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# COMPARING PERFORMANCE ASSESSMENT, CLASSROOM PRACTICES AND STUDENTS' / TEACHERS' ATTITUDES IN SIX COUNTRIES

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**Abstract:** There is a need to see how effective students are provided with an education in science in Singapore vis-à-vis other countries. This is because there has been emphases on technological entrepreneurship and a populace well-entrenched with science by the government. The quality of science education in schools will provide the platform in ensuring manpower needs of the country. The Third International Mathematics and Science Study (TIMSS) provides the opportunity to compare Singapore with five other countries, namely, England, United States, Switzerland, Hong Kong and Israel. This study compares the achievement of the countries in five science performance assessment tasks of the TIMSS and found that Singapore and England topped in the overall average. Hong Kong and United States scored below international average. The study also observed differences in attitudes and classroom practices that reflect the influence of eastern and western pedagogy. These differences such as emphasis on project or memorising of procedures will have implication to teaching if science.

## Introduction

In the recent Third International Mathematics and Science Study (TIMSS) carried out between end 1994 to mid 1995, Singapore topped in the Science assessment for Population 2 (age 13 to 14). However, there has also been criticism on multiple-choice formats and pigeonholing effect in test scores (Welch, 1995). Also, some think that this is due to rote learning. This view may not be true since Singapore also came out tops the performance assessment component of TIMSS. Performance assessment is viewed as involving higher level thinking than just recalling (Harmon *et al.*, 1997; Dalton et al., 1994; and Vygotsky, 1978).

This paper compares the data from the Singapore cohort with those of five other countries. The study examined 3 countries from the west (United States, England and Switzerland), 2 countries from the east (Singapore and Hong Kong), and one from the Middle East (Israel). This paper discusses the different outcomes obtained in each country for (1) the performance assessment and (2) the perceptions conveyed through the survey questionnaires of TIMSS.

The purpose of this study is firstly to compare achievement of the six groups of students. Secondly, it is to compare the practices during classroom lessons and

practical lessons. Thirdly, to compare the students' and teachers' attitudes toward science education.

Specifically, the aims of the study are:

1. To compare achievement in performance assessment (science) of students in Singapore, Israel, Hong Kong, U.S., Switzerland and England.
2. To compare the science classroom practices in the six countries.
3. To compare the attitude of teachers and students towards effective learning of science in the six countries.

## Findings

The achievement of the students were marked and coded. The performance was presented as percentage of score achieved by the student to the maximum points available for that item. A country's average percentage was the average of the percentage score of the students.

Students of Singapore were top scorers in three out of the five science tasks given. England had done well too with their students coming out top in two tasks. The countries, in order of increasing achievement for each task were:

Magnet Task: US < Hong Kong = Israel < Singapore < Switzerland < England

Pulse Task: US < Switzerland < Hong Kong < England < Singapore < Israel

Rubber Task: Hong Kong = US < Switzerland < Israel < England < Singapore

Batteries Task: US < Hong Kong < Israel < Switzerland < England < Singapore

Solution Task: Hong Kong < US < Switzerland < Israel < Singapore = England

The overall average score for the five tasks was computed. The countries placed in an increasing order overall average achievement of the five tasks were:

Overall average: US = Hong Kong < Switzerland < Israel < England < Singapore.

Of the six countries, Hong Kong and United States overall average achievements fell below international overall average achievement.

## Teachers' Perception

Teachers were asked about their perception concerning what would be essential in doing well in science.

The set of questions was concerned about the teachers' attitudes on what were important in learning science. The first question examined was "To be good in science how important is it to remember formulas and procedures?". Of the 6 countries, 33.4% of Switzerland's teachers and 31.6% of Israel's teachers felt that it is not important. In contrast the other countries studied had more than 80% responding that

they felt that it was somewhat or very important (Fig.1). Arranged in the order of increasing importance in remembering formulas and procedures, the countries were:

Switzerland < Israel < US < Hong Kong < England < Singapore.

37.5% of Singapore's teachers thought that it was very important, compared to the England's teachers (27.3%). This correlated with 86.9% of Singapore students who said that it was important to remember textbook and notes (Fig. 7). However, in England, 92.5% of the teachers felt that it was either somewhat or very important, only 56.0% of the students thought it was not important to remember textbook or notes.

