Attitudes Towards Science Of Gifted And Non-Gifted Upper Primary Students

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Abstract
The attitudes towards science of gifted as compared to mainstream students have not yet been explored in the Singapore context. As attitudes towards science are very much associated with achievement and future decisions on the part of the students, and particularly useful in conceptualizing innovations for teachers and curriculum developers, this investigation was undertaken to determine whether differences in such attitudes exists between gifted and non-gifted students (divided into EM1 and EM2 streams) and between boys and girls. A total of 653 upper primary students from co-educational government and government-aided schools were involved in this study. The attitude subscales included were enjoyment of science, appreciation of the social implications of science and preference for science careers. Using multivariate analysis of variance (MANOVA), it was found that gender and ability had significant effects on all the three attitude subscales, but gender and ability interaction was significant only on the first two subscales. Boys, in general, had more positive views about science than girls. Overall, the gifted and EM1 students had comparable attitudes towards science; both of them consistently showed more positive attitudes than EM2 students. Such general findings were also mirrored in career preference subscale results. Gifted and EM1 boys viewed science as more enjoyable and as having more importance in society than EM2 students. Girls from different ability groups had similar views on enjoyment of science, but differences on perceptions of the social implications of science were prominent among EM1 and EM2 girls.

Introduction
Attitude towards science refers to "a general and enduring positive or negative feeling about science" (Koballa Jr. and Crawley, 1985, p. 2223). Consistent with the notion that attitude serves as a driving force for people to learn, low to moderate positive correlation was found between attitudes towards science and science achievement (Stevens & Atwood, 1978; Willson, 1983; Harty, Beall & Scharmann, 1985; Lam-Kan, 1985; Lim, 1986; Weinburgh, 1995; Baker and Piturn, 1997, p. 48; Neathery, 1997; Martin et al., 1999). The literature shows a greater inclination towards the direction of attitude influencing achievement than the other way around (Osborne, Simon, & Collins, 2003, p. 1072). Many studies have revealed that positive attitude towards science is an important predictor of participation in science classes (based on review of studies done by Neathery, 1997) and subsequent performance in science tests (Stevens and Atwood, 1978; Cannon Jr. and Simpson, 1985), regardless of academic ability, at least for seventh-grade students (Cannon Jr. and Simpson, 1985). Furthermore, it was found that science-related attitudes
influence the selection of science courses of mixed ability students (Farenga & Joyce, 1998; Simpson & Oliver, 1990). Kelly (1986) even mentioned that attitudes have more lasting power compared to the knowledge acquired by students in science and will affect the way students cope with future life challenges. It is clear that cultivation of favorable attitudes is considered essential in promoting science learning.

Numerous studies revealed that positive attitudes towards science decline as students age (Stevens & Atwood, 1978; Simpson & Oliver, 1985; Yager & Yager, 1985; Kelly; 1986; Simpson & Oliver, 1990; Moffat et al., 1992; Speering & Rennie, 1996; Greenfield, 1997; Neathery, 1997; Pell & Jarvis, 2001; Osborne, Simon, & Collins, 2003). The decline in attitude of students was found more pronounced at the last stage of primary years or at the beginning of middle school years (Pell & Jarvis, 2001; James & Smith, 1985).

Another issue worth considering is the well-documented existence of gender gap in science education that is more prominent in relation to attitudes than achievement. Males tend to have more positive attitudes towards science than females (Lim, 1986; Power, 1981; Weinburgh, 1995; Martin et al., 1999; Simpson & Oliver, 1985; Simpson & Oliver, 1990; Kotte, 1992). Based on the Third International Mathematics and Science Study (TIMSS) that involved eight-grade students in 38 countries in 1999, boys generally have more positive self-concept in and attitudes towards science than girls, especially in physics, chemistry and earth science; girls, however, have more positive attitude towards biology (Martin et al., 1999). This gender gap in attitude remained stable from 1995 (the year when TIMSS was originally conducted) to 1999 (for 17 countries with the same cohorts of students participating in both years of study). Also in the TIMSS report, Singapore ranked third and second, in 1995 and 1999 respectively, among 14 countries (which teach science as a single subject) that had the widest gender gap in attitudes towards science, with a greater percentage of boys than girls being in the high level of positive attitudes towards science index (Martin et al., 1999, p. 152).

A potpourri of studies have indicated gender equality in terms of attitude. Neathery (1997) concluded that gender was not a predictor of attitudes towards science of Grades 4 to 11 students except that males viewed science as more exciting than girls. Gender equality in attitude toward science, as well as in achievement, was found specifically prominent and consistent during the elementary years, for instance Grades 2 and 5 (Shaw & Doan, 1990). Greenfield (1997) reported comparable attitudes towards science (specifically in career preference to science and perception of scientists) of boys and girls from Grades 6 to 12.

Most studies on attitude towards science focused on mainstream students, mainly of low, average and above-average intellectual or academic abilities. There is a shortage of studies dealing with the attitudes of gifted or high-ability students. Considering that gifted students are the ones with the relatively greater potential that can be tapped and directed towards the moulding of a technology-driven society in the future, there is a need to study their attitudes towards science. From such group can possibly emerge the new Einsteins and Newtons of the next generation. Determination of attitudes of gifted students per se and in relation to mainstream students would thus be useful for educational innovators, curriculum developers, program designers and teachers who intend to improve positive
attitudes towards science among students. The need for such studies is especially crucial at
the elementary level as it has been found that career aspirations are established even before
students enter secondary level (Naizer, 1993; Thomas, 1986).

