing and displaying data before drawing and verifying conclusions. This framework is selected due to the large amount of written and verbal data collected.

The quantitative data are analyzed using the Statistical Package for the Social Sciences (SPSS) to determine the more important and commonly used measures of central tendency and variability, the mean and standard deviation. Correlation studies of the variables is also carried out to further validate the findings. The reason why simple quantitative data analysis is used is to act as a supplementary support for qualitative data, which makes up the bulk of the data collected.

4. Review of Literature

As evident in the introduction, Singapore schools have realized their new goals for education are to develop students into life-long learners by developing in them the capacity for continued learning. The education system must encourage students to be creative, innovative and be able to solve problems; going beyond the present scenario of just being exam smart. Consequently, critical and creative-thinking activities and practices are increasingly being promoted in schools.

The adoption of a Thinking Programme is perceived as a means of creating the type of thoughtful classroom environment that supports students' critical and creative thinking. However, schools in Singapore have been expected to 'produce' students who acquire set content and master specific skills. This is known as the reductionist approach (Jeroski, 1992) in which evaluation is largely a matter of quality control – of monitoring the 'products' to ensure that they met standard specifications, like test scores. One of its pitfalls is the overuse of test scores, resulting in the creative thinking of students being undervalued (Sternberg & Spear-Swerling, 1996). It is thus inappropriate to measure critical and creative thinking, which is a process-oriented goal, with product-oriented assessment techniques, such as tests and examinations. Such standardized test scores can only give us a static number that reflects the achievement and performance of isolated skills at a particular moment in time.

However, experts like Sternberg & Spear-Swerling (1996), Perkins & Tishman (1995) and Costa (1985) have argued for a different kind of evaluation of thinking, moving away from the reductionist approach. Evaluation for thinking is much more than a way of monitoring and measuring quantitative results; it involves the qualitative assessing of learning attitudes and behaviours.

Thinking is dynamic; we learn from experience, react emotionally to situations, experience power in problem-solving and are energized by the act of discovery. Therefore, it is unsatisfactory to measure it through the amount of time spent on a task, minutes of instruction, scores gain on achievement tests, IQ scores or percentage of objectives attained. All these measures are irrelevant in collecting evidence of students' growth in thinking. It has been suggested by leading experts like Sternberg (1985), Costa (1997) and Perkins (2000) that good thinking can be identified through certain 'thinking dispositions' or 'intellectual characters'.

In the 'Triachic Theory of Human Intelligence', Sternberg (1985) believed that good thinking involves three different aspects namely analytical, creative and practical thinking. Underlying these aspects of thinking are at least seven fundamental skills to be displayed: (a) problem identification, (b) process selection, (c) representation of information, (d) strategy information, (e) allocation of resources, (f) solution monitoring, and (g) evaluating solutions.

According to Sternberg and Spear-Swerling (1996), analytical (critical) people are particularly adept in applying these skills to familiar and often academic kinds of problems; creative people are particularly adept at applying them to relatively novel problems; practical people are particularly adept at applying them to everyday problems. Though creative and practical intelligence matters, unfortunately, it is not sufficiently emphasized in schools because it is not what the tests measure. Analytical skill alone is not a good indicator of a student's growing intelligence and thinking capacity. There is a need to foster all these three aspects of intelligence, and not to favour just one especially if we think about schooling as preparation for the world of work.

In the recent completed project 'Patterns of Thinking', Perkins and Tishman (2000) have investigated several key thinking dispositions that support high-level thinking in and across subject matters. They further supported this notion that thinking disposition is a tendency toward a particular pattern of intellectual behavior. For example, good thinkers have the tendency to identify and investigate problems, to probe assumptions, to seek reasons, and to be *reflective*.

Their project has identified three logically distinct components that are necessary for dispositional behavior: ability, inclination, and sensitivity. Ability is concerned with the basic capacity to carry out a behavior. While inclination is associated with the motivation or impulse to engage in a certain appropriate behavior, sensitivity deals with the likelihood of noticing occasions to engage in that behavior, like being open-minded to new ideas. Perkins and Tishman (2000) believed that in order to engage in an episode of open-mindedness, one has to have the basic capacity to see a situation from more than one perspective, feel inclined to invest the energy in doing so, and recognize an appropriate occasion to be open to alternative perspectives.

As for Costa (1997), he has distilled the thinking dispositions and intellectual characteristics into 10 indicators. He believed that a student's acquisition of these types of behaviours provides more usable information about growth in intelligence.

The first indicator is **perseverance**. Students very often give up easily when answers to problems are not evident. They are unable to analyze the causes, develop strategies to solve them. A thinking student, Costa feels, will not give up but generate new strategies and methods to tackle the problems. If one strategy does not work, they are able to generate more back-up ideas and plans.

Decreased impulsivity is another observable behaviour that can be seen in a thinking student. Sometimes, students shout out their answers or start to work without fully understanding the directions and requirements. They are also quick to make judgements, jump to conclusions and are less patient to consider alternate viewpoints. According to Costa (1997), those who manage their impulsivity will take time to think, plan and consider different possibilities.

Another distinguishing characteristic of a thinking person, as proposed by Costa (1997), is the ability to **pose questions and problems**. The types of questions they ask should progress to become more specific and profound in nature. Their ability to recognize discrepancies, bias and other phenomena becomes better.

According to Costa (1997), **flexibility or open-mindedness** in thinking is another important element because some students have difficulty in considering alternative points of view or dealing with several sources of information simultaneously. Some of them are still existing in Piaget's ego-centric stage. Their way to solve a problem seems to be the only way. They are more interested to know whether their answer is correct, rather than being challenged by the process of finding the answer. Some would feel insecure without a definitive 'right' or 'wrong' answer given by the teacher and thus are reluctant to proceed without a definite solution offered to them. He felt that such inflexibility hampers fluency; the ability to generate more ideas.

Meta-cognition of the students should improve when they become more thoughtful. When they become more aware of their own thinking process, they are able to describe and explain their problem-solving skills or thinking strategies. This reflects what Costa (1988) believes to be intelligent thinking and behaviour. When they are presenting their ideas,

students need to be simultaneously conscious of their own thinking process as well as describing what goes on in their heads.

To Costa (1997), a thinking student is also one who can expand the number of **connections** between existing knowledge and new knowledge by extending, integrating, elaborating, analyzing and evaluating their ideas. They must be able to call on their store of knowledge and experiences as sources of data to support, theories to explain, and process to solve new challenge.

The ultimate goal of teaching thinking skill is for students to **apply** them to real-life situations. This means that the students must be able to use the skills effectively to generate creative ideas in different situations.

Enjoyment of problem solving is the most imperative indicator in assessing the growth in thinking. The thinking capacity of the students has not changed if they still perceive thinking as difficult and avoid situations that they view as demanding. An indication of growing thinking ability is the change of attitude. The attitude should move from a not only "I can" but "I enjoy" feeling.

Costa's 10 indicators of intellectual growth definitely do not to serve as a convenient competency checklist. The development of thinking skills takes time. It is not a 'quick-fix' concept. It needs consistent and sustained instruction, carefully designed curriculum and well-trained teachers. The effectiveness of the teaching of thinking skills is demonstrated by sustained performance in a variety of situations that demand selective and spontaneous use of different problem-solving strategies rather than singular, isolated behaviour.

Therefore, in order to evaluate thinking effectively, teachers need to expand the range, variety, and multiplicity of assessment techniques, by moving away from norm-referenced, multiple-choice, standardized achievement tests. Costa believed that the emphasis is 'not on how many answers they know, but on how they behave when they don't know' (1985: 288).

Costa and Kallick (1992) suggested that to recognize improved students thinking, teachers can collect data through a repertoire of assessment techniques and systematize assessment procedures.

One of them is direct observation of student performance in problem-solving situations. Teachers can describe students' progress: the lights that go on in students' eyes or the 'a-ha' of discovery in students' exuberance; the enthusiasm they display when engaged in a thinking activity; the sense of satisfaction and pride felt when they achieved the desired results. Such observation can be done by employing technology like videotaping students' interactions and expressions.