Next level of learning science would be "understanding". On the question "To be good in science how important is it to understand scientific concept?" A high 97.2% of Singapore teachers thought that it was very important and none of the teachers thought it was not important (Fig. 2). On the other end, only 41.5% of Switzerland's teachers thought that it was very important and 9.4% thought that it was not important to understand scientific concept. Arranged in the order of increasing importance in understanding scientific concept, the countries were:

Switzerland < Israel < Hong Kong < US < England < Singapore.

Another question that was asked to reflect the focus on understanding was "To be good in science how important is it to be able to provide reasons to support solutions?" Agreeing that it was important would imply that the teacher expected students to be able to understand and apply scientific concept to solve scientific problems. Regarding this statement, the countries, placed according to increasing importance (see Fig.3) on the statement were:

Switzerland < Israel < Hong Kong < Singapore < England < US.

It was interesting to note that both Switzerland and Israel had the same position on the two questions related to understanding scientific concept.

The question "To be good in science how important is it to think in a sequential and procedural manner?" aimed to assess teachers' attitude on the importance of logical thinking. Interestingly, all except Israel said that it was very important to think sequentially (Fig. 4). Only 31.4% of the teachers in Israel thought that it was very important and 65.4% indicated it as somewhat important, compared to the other five countries, where more than 70% of the teachers said it was very important. The countries, arranged in the order of increasing importance in thinking sequentially, were:

Israel < Hong Kong < England < Switzerland < US < Singapore.

How did the teachers view the relationship between creativity and doing well in science? Most of the countries' teachers felt that it was important to be creative. Arranged in the order of increasing importance in thinking creatively (see Fig. 5), the countries were:

Switzerland < Israel < Hong Kong < US < England < Singapore.

## Students' attitudes

The students' attitudes on what were essential to do well in science were examined. Students were asked if they strongly agree, agree, disagree or strongly disagree with the statement "To do well in science you need lots of hard work at home". Most of the students agreed or strongly agreed with the statement (Fig. 6). However, a significantly high 24.6% of Switzerland students disagreed or strongly disagreed with the statement. Only 28.8% of Switzerland's students strongly agreed with the statement compared with the other countries where more than half of the students strongly agreed that they need to work hard at home. Based on the mean score (where 4 being strongly agree and 1 being strongly disagree) the countries, in increasing positive attitudes towards working hard at home were:

Switzerland < US < England < Hong Kong < Singapore = Israel.

On their attitudes towards memorising textbook and notes, a much higher percentage of students from the Asia, namely Singapore and Hong Kong agreed more readily with the statement "To do well in science you need to memorise the textbook and notes" when compared to the other countries (Fig. 7). The countries arranged in an increasing order where students agreed with the statement were:

Israel < England < Switzerland < US < Hong Kong < Singapore.

## Classroom Practices

On classroom practices, two questions directed to the students were studied. The first question was "How often does the teacher show how to do science problem in lesson?" More than 80% of Singapore's and Hong Kong's students said that their teachers showed how to do science problem during class lessons pretty often or almost always (Fig. 8). This was much higher when compared to the other four countries where the average percentage of students who said that it was pretty often or almost always was 58.5%. This seemed to agree with Ong (1999) who said that eastern countries tend to be more teacher-centred. In order of increasing frequency of demonstrating problem-solving, the countries were:

Israel < England < Switzerland < US < Hong Kong < Singapore.

In terms of science project, each country had very different emphasis. The difference might be observed where 35.9% of Israel's students said that they *never* had project work, while only 6.5% of Singapore's students said so. The teachers in United States were most frequent in giving project work. In increasing order of frequency, the countries were:

Israel < Hong Kong < Singapore < Switzerland < England < US.

The western countries showed strong preference in giving project work.

In terms of classroom practice during experiment, the statement "Give students prescriptive directions for doing science experiments" was directed to the teachers. A high 94.6% of Hong Kong's teachers either agreed or strongly agreed with the statement. Based on teachers' response of either agree or strongly agree that they gave prescriptive directions, in increasing percentage, the countries were:

Switzerland < England < US < Singapore < Israel < Hong Kong.

## Discussion

From the achievement scores, Singapore had performed well in the performance assessment. This was consistent with the written component of TIMSS. United States and Hong Kong did not do well in all the tasks.