But to adopt such direct observation approach, the challenge is to come up with a systematic way of collecting and reporting such evidences. Teachers first need to refine their skills of observation and to record down their observations consistently. There is also a need to design assessment that is reliable, independent of the specific assessor. Teachers need to identify and define terms precisely and adopt common specific common goals.

Collecting portfolios of selected students' work over time and inviting students to keep journals are ways to document student's growth. By collecting and organizing samples of accomplishments, these portfolios offer rich resources for teacher evaluation and self-evaluation. Thinking journals serve as a reflection log. Students could pen down their insights, draw an image, model or picture or write down their inner feelings about the thinking lesson. Getting them to record critical incidents such as vignettes, sayings which

indicate transfer, application, and internalization of concepts and strategies. Through metacognition or thinking about their own thinking, one can dramatically improve learning and significantly increase the levels of transfer of learning beyond the classroom situation into life (Lazear, 1991).

Interviewing students about their own self-concept and perceptions of themselves as learners is another way of evaluating thinking. Teachers could record down their feelings and learning experiences within the classroom. But most importantly, interviews can also help to capture students' personal insights and experiences outside the classroom that we cannot observe.

Assessing students' presentations, displays, exhibitions, and performances according to a set criteria and to record indicators of dispositions and habits of mind exhibited during group projects and discussions are some methods of evaluating thinking.

Assessing thinking through the exclusive use of standardized, paper-pencil techniques is inadequate. To evaluate the effectiveness of the teaching of thinking, teachers must be able to observe and recognize thinking dispositions, behaviours and characteristics display by the students daily and through a repertoire of other evaluative methods.

6. Methodology

The first step in the study involved data gathering in relation to students' perception and actual experience of their learning. A combination of quantitative and qualitative approaches is used. The qualitative data gathered comprised the use of focus group interviews, thinking journals and open-ended survey questions (Appendix 2), and a quantitative data is gathered through an evaluation survey (Appendix 2). The rationale for seeking a quantitative and qualitative methodology is to enhance the validity of the findings by checking the results of the qualitative investigation against the quantitative study (Punch, 1998). Though quantitative research may be sufficient to facilitate the interpretation of relationship between variables, it is often weak when it comes to exploring the reasons for those relationships (1998: 247). Therefore, qualitative research may facilitate the interpretation and explanation of factors underlying the broad relationships that are established.

6.1 Participants

A survey of 103 students from three classes taught by the same teacher was administered. The students form a homogeneous group of Secondary One boys with ages ranging between 13-14 years old. They are from middle-ability classes.

In addition, three focus group interviews were conducted. Each group has 6-9 Secondary One boys who volunteered to be participants. In all, a total of 21 volunteers from three different classes of the Thinking Programme were interviewed. The purpose of the interview was explained to them.

6.2 Data collection - Instruments, Materials and Procedures

6.2.1 Survey Questionnaire:

The questionnaire was administered in class in Term 3-Semester 2, during the last lesson of the Thinking Programme for the year. The students were given 50 minutes to reflect on the year's work and their learning experiences.

The questionnaire in this study was designed to ask participants to respond to specific queries about their learning from the Thinking Programme. The two formats used here are the rating scales and the open-ended questions. The first part of the questionnaire, which comprised of 18 statements, used a four-point Likert scale of Strongly Agree, Agree, Disagree and Strongly Disagree (Appendix 2). The 20 survey questions are designed as a self-reflection exercise based on Sternberg, Perkins and Costa theories of thinking behaviours. The first 10 statements are designed to check if they have acquired analytical-critical and creative thinking habits, like the ability to focus on problematic issues and thinking of different strategies to analyse problems. There are six statements on meta-cognitive thinking and behaviours, like being aware of their strengths and weaknesses and two questions on practical thinking like whether they apply thinking skills beyond the thinking class.

Such a rating scale can help obtain feedback from the participants on the strength and direction of their feelings about the Thinking Programme. Another plus point of this self-reflective questionnaire using the rating scale is that it was able to elicit responses to specific research questions in the form of scaled, quantifiable data which can then be subjected to powerful statistical analyses (Bachman et al, 1996). However, because the nature of such a rating format restricts the range and content of participants' responses, open-ended questions are given to increase the validity of this data-collection procedure.

In the open-ended questions, the participants are asked to provide feedback by means of a free response to a question. The last two questions, Question 19 and 20, in the reflection survey are open-ended questions. Question 19 asked 'What do you like about the Thinking Programme?' and Question 20 required the respondents to suggest areas for improvement in this programme. A strength of the open-ended questionnaire format is that it elicited responses that might not be anticipated. One respondent commented that his poor linguistic abilities had hindered his spontaneity in class, making it difficult for him to participate and speak up during Thinking lessons.

6.2.2 Focus Group Interview:

Follow-up interviews are then conducted as Clapham noted, "In most cases respondents did not complete the questionnaire themselves, but were interviewed.....so that potentially interesting answers could be followed-up in detail' (1997:51). In fact, interviews not only have great potential for following-up interesting points, they provide the interviewer with the opportunity to ask questions focusing on specific kinds of information.

The focus group interviews took place in Semester 2 in late October 2001 immediately after the questionnaire exercise. The interviewer must not wait too long to gather data so that there would not be any data loss. Student volunteers for the focus groups are called for during the thinking lesson and the purpose of the exercise is explained to them. The 3 focus groups, made up of between 6-9 members each, then met outside class times.

To maintain spontaneity, the sessions are relatively unstructured and not taped primarily to allow the interviewees to express their feelings uninhibited about the Thinking Programme. However, responses are noted and recorded (Appendices 4, 5 & 6). The interview context, very much simulated to that of a classroom environment, encouraged the students to speak aloud without inhibition because they are interacting with their peers. Interviewees are asked to reflect on a series of questions that explore the benefits and shortcomings of the Thinking Programme (Appendix 3). Sample interview questions included 'Do you think you have benefitted from the Thinking Programme?', 'What are the thinking skills that you find most helpful in developing your creative thinking?', 'In what ways do you think you have become a better thinker?'

The strength of a follow-up interview is that it provides the participants with an opportunity to vocalise their thoughts on the Thinking Programme and let them know that they have been heard and what they have expressed may contribute to positive impact. However, the drawback of an interview is that it is time-consuming. Moreover, the validity of the data collected has been questioned because the researcher can impose a high degree of subjectivity at the data collection or analysis and interpretation stages and thus, nullify any conclusions made (Seliger & Shohamy, 1989).

6.2.3 Thinking Journals:

The thinking journal is a purposive collection of a student's thinking over time, which contains exhibits showing the reflection processes the student has gone through after each thinking lesson (Stiggins et al., 1986). It should yield valuable evidence on the student's self-reflection about his thinking as well as his thinking process. The three classes of students are encouraged to keep thinking journals for the lesson since the beginning of Semester 1 in January 2001. They are encouraged to doodle, draw, write and express their ideas and thoughts. In order to encourage them to be fluent with their ideas, grammar and sentence structures are ignored. Their entries thus served as a source of data for evaluation. With the permission of the students, all journals are collected on the last day of the Semester 2. About 15 journals are randomly selected as a sample for this research paper.

Although the interviews and thinking journals do provide a reservoir of data for the researcher, the contents and the intentions for their collection, collation and evaluation are highly subjective, making them a suspect in the eyes of certain audiences. Often, such qualitative data are considered not as meaningful or convincing as quantitative data. Hence, what is important is that the data from the interviews and journals are triangulated with other quantitative procedures (Cohen, 1997) so that the validity of the findings can be enhanced (Punch, 1998).

6.3 Data Analysis Strategies

The qualitative data, recorded focus group materials, journal writings and open-ended survey question-answers, are analyzed using the Miles and Huberman framework. Their framework for qualitative analysis has three main components namely, data reduction, data displays and drawing and verifying conclusions. Data reduction is an on-going process throughout the analysis of qualitative data (Punch, 1998). The first stage of data reduction is to edit, segment and summarize the data (1998:203). In this present study, the writer reflected on the recorded notes taken during the interviews as well as the entries made by the students in the writing journals in one sitting. An editing of the major points brought up by the students is done and the key points are condensed and important segments of the texts summarized.