The effect of eastern and western pedagogy could be observed from the survey done on the attitudes of teachers and students, and the classroom practices. Students and teachers from the east, namely Singapore and Hong Kong had the idea that to do well in science, one must memorise formulas, procedures, textbook and notes. This could be due to the emphasis in eastern pedagogy, where recitation and imitation were emphasised (Ong, 1999). The teacher-centred pedagogy of the east also affected classroom practices where Singapore's and Hong Kong's teachers frequently demonstrated how to solve science problem and provided prescriptive instructions during science practical lessons. In contrast, the western pedagogy stressed on student-centredness, and speculation, experimentation and innovation (Ong, 1999). This could be observed where the western countries' (United States, England and Switzerland) teachers preferred to have project work for lessons. However, it would be too premature to be conclusive of how these differences affect the achievement of the students in the performance assessment.

Singapore's teachers viewed that to do well in science, students need to learn at different levels of Bloom's learning taxonomy like knowledge (memorising), comprehension (understand concept), application (provide reasons), and synthesis (creativity). Switzerland represented the other end of the continuum where the teachers thought that not all levels of thinking were necessary to do well in science. There might be some relationship between the teachers' attitudes toward doing well in science and the students' attitudes on working hard at home. These findings seem to imply that teachers and students of Switzerland hold the view that learning of science was not complicated but rather simple.

Finally, TIMSS offered many more potential conclusions to understand how these differences and similarities contributed to the achievement or success in the performance assessment tasks. A further step would be to look into the other questions asked to identify the cause and effect of these differences and similarities.