According to Miles and Huberman (Punch, 1998), the next stage is to put labels on the 'reduced data' in order to find regularities, themes, clusters and patterns. In this study, sub-headings and themes are given to salient points sift out in the first stage of data reduction. Examples of themes related to thinking given by the writer are meta-cognition, creative problem-solving skills and flexibility. In the later stages, based on these themes, the writer managed to identify three major thinking concepts: critical, creative and constructive thinking.

The availability of a sophisticated computer programme, Statistical Package for Social Sciences (SPSS), has made it possible to display the data in a variety of ways. According to Miles and Huberman (1994:11), ".....better displays are a major avenue to valid qualitative analysis". For the present study, data displays are in the form of tables and charts.

The final component in this framework is the drawing and verifying of conclusions. This stage of the analysis occurs concurrently with the other stages of data reduction and displays although conclusions drawn before all the data are analysed would render the conclusions premature. While editing the data, the writer has come up with several plausible conclusions about the effectiveness of the Thinking Programme, one of which is that the Programme has developed a balanced world view among students, reducing personal bias .

The quantitative data derived from the first part of the survey which used a four-point Likert rating scale was analysed by the computer software SPSS. Descriptive statistics like the mean, standard deviation and correlation would be used to validate the qualitative data. The mean, a measure of central tendency, is the arithmetic average of all scores in a data (Hatch and Lazaraton, 1991). In this study, the mean is the average of all scores that measure intellectual growth. The standard deviation, a measure of variability, gives us a measure that shows us how much variability of the data from the point of central tendency (Hatch and Lazaraton, 1991). The standard deviation gives us information that the mean score alone cannot give. It helps us to make more informed conclusions about the qualitative data. The correlation allows us to establish the strength of relationships of continuous variables. A detailed discussion of how these descriptive statistics help to validate qualitative data is presented in the following section.

7. Discussion of Findings

According to Forgarty (1992), he advocated that if all teaching is for transfer; all learning is for transfer. Then the mission of the THINKING PROGRAMME is to lead students towards relevant transfer and use of the thinking skills. The primary focus of this research paper is to find out how effectively students have applied thinking skills in the class, in their academic studies and their life situations. The following discussion examines the effectiveness, firstly, of critical-analytical thinking and then, creative thinking.

From the focus groups interviews and the response from the open-ended survey questions, the students expressed very positive attitude towards the Thinking Programme. Many of them felt that they have benefited from the programme. This can be seen from the low mean scores of the 18 statements in Table 1 (1 means 'strongly agree', 2 is 'agree', 3 is 'disagree' and 4 is 'strongly disagree' in the likert scale). Most of the mean scores fall below 2. Since the mean does not take into account extreme scores, we have look into the standard deviation to validate the findings. Table 1 reports that the standard deviations of all statements fall below 1. This means that the spread of scores is small and all of them cluster around 'strongly agree' and 'agree' ratings.

Table 1 : Mean Scores and Standard Deviation for the 18 Statements

No.	Statements	Mean	Standard Deviation
1	I learned how to focus issues/problems by asking the right questions.	1.84	0.5
2	I improved my ability to use different strategies to analyze problems.	1.87	0.64
3	I do not give up easily and learn to persevere when answers to issues/problems are not evident.	1.76	0.59
4	I become less impulsive by taking my time to reflect on answers before giving them.	1.89	0.7
5	I learn to listen & respect alternate viewpoints.	1.69	0.54
6	I am able to evaluate the merits & demerits of new ideas.	1.83	0.63
7	I improve my ability to use different skills to generate new ideas/solutions.	2.02	0.67
8	I like the challenge of thinking of new ideas.	1.77	0.78
9	I enjoy problem-solving/decision making.	1.75	0.72
10	I improve ability to detect bias/errors.	1.69	0.58
11	I am more ready to describe/write down own thinking strategies.	2.23	0.74
12	I learn about my own strength and weaknesses by reflecting on my actions.	2.08	0.79
13	I am more aware of the things around me and ask more questions so as to understand better.	1.93	0.68
14	I learn to probe by asking more specific questions.	1.87	0.75
15	The thinking skills that I learn have helped me in the learning of academic studies.	1.92	0.84
16	I apply the thinking skills learned in class to real-life situations.	2.18	0.78
17	I am less afraid to express my thoughts/ideas.	2.02	0.73

18	I am less afraid to make mistakes.	2.07	0.77
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Students agreed that they have improved in their analytical (critical) thinking, as evident in Statements 1 and 2 that have means/standard deviation of 1.84/0.5 and 1.87/0.64 respectively. This is substantiated by the journal writings, interviews and open-ended questions. Most of them observed improved thinking in themselves, citing that they are more 'systematic' and 'analytical' and 'organized' in their thinking. They have benefited from the range of skills taught to them. Examples of such critical thinking skills are FORMULATING QUESTIONS and DEFINING PROBLEMS. Below are three excerpts from an interview and two journal entries.

In Interview One, student 4, expressed the sentiment:

thinking skills help me to analyze things and situations better. In the past, I drew conclusions very quickly just basing on a few facts. But now, I collect more facts, evidences, judge them carefully before I decide.

Student B reflected in his journal writing on his achievements after the lesson on 'Identifying Relationships and Patterns' (Appendix 1) was taught:

I have learnt to analyze the purpose of doing something, be it a project or a webpage, so I can make the project more effective in its purpose. There won't be irrelevant parts of the projects. Also, no useful parts would be excluded accidentally. Because when doing a project or presentation, we need to know what is essential.

Similarly, after a lesson on 'Formulating Questions', Student A wrote in his journal:

It is actually a useful lesson to help us think critically and properly. I learn how to use the 5Ws and 1H (who, when, why, what, where and how). This technique enables me to arrive at the answers for questions fast. It also enable me to think more deeply into a problem.

It is evident that the students have acquired a satisfactory level of analytical or critical thinking. They have acquired the ability to identify problems and use different strategies to analyze them. However, it is insufficient if they are good at problems identification without working on solutions and evaluating their solutions (Sternberg & Spear-Swerling, 1996). Thus, it is important to know if the students have improved their abilities such as using different thinking skills to generate new ideas and solutions or creative thinking. Statistical results show that the students have achieved creative thinking skills as statements 7 and 8 (see Table 1) have mean scores of 2.02 and 1.77 respectively. The standard deviations of 0.67 and 0.78 confirm that their spread of scores is small and they cluster around ratings of 1 and 2.

There is also a strong correlation between their analytical and creative thinking ability. Looking at Table 2, it is statistically significant at 0.01 level. The correlation is moderate because $(R_{2,7})^2 = 0.26$ or 26%. This means that the acquisition of analytical-critical and

creative thinking skills complemented each other in improving their thinking ability or intelligence.

Table 2 : Correlation between Ability to Analyse Problems & Generate New Ideas

Correlations

		2) Ability to use different strategies to analyze problems	7) Ability to use different skills to generate new ideas
2) Ability to use different strategies to analyze problems	Pearson Correlation	1.000	.510**
	Sig. (2-tailed)	.	.000
	N	103	103
7) Ability to use different skills to generate new ideas	Pearson Correlation	.510**	1.000
	Sig. (2-tailed)	.000	.
	N	103	103

** . Correlation is significant at the 0.01 level (2-tailed).

Through qualitative data such as the focus group interviews, we have further evidence to validate the above findings. Several students expressed that their ability to generate new ideas to solve problems have improved. They were able to apply the various creative thinking skills like SCAMPER, QUESTIONING CONCEPTS and RANDOM WORD to seek breakthroughs in their thinking. This is put forth by two students:

Today, we have learnt to question and challenge concepts. We (the small group discussion) challenge the concepts of a supermarket. We thought of ways to challenge the concept of a cashier, as in instead of human one, we could have robots; instead of always going the cashier to line and pay up we could have a gantry scanner which as you walk through it with your trolley, it immediately scans your good and deducts money form your bank....It has certainly made us think of different ways to change daily concept (Student G's Journal writing).