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**Appendices**

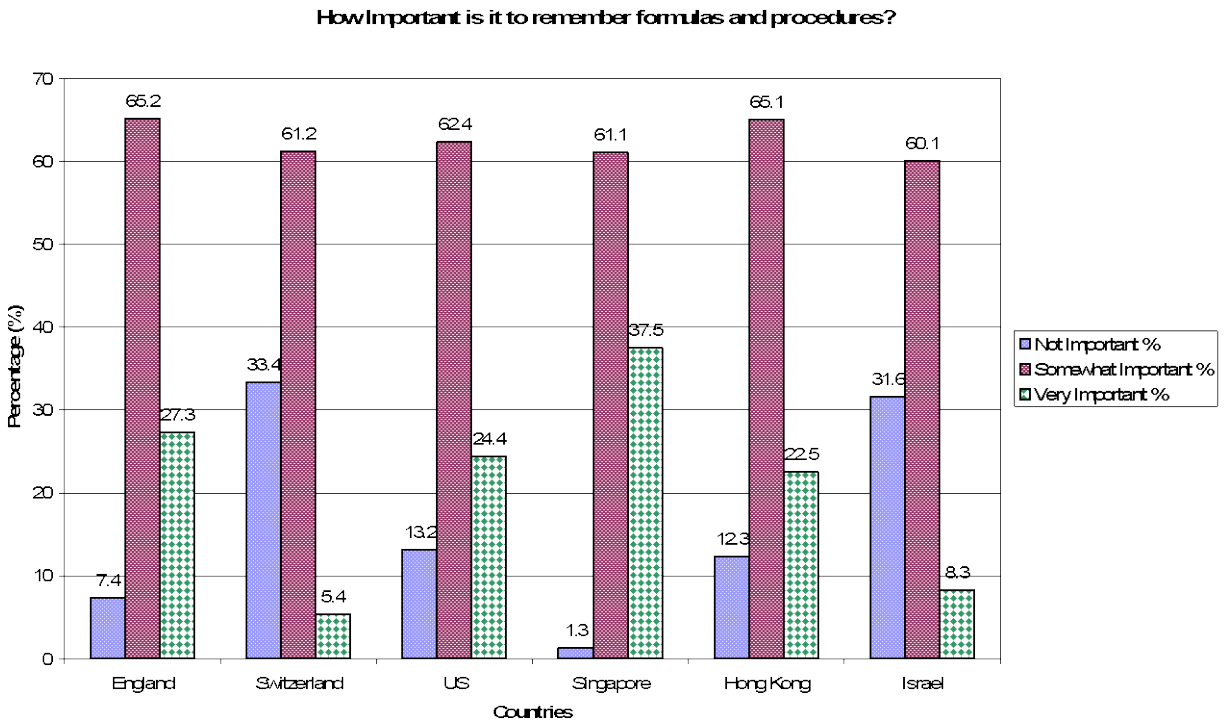


Fig. 1: Teachers' responses on importance of remembering formulas and procedures

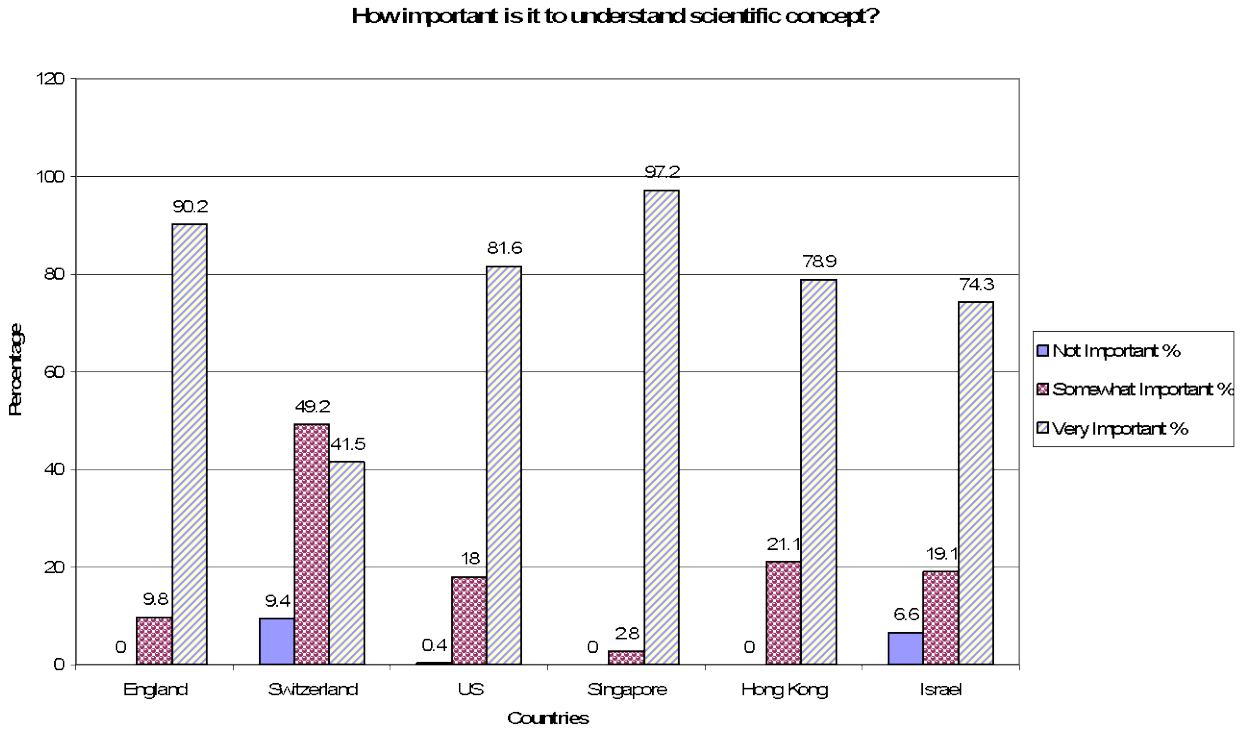


Fig. 2: Teachers' responses on the importance of understanding scientific concept

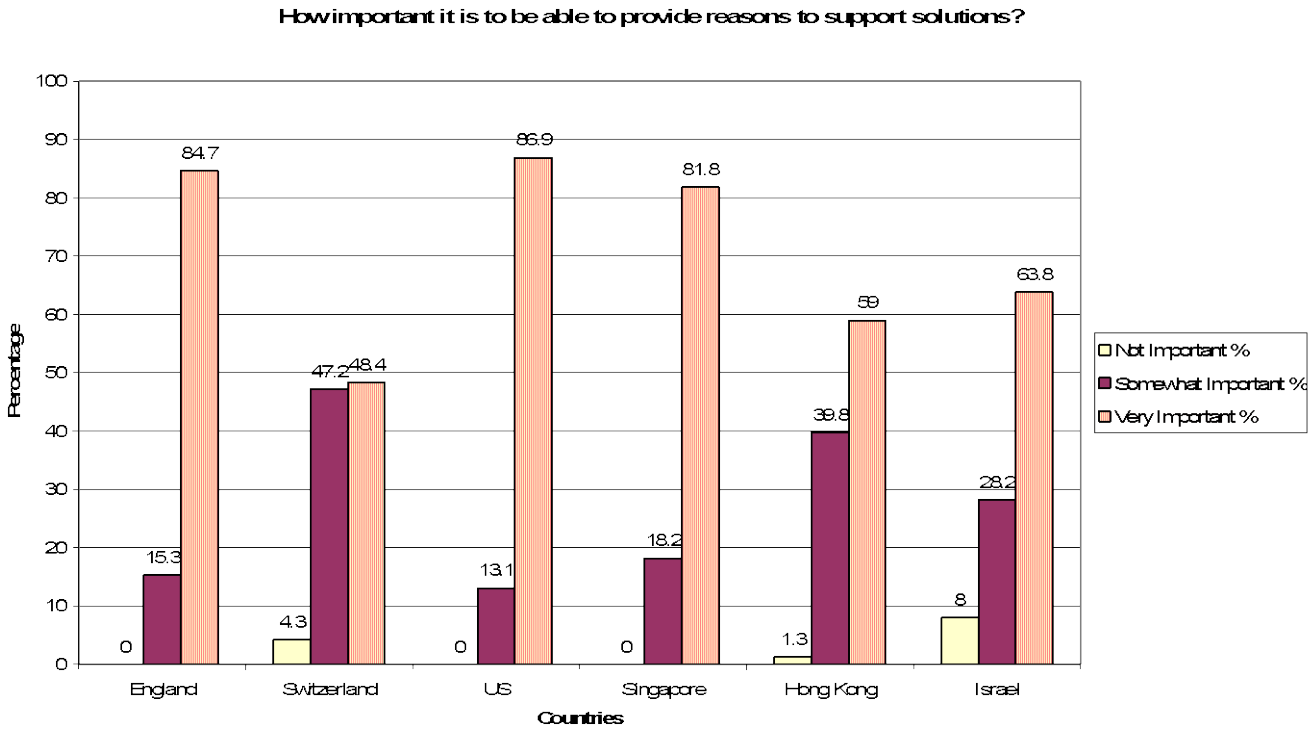


Fig. 3: Teachers' responses on the importance of providing reasons to support solution