I think the use of RANDOM WORD has helped me. When I have mental block and I don't know what to do, I try RANDOM WORD. I applied it for my Art Project. We are supposed to do a LOGO design. I had a mental block, I don't know how to design. So I tried RANDOM word technique. I used the word 'TEO' which is my surname. Then my 'TEO' was transformed into a logo of a key for a key company (Student 8, Focus Group Interview Two).

In order to tap into the creative potential, the students have to push beyond the limits of his personal knowledge and abilities. Creative performance definitely requires creative intelligence or skills but more importantly personality attributes such as perseverance or the willingness to overcome obstacles (Sternberg, 1996). Costa (1985: 288) reiterated this observation, 'we are not only interested in how many answers students know but also in knowing how to behave when they do not know' - meaning do they give up when answers to questions/problems are not evident? Student 6 in Interview Three felt strongly that in the course of the Thinking Programme, he has developed this important attribute of perseverance that enhances his thinking:

Before attending the Thinking Programme, I am less creative. When I have no solutions, I give up. Now I persevere by using different methods.

From the quantitative data, the Statement 3 on perseverance has yielded very positive response from the students with a mean of 1.76 and standard deviation of 0.59. Therefore, one can conclude that students have acquired important thinking disposition of persevering in face of the challenge.

It is interesting to find out in this research that often it is because they have improved their ability to generate new ideas, therefore they relish the challenge of thinking of new ideas. This conclusion is validated by the correlation of Statements 7 and 8. It is statistically significant at the 0.01 level. The correlation, shown in Table 3, is moderate with $(R_{7,8})^2 = 0.09$ or 9%.

Table 3 : Correlations between Ability to use Different Skills and Like the Challenge of Thinking

Correlations

		7) Ability to use different skills to generate new ideas	8) Like the Challenge of thinking of new ideas
7) Ability to use different skills to generate new ideas	Pearson Correlation	1.000	.307**
	Sig. (2-tailed)	.	.002
	N	103	103
8) Like the Challenge of thinking of new ideas	Pearson Correlation	.307**	1.000
	Sig. (2-tailed)	.002	.
	N	103	103

** . Correlation is significant at the 0.01 level (2-tailed).

To be a self-regulated thinker, one has to be able to generate new ideas, evaluate their solutions by considering the merits and demerits and monitor their solutions (Sternberg &

Spear-Swerling, 1996). To engage in this higher level of process thinking, the students must first develop thinking dispositions such as meta-cognition and open-mindedness (Costa, 1985).

The quantitative data of this study shows that while students are receptive to new ideas (Statements 5 & 6 with mean scores of 1.69 and 1.83), they may not necessarily be ready to engage in meta-cognitive thinking (Statement 11 with a mean score of 2.23) ; that is to think about their own thinking. A correlation study in Table 4 shows that there is a weak relationship between open-mindedness and meta-cognition because the values of 0.011 shows that there is hardly any strength between the two factors.

Table 4 : Correlations between Open-mindedness and Meta-cognition

Correlations

		5) Listen & respect alternate viewpoints	11) More ready to describe/write down own thinking strategies
5) Listen & respect alternate viewpoints	Pearson Correlation	1.000	.011
	Sig. (2-tailed)	.	.912
	N	103	103
11) More ready to describe/write down own thinking strategies	Pearson Correlation	.011	1.000
	Sig. (2-tailed)	.912	.
	N	103	103

Although there is a weak correlation between open-mindedness and meta-cognition, Table 5 shows that the correlation between evaluation of merit and demerits of ideas and meta-cognition is statistically significant at the level 0.01 because $(R_{6,11})^2 = 0.9$ or 9%. It means that the students' ability to evaluate ideas depends on the development of their meta-cognitive skills. In the Thinking Programme, students are taught and train how to verbalise, structure, write or even draw out their ideas as a result they are able to evaluate different ideas.

Costa (1997) believed that to be receptive to the opinions and ideas of others other than oneself is one of the higher forms of intelligence. This is because students would need to listen so that they could elaborate on the ideas by adding details, explanation, examples or other relevant information from prior knowledge in order to improve understanding. As a result, they are able to consider the merits of or build upon another person's ideas (1997).

Table 5 : Correlation between Evaluation of merits & demerits and Meta-Cognition

Correlations

		6) Evaluate the merits & demerits of new ideas	11) More ready to describe/write down own thinking strategies
6) Evaluate the merits & demerits of new ideas	Pearson Correlation	1.000	.293**
	Sig. (2-tailed)	.	.003
	N	103	103
11) More ready to describe/write down own thinking strategies	Pearson Correlation	.293**	1.000
	Sig. (2-tailed)	.003	.
	N	103	103

** . Correlation is significant at the 0.01 level (2-tailed).

The qualitative data are filled with examples of the increased open-mindedness of the students. The students described themselves as being more 'sensitive' to the feelings of others, able to see things from 'different angles' and able to accept 'crazy' ideas. Such attitudes are important for ideas to grow as they learn to listen, understand different points of views and build on one another's ideas.

In the words of a student, written in his journal, 'I learn to offer ideas and not canceling any of them out.' De Bono (1992) believed that this is important in promoting divergent and creative thinking, subsequently, 'lateral thinking' – a creative thinking skill that encourages the interaction of new ideas with old ones, deferring judgements.

It is also very encouraging to see from the qualitative data that students are not only less afraid to express their thoughts and ideas, they are even less afraid to make mistakes. The two Statements 17 and 18 have means/standard deviation scores of 2.02/0.73 and 2.07/0.77 respectively. This demonstrates that students have not only gained confidence in their own ability to engage in critical and creative thinking but value the process of thinking. By valuing the process, they are willing to take the risk of failing, being laugh at or put down by others. Without taking any risk, they do not realize their full intellectual potential (Sternberg, 1996).

Learning to think, like any form of learning, requires experimentation. However, it is important to build a safe environment. In this context, safe does not mean that students are free from the fear of failures but fear of rejection and ridicule. If students believe the products of their thought processes will be criticized by their peers and teachers, they will refrain from thinking creatively.

Students felt that they are encouraged to think critically and creatively because ‘the teacher accepts any idea which may seem impossible’ and they can ‘express their opinions without being scolded’. In Table 6, the correlation between liking the challenge of thinking and being less afraid to express their thoughts/ideas is statistically significant at 0.01 level. The correlation is moderate because $(R_{8,17})^2 = 0.16$ or 16% of the variance in Statement 8 can be accounted for by the variance in Statement 17.

Table 6 : Correlation between Liking the Challenge of Thinking & Being Less Afraid to Express Thoughts/Ideas

Correlations

		8) Like the Challenge of thinking of new ideas	17) Less afraid to express my thoughts/ideas
8) Like the Challenge of thinking of new ideas	Pearson Correlation	1.000	.387**
	Sig. (2-tailed)	.	.000
	N	103	103
17) Less afraid to express my thoughts/ideas	Pearson Correlation	.387**	1.000
	Sig. (2-tailed)	.000	.
	N	103	103

** . Correlation is significant at the 0.01 level (2-tailed).

Team effort is also an important factor for creating the synergy in motivating and stimulating the students to think creatively. Very often, good creative ideas are generated by members in the group and not just an individual, as they work as a team to integrate, refine, extend on all the suggested ideas. Such an effort to use their knowledge meaningfully often leads to more creative synergy. This was put forth aptly by as student, ‘ I can gain more knowledge when my classmates share their points of views’.

Thinking and learning at a deep level requires active rather than passive learning. In order for the students to internalize the skills so that they can apply them creatively and constructively in real-life situations, the lessons must present them with activities and opportunities to apply the repertoire of skills; not just theories. Students respond enthusiastically to challenging creative problem-solving activities. In the interview, students likened ‘real-life’ situations as ‘hands-on’ problem solving activities.

They described the ‘egg-throwing’ activity as ‘fun’ and ‘challenging’. In the interviews and open-ended questions survey, many students requested for more such hands-on activities to be integrated into the Thinking Programme. A student’s account of his experience in the interview reinforces this point:

I remember better and this activity (egg-throwing) left me a deep impression. The visual and hands-on experience make me think creatively and the skills we learn become more concrete. Because I have gone through them; I know how I got the answer; I implement my ideas. Lots of laughter...I won't forget.

In Table 7, the correlation, which is significant at 0.01 level, shows a moderately strong relationship between applying thinking skills to real-life situations and enjoying problem-solving with $(R_{9, 16})^2 = 0.06$ or 6%. This means that students do enjoy applying thinking skills to real-life problem solving situations.

Table 7 : Correlation between Applying Thinking skills to Real-life situations and Enjoying Problem-solving/Decision-making

Correlations

		9) Enjoy problem-solving/decision making	16) Applying thinking skills to real-life situations
9) Enjoy problem-solving/decision making	Pearson Correlation	1.000	.258**
	Sig. (2-tailed)	.	.008
	N	103	103
16) Applying thinking skills to real-life situations	Pearson Correlation	.258**	1.000
	Sig. (2-tailed)	.008	.
	N	103	103

** . Correlation is significant at the 0.01 level (2-tailed).

What other indicators are there to show that students have become better thinkers? Perkins and Tishman (2000) believed that good thinkers not only able to identify and investigate problems, to probe assumptions, to seek reasons but more importantly to be **reflective**. They are less impulsive, bias and judgemental. A student wrote in the open-ended section:

I found out how "bad" I am at thinking. I realized that I'm quite a biased person, and I only think from my own views which is quite limited.

It is only when students get more reflective, they would be more aware of bias views and be able to detect errors in different situations. But more importantly, thinking reflectively helped students to seek continuous improvements in their lives. This is actually one of the primary aim of Thinking Programme – to nurture life-long learners. In Interview One, student 1 actually discussed and reflected on his recent failure:

When I meet failures now, I think of what I did wrong. I will think if I am given another chance, how I can do it better or improve. Like recently, I didn't do well for my National Cadet Corp shooting session. I reflected on my mistakes... One of the reason is the lack of concentration. Secondly, I placed my sandbags too high and I didn't ask for help to move them. Third – bad positioning. My elbows didn't touch the ground so I didn't get a good support.

Another student wrote about his reflection on the terrorist attack of the World Trade Center, New York in September 11:

I stop making wild accusation against the Arabs and Muslims. I learnt to look at the WTC incident at different points or perspectives. This allows me to understand the problems of different countries before arriving at any conclusion.

Decreased impulsivity is another indicator of intellectual growth (Costa, 1997). From the interviews and open-ended survey questions, several students discussed how the Thinking Programme has helped to restrain their impulsivity in situations that would normally infuriate them and cause them to act rashly. Therefore, engagement in reflective thinking has not only reduced impulsivity but also help in their emotional maturity. It has actually helped them to conduct themselves more effectively with their peers as seen in the following account:

Thinking Programme has made me understand myself better. When people criticise me, I will think and find out if I'm wrong or my friend is wrong. I will reflect. (Can you give me example?) Last week, I got into a heated argument with my classmate. He blamed for spoiling the fun of the basketball game...for being too domineering. Instead of getting really angry and fought with him, I walked away. (So who's fault?) I went home and think...pause...it's my fault. I played too rough.

By going through Costa's 10 indicators of intellectual growth, the evidences from the three accounts show that the students have become better thinkers, as they become less impulsive and bias and consequently, more emotionally matured and reflective too.

The research is also interested in finding out in what ways the students have applied the skills in their academic learning. Through the interviews, the students felt that the Thinking Programme has helped them in their academic studies especially in their project works. But interestingly, one of students responded, 'Thinking is for everyday life not just for my study. But I am more reflective now. I think a lot more for subjects like Literature and Social Studies'. The students felt that Thinking skills have helped them not only in memorizing and organizing facts but also generate new ideas for writing. Some learned to check for accuracy thus making less careless mistakes in their answers.

There is no doubt that students applied thinking skill in the academic studies and have extended them beyond the content-subject such as in project works and debate. In one of the interview, a student accounted how he and his debating team-mates use the skill of formulating questions to anticipate the kind of questions the opposition and audience would ask, so that they would not be caught off-guard. Statistically, there is strong evidence to support the above qualitative data. A correlation of Statements 1 and 14 is shown in Table 8.

Indeed, there is quite a strong agreement of 0.339 between focusing issues/problems and probing by asking more specific questions. This means that $(R_{1,14})^2 = 0.1$ or 10% of the variance in Statement 1 can be accounted for by the variance in Statement 14. This validates the student's response that the skill of formulating questions has been adequately honed and that in their learning to ask correct and specific questions, they have transferred this understanding to anticipating the types of questions that would be asked of them.

Table 8: Correlation between focusing on issues/problems and more asking more specific questions

Correlations

		1) How to focus issues/problems by asking the right questions	14) Probe by asking more specific questions
1) How to focus issues/problems by asking the right questions	Pearson Correlation	1.000	.339**
	Sig. (2-tailed)	.	.000
	N	103	103
14) Probe by asking more specific questions	Pearson Correlation	.339**	1.000
	Sig. (2-tailed)	.000	.
	N	103	103

** . Correlation is significant at the 0.01 level (2-tailed).

8. Significance of the Study

The research shows that the thinking skills acquired through the Thinking Programme are actually applied in their real-life situations. Such 'practical' thinking which Sternberg discussed in 'Teaching for Thinking' (1996) involves the art of transfer. It is important to observe such a phenomenon as it shows that something learned in one situation is carried over to another (Perkins & Salomon, 1992). In this case, the transfer of thinking skills has taken place. The students have internalized and applied the skills in their various endeavours.

This research shows that the application of thinking skills have been transferred to the students beyond the classroom boundaries into their personal and social lives. Such transfer to new situations is not easy and it does not happen on its own; it requires the mindful abstraction of a principle, the effortful search in one's memory, the selection of appropriate principle, and, finally its application to a new instance (Perkins & Salomon, 1992: 205). Therefore, it is not only achieving practical thinking but **constructive** thinking. Constructive

thinking is achieved when both critical and creative thinking are applied as the building blocks to achieve life goals successfully in the different areas of endeavour (see Figure 1).

Figure 1: Model of Constructive Thinking



In order for internalization and application to take place, the thinking class must be student-centered and have more challenging hands-on activities so as to improve practical thinking. Therefore, the day-to-day perplexing situations, real life problems are good examples to stimulate the brain to think and imagine possible solutions. Even the late philosopher, Dewey, believed that unless the learner had struggled personally with the issue, the information was likely to be committed to memory in a rather lifeless or mechanical way (Tishman & Perkins, 1995). Unless the pupil has an opportunity to use the thinking skills in problem-solving and decision-making, it would be sterile; information severed from thoughtful rumination is a dead, mind-crushing load. It is only then that the students are truly empowered to think, to **construct** new values and meanings in their lives.

9. Limitations

There are some limitations in this research. One of the limitations is sample size of the survey. Not all Secondary One students will be involved in the questionnaire due to the constraint of time and resources. Only three classes or one-third of the secondary one cohort students are involved in the study. Therefore, the evaluation of the effects and outcome of the Thinking Programme are limited to the three classes taught by the same teacher. It is not representative of the entire Secondary One in The Chinese High School.

Due to the small and homogeneous sample size, the correlations that have been illustrated in many cases also appear weak or low in the interpretation. The correlation of variables also does not imply causation. It is to give support and logical explanations to the qualitative data. Hence, the correlation is used to as the first stage of evaluating the effect of the Thinking Programme on the students' critical and creative intelligence.