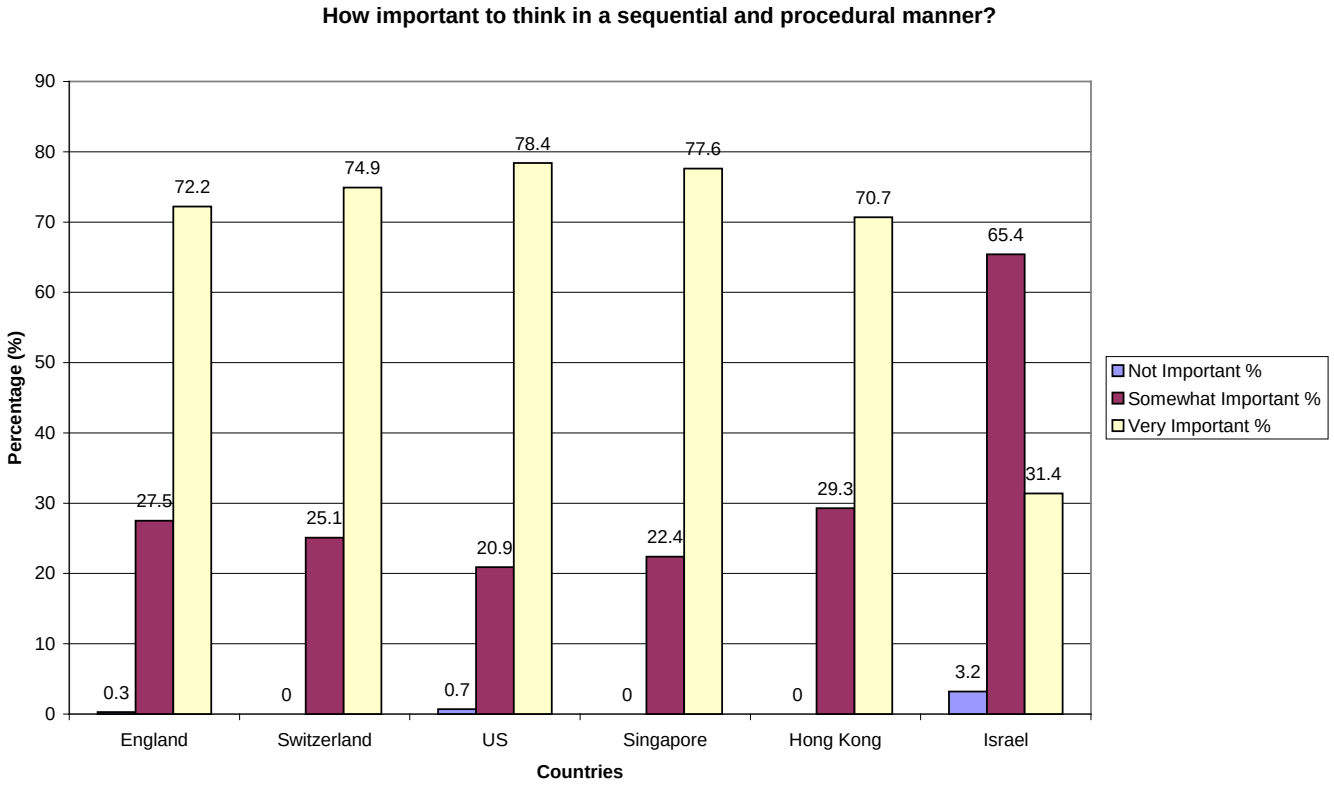


Fig. 4: Teachers' responses on the importance of thinking in a sequential and procedural manner