The use of two groups, one being the target group for study and the other the control group, is not implemented. In this study, there is only one group, the target group that is taught the Thinking Programme. No control group is set up. In fact, the best way of seeing whether the Thinking Programme affects the students' critical and creative levels is to see how these levels for a group of students change after being taught the skills, and compare it to the change in the group that has **not** undergone the programme. This could not have been done because all the participants come from the same school and it is mandatory for all Secondary One students in the school to undergo the Thinking Programme simultaneously from the start of the semester.

Therefore, without an experimental and a control group, no comparison can be done. It is thus difficult to conclude that their improvement in thinking abilities was affected solely by the programme and not by other factors like their differences in attitudes.

There is also no pre-test given to the participants at the start of the Semester in January. Therefore, it is not possible to compare or detect any changes in the students' critical or creative thinking ability before and after they have gone through programme. The research data is collected from only one evaluation that is carried out in October at the end of programme.

10. Delimitations

The study only includes the pupils in the main stream programme and not the GEP (Gifted Education Programme) pupils in The Chinese High School. The research does not take into account the Secondary Two, Three and Four.

It is also important to note that this study does not seek to examine the relationship of the thinking programme and the academic performance of the pupils.

Any assessment of student performance in thinking must also include assessment of school culture, teachers and classroom conditions. However, these imperative factors are not included in this research paper. This aspect of monitoring the 'intellectual ecology', as what Costa and Kallick (1992) described, is important. It is to insure that intellectual growth for all participants does not become 'endangered' (1992:280). This will provide scope for future studies.

Moreover, the data are derived directly from the students' feedback without additional observation conducted by the researcher to verify the accuracy of the statements made in the open-ended questions and the focus group interviews. As such, future studies could see a video-taping of the students' interaction and behaviour during a thinking lesson as well as direct observation by the teacher.

11. Conclusion

In this research, many characteristics of a good thinker are mentioned. They are not characteristics measured by conventional intelligence tests. But we must not lose sight of what matters most: the balance combination of critical, creative and constructive thinking skills that will bring about inventiveness and innovation. The explicit teaching of thinking skills has brought about positive change in the students' thinking dispositions and intellectual characteristics. The students have acquired the *ability* to think and most important the *inclination* to think. In another word, they are motivated thinkers who like the challenge to think 'out of the box'.

For many years, educators thought that thinking skills programmes were intended to challenge the intellectually gifted. Some even thought that any child whose IQ falls below a certain static score would forever render him or her doomed to remedial or compensatory drill and practice. Thus, it is essential for educators to change such mindset to accept that all students have the ability, talent and most importantly, capacity to think. It is to have the faith that all students can engage not only in critical, creative thinking but constructive thinking.

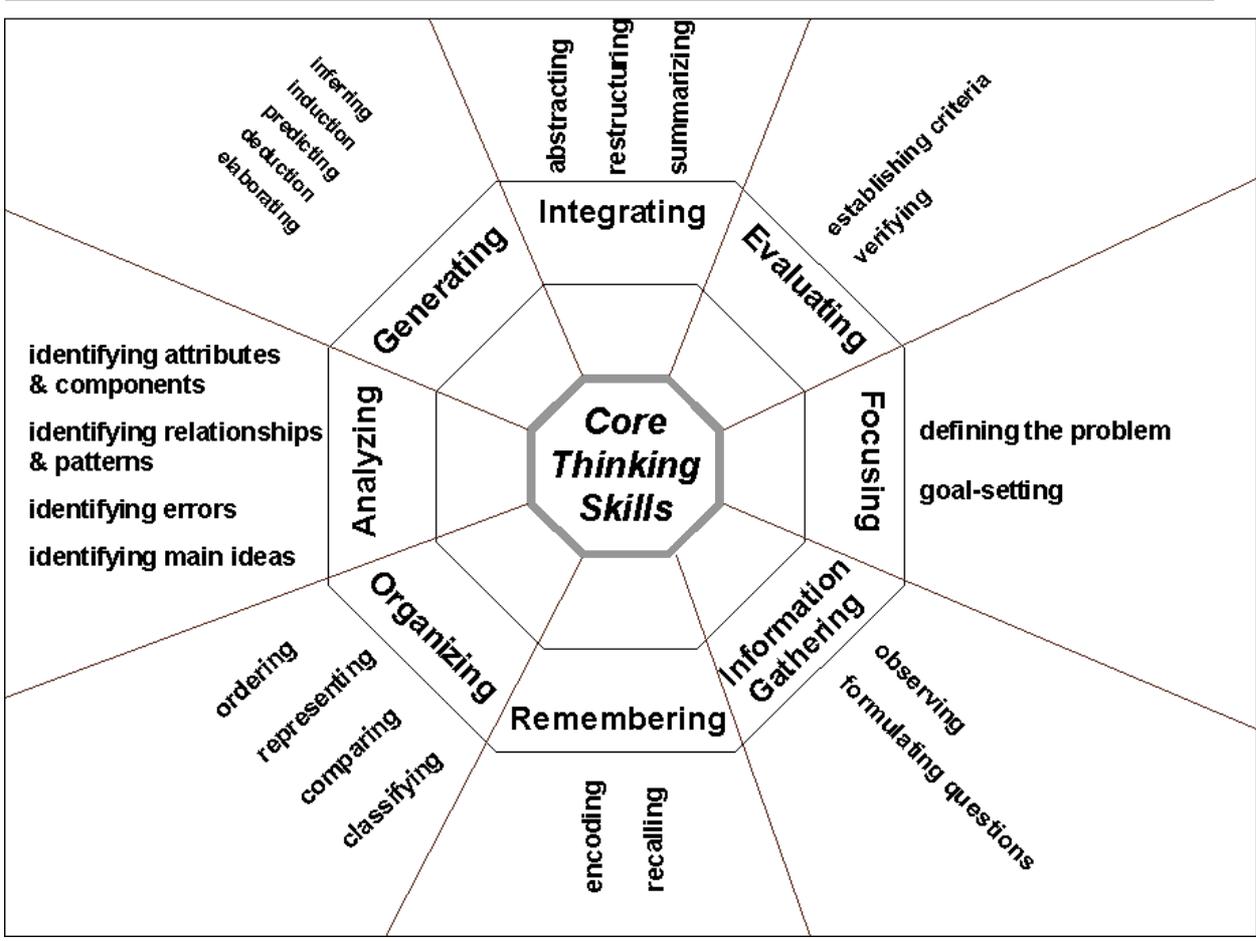
The research has shown that critical thinking and creativity can be learned through proper 'programming' of the mind that will eventually lead to more good constructive thinking or 'breakthrough insight'. Good thinking can improve intelligence and intelligence is not a static reality that is fixed at birth. It is dynamic, ever-growing, changing reality throughout one's life.

Successful intelligence is not an accident; it can be nurtured and developed in schools by providing students with curricula that will challenge their thinking (Sternberg, 1996).

The teaching of explicit thinking skills is essentially what the great philosopher and educationist John Dewey believed in. It is the method and not merely the content that should take primacy in education. Activities that engage the pupils to discuss and communicate their ideas and thought are important to make them think more reflectively. For Dewey, the practical application of knowledge was not just an end but a means to the end of learning the disciplines. Therefore, thinking skills taught to the pupil will enhance their learning and capacity to think critically, creatively and constructively. This is contrary to what some critics believed that creativity cannot be taught. Only if ample opportunities are given to them to explore with instructional strategies based on an organizational framework, creativity, originality of thought and inventiveness can be taught and learned. It is this kind of intelligence that the students need to develop that will be the most valuable and rewarding in the real world after school.

Appendix 1

Marzano's Eight Core Thinking Skills



A Self-Reflection on Your Thinking & The Thinking Programme

Name: _____ ()

Class: _____

Please indicate by ticking the box the extent to which you agree or disagree with each statement regarding the Thinking Programme.

SA = Strongly Agree A= Agree

DA=Disagree SD = Strongly Disagree

		SA	A	DA	SD
1	I learned how to focus on issues/problems by asking the right questions.				
2	I improved my ability to use different strategies to problems.				
3	I do not give up easily and learn to persevere when answers to issues/problems are not evident.				
4	I become less impulsive by taking my time to reflect on answers before giving them.				
5	I learn to listen and respect alternate viewpoints.				
6	I am able to evaluate the merits and demerits of new ideas.				
7	I improve my ability to use different thinking skills to generate new ideas/solutions.				
8	I like the challenge of thinking of new ideas.				
9	I enjoy problem-solving/decision-making.				
10	I improve my ability to detect errors/bias.				
11	I am more ready to describe/draw/write down my own thinking strategies.				
12	In the course, I learn about my own strength and weaknesses by reflecting on my actions.				
13	I am more aware of things around me and ask more questions				

	so as to understand something better.				
14	I learn to probe by asking more specific questions.				
15	The thinking skills that I learn have helped me in my academic learning.				
16	I apply the thinking skills learned in class to real-life situations.				
17	I am less afraid to express my thoughts/ideas.				
18	I am less afraid to make mistakes.				

19. What do you like about the Thinking Programme?

20. What do you think can be improved?

Appendix 3

Focus Group Interview Questions

1. Do you think that you have benefited from the Thinking Programme?
2. Why do you find the programme beneficial/not beneficial?
3. Are there any thinking skills you have acquired which you find most helpful?
4. Do you consciously apply some of the thinking skills? If yes/no why?
5. Do you think that the Thinking Programme is helpful in improving your academics?
6. Do you think you have become a better thinker after attending the programme? If yes, how? No, why?
7. Do you think thinking lessons are challenging? If yes/no, why?

Focus Group Interview One

Date : 29 October 2001

Time: 2.30 pm

7 Students

Student 1 Student 2 Student 3 Student 4

Student 5 Student 6 Student 7

Q1. Do you think that you have benefited from the Thinking Program?

All answered 'yes' unanimously.

Q2. Why do you find programme beneficial/not beneficial?

S7: I learn how to generate more new and creative ideas much faster than before. I can think more effectively. I do not jump to conclusions. My mind works more systematically because the skills help me to 'sort' my thinking, ideas out.

S1: Now, I know how I am thinking. Much more aware of the skills I apply to my thinking. I know what are the best methods to help me.

S4: As for me, thinking skills help me to analyze things and situations better. In the past, I drew conclusions very quickly just basing on a few facts. But now, I collect more facts, evidences, judge them carefully before I decide.

S5: I have clearer ideas of what I am thinking. Example, I think of consequences of my things and my actions. I learn to check for accuracy.

S6: I won't be stunned or feel lost when I encountered problems. Because now I am able to generate new ideas to overcome my problems.

Example for my project works. I was facing time constrains and was pretty difficult but I was able to use SCAMPER and I managed to accomplish it.

S7: I think more systematically. Won't jump to conclusion and I am able to resist thinking and acting on impulse. I will look for the best solutions.

Q3. Are there any thinking skills you have acquired which you find most helpful?

S1: Decision-making

Lately, exam is coming. I decide when and what to study and revise first. I learn how to prioritize, allocate the number of days for each subject.

S2: Detecting Bias and errors

How to detect bias and to check for reliability of sources and materials I am reading.

E.g. With this skill in my mind when I read the articles about the terrorist attack on America I am able to detect if the writer is pro or against America.

S3: SCAMPER

I look around and see difficulties and inconveniences. I observe my surrounding more carefully. I use SCAMPER trying to solve these inconveniences or difficulties.

I am thinking how wonderful if these new improvements can be introduced. E.g. adding on a dustpan and deodorizer to our classroom's dustbin.

Q4. Do you consciously apply some of the thinking skills/behaviour? Can you give an example.

S4: When I am in a conflict, quarrel or argument with family members or friends, I can now trace back to the root cause. I pause and think why I am caught in this situation? And why? I am more reflective and aware. Could I have made a mistake? I am more reflective of my mistakes.

S5: Restraining Impulsivity

For example, the recent terrorist attack on America. I stop making wild accusation against the Arabs or Muslims.

S6: Yes I agree. I do not jumping to conclusion easily now and I check for bias in my views. I less prone of saying 'this must be right' and 'that must be wrong'. I am more careful before I judge or jump to conclusion. I ruled less by my feelings too.

S7: I make better decision now. I will think of the different factors and its criteria. E.g. today's lesson. You gave us the activity on dropping an egg without breaking it. I came up with lots of ideas but I learn to choose the best solution. Our team won. We didn't break the egg.

S1: When I meet failures now, I think of what I did wrong. I will think if I am given another chance, how I can do it better or improve. Like recently, I didn't do well for my NCC shooting. **I reflected on my mistakes.** What are the mistakes?? One of it is lack of

concentration. Secondly, I placed my sandbags too high. Third – bad positioning. My elbows didn't touch the ground so I didn't get a good support.

S4: Yes definitely even in our English debate. We use the skill of formulating questions to anticipate what kind of questions the audience will ask during Q&A, so that we will not be caught. And we came up with lots of questions we think our opposition will attack us as 'point of information' during the debate.

Actually, Thinking programme also taught me how to 'lie' better. For projects day judging, my project wasn't totally fabulous. Before I present to the judges, I thought of all possible questions they will ask me about the projects. So I worked them out mentally. And I pulled through.

Q5. Do you think that the Thinking Programme is helpful in improving your academics?

S1: Yes, especially for my social studies. When I study for test and this coming exam, I constantly generate questions to ask myself. If I am able to answer the questions myself that means I understand the fact.

S3: I agree too. I use the 5 wives and 1 husband (what, why, when, who, where and how) to remember content and notes. It really helps me to remember facts so much better. It triggers off my memory when I use it to recall my facts.

S7: I learn to check for accuracy so now I make less careless mistakes in my English composition. My grades improve because there are less grammar and spelling mistakes.

S2: I have more ideas for English compo now because I learn how to generate new ideas through brain-storming and random-trigger. The story I write is less boring now.

S6: I am exempted from Science exam this year because my science has improved. How? I am less careless, less impulsive. Last time, before I finished reading the whole question I will start writing. Now I read the whole question before I start to answer.

Q6. Do you think if have become a better thinker after attending the programme?

All answered: Yes. definitely.

S3: I see myself making better decision. I have the urge to buy and trade magic cards. I love to play them. With exam coming, now I shaft all my cards in the drawers and locked them all up.

S4: I like to buy CD but very expensive. I went to J.B. (Johore Bahru, Malaysia) last weekend and I saw so many of my favourite CDs. But they are all pirated. So tempted to buy. In the end, I didn't. I went to a proper shop to buy original. Just not worth taking the risk.

S2: Oh yes. Decision-making skills help me a lot. To play computer games or to study. I can actually think of all the bad consequences if I play too much computer games and not study. I can 'visualize' the scenarios of those nasty consequences.

Q7. Do you think thinking lessons are challenging? If yes/no, why?

ALL: Most of the time.

S1: It is not challenging when there's little activity or opportunity for application. Worksheets are not enough. We need more real life incidents that make us think. I like it when articles and bias statements regarding the terrorist attack in America are brought up for us to think. It would be great if there are more hands-on activity.

S2: I like the egg experiment. Very fun. I enjoyed doing SCAMPER too when you asked us to create a new type of dustbin.

S3: I think so too. Very challenging. Sometimes, your ideas are creative but not practical; practical but not very creative. We have to think deep in order to present the best ideas to the class.

S7: I particularly enjoy the Induction and Deduction class. You taught these skills by asking us to solve a murder crime scene. I like this kind of case studies.

S4: Quite challenging. The one I think it challenged me is the one we did role play and I am asked to be real estate developer to build condominiums without cutting down trees. But I think it can be improved if some other skills are taught to us too. Example? What skills?

Skills that helps to increase memory power, help us to memorize things faster and better. E.g. mind mapping and mnemonics.

Focus Group Interview Two

Date: 30 October 2001

Time: 3.00pm

Students

Student 1 Student 2 Student 3

Student 4 Student 5 Student 6

Student 7 Student 8 Student 9

Q1. Do you think that you have benefited from the Thinking Program?