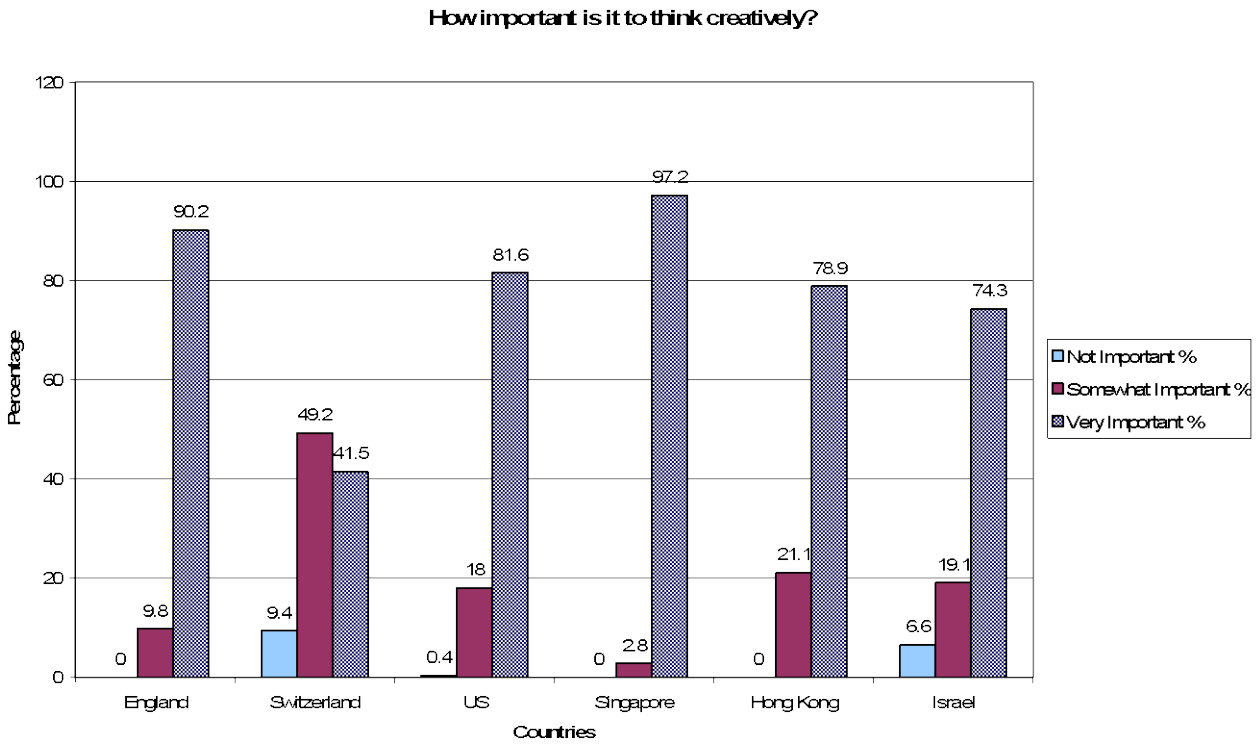


Fig. 5: Teachers' responses on the importance of thinking creatively

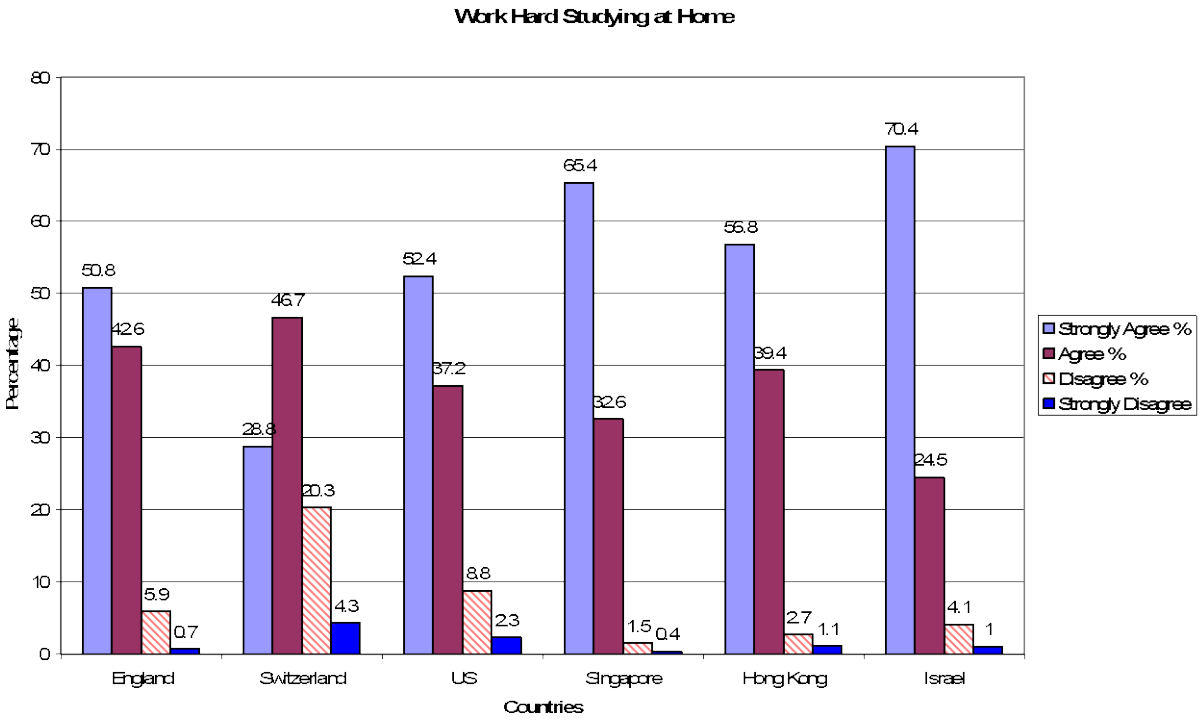


Fig. 6: Students' responses on the importance of studying hard at home to do well in science

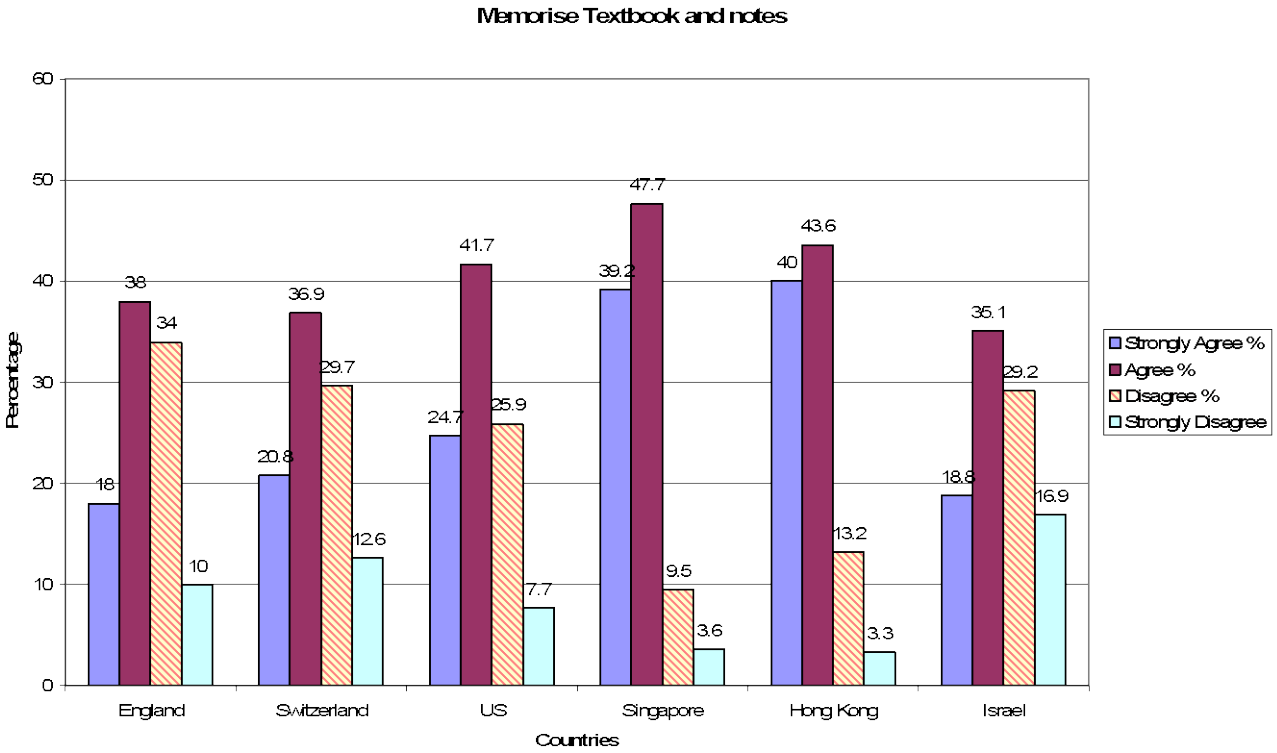


Fig. 7: Students' responses on the importance of memorising textbook and notes to do well in science

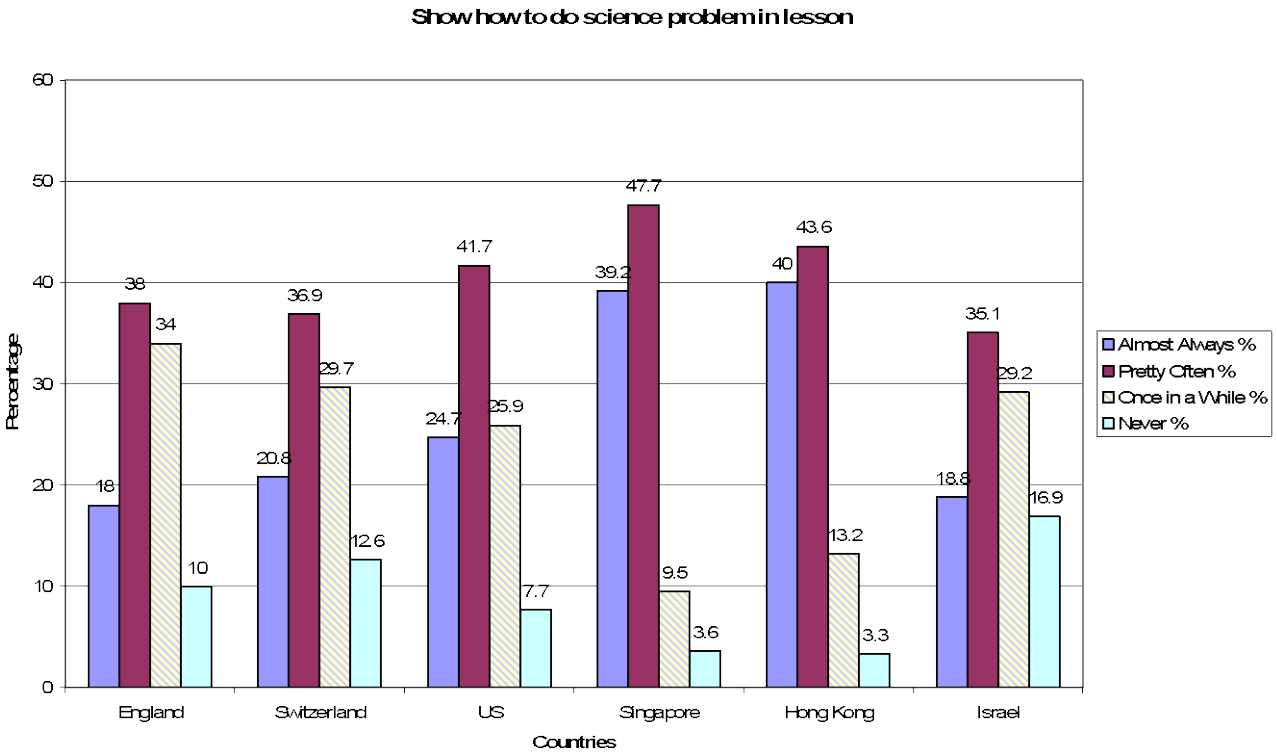


Fig. 8: Students' responses to the frequency of teachers showing how to do science problem in class