- Most answered 'yes' confidently.
- Of course
- Very sure
- Definitely

Q2. Why do you find programme beneficial?

General Comments:

I enjoy very much. There's no stress in learning for Thinking lessons.

I learn how to organize my ideas.

It is very interesting

I use the skills to improve other subjects I'm studying

It's very interactive, I get to share and present my ideas and knowledge in class

I learn new ways to solve problems

I am able to think more systematically

Q3. Are there any thinking skills you have acquired which you find most helpful?

S2: I find that thinking is very helpful for my Social Studies. Like learning how to categorize and listing out the facts. I produce better answers because I'm more organized.

S3: TP provides me with new alternatives to solve problems. It taught me to more open-minded. I apply my TP skills in my EP3. I am in the Rugby team. And the team members come from different class and levels and we used to have problems communicating and getting messages to one another. So I thought of the messenger buddy system. It functions like a cell group and we use different methods to communicate. Sometimes, it's difficult to reach members on the phone. So we used the internet electronic board, discussion groups.

S5: TP has made me understand myself better. When people criticize me, I will think and find out if I'm wrong or my friend is wrong. I will reflect. **Can you give me an example?** Last week, I got into a heated argument with my classmate. Arthur blamed me for spoiling the fun of the basketball game. Blame me for being too domineering. Instead of getting angry and fought with him, I walked away. **So who's fault?** I went home and think...it's my fault. I played too rough.

Q4. Do you consciously apply some of the thinking skills/behaviour? Can you give an example.

S7: I use it for my social studies especially in answering structured questions. I use the skill 'Part & Whole', I learn to prioritize by stating the most important things first. My answers are more organized, more complete and I got higher grades now.

S3: I apply thinking skills in playing computer game. You know there is this website known as cyki.com. I learn how to play shares and earn money on-line. Then with the money you can "buy" players to form your personal "football" team. So far, I have about 70 million pounds. **How is this game need you to apply thinking skills?** I need to "research" by asking a lot of questions whether my investment is sound. It doesn't mean buying cheap stock will guarantee a profit. There are many decisions to make.

Q6. Do you think if you have become a better thinker after attending the programme?

S5: I understand myself better. **How?** When other people criticize or compliment me, I will think through to see if it is true or false.

S9: I make more effective decision. I will find out the good and bad points. My mind is more discipline and won't stray away for too long because I will keep the whole picture in my mind. I check also to see if my decision is bias.

S3: Yes, I spend more time finding out information before I make decision. It very vital. **Why? Any e.g?** I play stocks in this new game "Neopets" and earn more neo-cash. If I don't make the right decision, I will lose everything.

I plan and organize better now because when I set myself something to do, I will find ways to do it systematically. I'm also more open-minded now. I listen more before I make decision.

S6: When I was in primary school, I can't think of many ideas. I took a long time to think. In discussion, I don't contribute much. Now I am able to contribute more ideas and discuss them with my group. **Why can you contribute more ideas now?** My brain is more open. Thinking skills help me to think of more possibilities. E.g. SCAMPER, Formulating Questions and Generating Possibilities, they are all very helpful.

S8: I think the use of RANDOM WORD has helped me. When I have mental block and I don't know what to do, I try RANDOM WORD. **Any example?** Recently, I apply this skill for my Art Project. We are supposed to do a LOGO design. I had mental block, I don't know how to design. So I tried the Random word technique. I used the word 'TEO' which is my surname. Then my 'TEO' was transformed into a key logo for a key company.

S1: I turned useless things to useful things. For my project, I use a piece of junk wood as the handle for my cap-turner. I learn to see value in junk.

Q7. Do you think thinking lessons are challenging? If yes/no, why?

S6: Yes it allows my imagination to go wild. It's really fun to do those activities. They made me think of things that I never thought of.

S4: I see it as Practical Fun. You need to use your brain and hands. Especially when you ask us to do the egg throwing activity, different groups came up with different ideas. I love forward to seeing the results whether my egg will be broken.

S1: In thinking lessons, very often the results and answers are unknown and we have to think and look for the answers. It's like making the impossible, possible. It's special.

S7: I remember better and the activities left me deep impression. The visual and hands-on experience make me think creatively and the skills we learn becomes more concrete. Because I have gone through them; I know how I got the answer; I implement my ideas. Lots of laugh, I won't forget.

Focus Group Interview Three

Date: 31 October 2001

Time: 2.30pm

6 students

Student 1 Student 2 Student 3 Student 4

Student 5 Student 6

Q1. Do you think that you have benefited from the Thinking Programme?

- All six students found it useful.
- Special mention of certain thinking skills like SCAMPERS, Six Thinking Hats.

S5: TP is good because it helps in developing my decision-making skills. I find that my thinking is more procedural. My thinking is less messy.

Q2. Why do you find programme beneficial/not beneficial?

S4: Before the programme, I used to think and act quickly but now I am less impulsive. I will think of the pros and cons. I understand what is bias thinking. I am more aware of my thinking.

S6: It's especially beneficial for my projects work, specifically SCAMPERS. It helps me to think of better ideas, designs and solutions to problems.

S1: Before I attended the thinking programme, I 'anyhow think', it's very disorganized. And my decision and thinking is ruled my feelings or what you called RED hat.

Q3. Are there any thinking skills you have acquired which you find most helpful?

S2: Yes, I learn not to eliminate ideas that comes to my mind or suggested to me. I am able to use and see other people's points.

S5: Yes, I can understand the world more. I can understand the difficulties.

S1: I feel that thinking skills have to be applied together and not use just one. Each is special. Like a sportscar, you need to combine all the good properties.

Q4. Do you consciously apply some of the thinking skills? Can you give an example?

S4: Sometimes yes, sometimes no. If I am caught in dilemma. E.g. Should I stay in school to play or go back and do homework. I will apply my decision making skills. I will have to see if there are test tomorrow? Is the game short or long? I will weigh the pros and cons.

S5: Yes, I used it in my daily lives. Recently, I have got English homework to complete but I really want to go out and play computer games and I think of the consequences if I did not complete my homework.

S6: I started to learn computer programming and I find that my thinking skills help me deduce my problems e.g. looking out for errors in my coding. And to conclude what went wrong in the process.

S2: I really like the decision-making skill. I broke my arm because of Rugby and my parents want me to quit Rugby and choose a new EP3. After going through some decision-making procedures like using the different thinking hats, I decide to hang on.

Q5. Do you think that the Thinking Programme is helpful in improving your academics?

S5: Thinking is for everyday life not just for my study. But I am more reflective now. E.g. I think a lot more for my Literature, English and Social Studies. I want to push myself to explore more possibilities.

Q6. Do you think if have become a better thinker after attending the programme?

S2: Yes, I think I have become a better thinker. My point of views are much wider now. I learn to be more empathetic. I know and understand how a person is feeling. I also get more ideas for my projects and homework.

S4: Yes, I learn not to eliminate ideas which may seem very stupid and lousy at first.

S5: Yes, I feel the same way too. Last time when I read or study, I just see a mass of information in front of me. Thinking skills helps me to classify and organize the information I read or study. As a result, I get good ideas from there too.

S3: Yes. I am now more systematic. I can now answer questions step by step. Points do not jump around.

S6: Yes. I can generate a lot more ideas now. Before attending the Thinking Programme, I am less creative. When I have no solutions, I give up. In the Thinking Programme, I learn skills and I used them to try to solve my problems. I persevere more by using different methods to solve my problems.

S1: Slightly better. At least , I am more aware of my line of thinking. I learn different methods to solve problems and to find solutions.

Q6. Do you think thinking lessons are challenging? If yes/no, why?

S1: Sometimes yes, sometimes no. I like certain lessons. E.g. the

one on decision making. We have to decide and find solutions how not to cut down the heritage trees and yet continue to build the condominiums.

S6: I like certain lessons more than other too. I find SCAMPERS very helpful and challenging.