One of the few studies that involved attitude to science of gifted students was done by
Barrington and Hendricks (1988). They compared the attitudes of 143 third-, seventh- and
eleventh-grade students who were either intellectually gifted (with IQ score greater than
130 in Otis Test of Mental Ability) or intellectually average students (with IQ between 95
and 105). They found that significant differences existed between average and gifted
students in relation to interest in becoming a scientist, views on usefulness of science, and
overall attitudes towards science, with the attitudes of the former being greater than the
latter. The researchers were not able to detect any significant gender difference and
interactions of gender with either ability or grade in both overall and subscale attitudes.
They also reported that attitude towards science and science lessons were significantly
lower for third-graders than for seventh-graders, yet the attitudes of eleventh-graders were
significantly higher than those of seventh-graders, particularly for gifted students.

The studies of Harty and Beall (1984) partly deviated from the findings of Barrington and
Hendricks (1988). They reported a lack of significant difference between the attitudes
towards science of 50 gifted (identified using Iowa Test of Basic Skills and Cognitive
Abilities Test) and non-gifted fifth-grade students, but they also found statistically
comparable overall attitudes for boys and girls. Nevertheless, they detected significant
gender differences in relation to some attitude items: Girls expressed greater desire to
spend more time in carrying out science experiments than boys; boys indicated greater
interest in “reading about science” and greater ease in “understanding science
experiments” than girls.

This research report is a part of a study involving the evaluation of the impact of
enrichment programs at Snow City, an institution for the promotion of informal science-
education in Singapore. It serves as a follow-up to the research conducted by Harty and
Beall (1984) and Barrington and Hendricks (1988). Primary Five and Six students in
Singapore served as subjects in the current study. No previous study on attitudes towards
science involving gifted students has been reported in the Singapore context. For this
study, a sample size greater than that used in the two cited studies on gifted and average
students was used, and a distinction was set among average and above-average ability
students forming the non-gifted group. In essence, this paper aims to explore the relative
attitudes of three ability groups: gifted, above-average and average learners. In addition,
the interaction of ability and gender in relation to attitudes towards science will also be
presented.

Methodology
Evaluation Instrument
A shortened version of Attitude to Science Instrument (ASI) that was developed by Foong
and Lam (1988) was used for data gathering. Three of the five subscales of the original
ASI were used: enjoyment of science (which covers interest in out-of-school science
activities), social implications of science (which measures the value that students give to
science in improving lives) and career preference for science (which measures preference, interest and enjoyment in science careers). The shortened instrument consists of 17 positively worded statements requiring Likert-type responses (ranging from 1=strongly disagree to 5=strongly agree): six items each for enjoyment and career preference subscales and five items for social implications of science subscale. The positive wording of all ASI statements is presumed helpful in eliciting more valid or accurate responses from young subjects (Schriesheim & Hill, 1981; Benson & Hocevar, 1985).

Foong and Lam (1988) had their instrument content-validated by 21 trainee teachers and three lecturers from the National Institute of Education in Singapore. Based on a sample of 1528 lower secondary students (737 boys, 791 girls; with mean age of 14.5 years) from 13 schools in Singapore, the reliability of the instrument using Cronbach alpha was found equal to 0.90. The reliabilities of subscales involved in the instrument ranged from 0.63 to 0.86. Concurrent validity of the instrument was established by correlating the instrument subscales with results derived from validated instruments of school climate. The results were found to be satisfactory.

Since the original instrument was validated using lower secondary students, it is not clear whether it could be used on the young subjects of this study to discriminate among the five-point Likert type responses used therein. It was deemed necessary to place a Likert style “Smiley face” alongside the choices in each item, following the examples of researchers (Mortimore et al., 1988; Pell & Jarvis, 2001; West, Hailes & Sammons, 1997).

The shortened ASI instrument with Likert-type Smiley face was validated and found to have Cronbach alpha reliabilities of 0.89 overall, 0.74 for enjoyment of science subscale, 0.87 for career preference and 0.68 for social implications subscales, using the samples involved in this study (N= 651). The Flesch-Kincaid readability level of the adapted instrument is 3.9, suggestive of its suitability for the reading level of fifth- and sixth-grade students. Samples of the items used for the study are given in the appendix.

Samples
The samples involved in the study were Primary Five and Six students of the 2003 and 2004 cohorts respectively. The samples were from six co-educational schools in Singapore: three were government schools and the other three were government-aided schools (which offer the gifted education programme). They were participants of the complimentary educational enrichment programs that were held at Snow City for this study. Their teachers volunteered for their participation in the said programs.

The samples were of mixed ability. The Primary Five students were from EM1 and EM2 streams. The Primary 6 students belonged to EM1, EM2 and gifted groups. A total of 24 classes were involved in this study: 10 EM1, seven EM2 and seven gifted classes. Although similar number of classes were used for EM1 and gifted students, there were fewer students who belong to the latter than the former group (see Table 1). This is because gifted classes have smaller size (around 25 students per class) than mainstream classes (around 35 to 40 students per class). The distribution of the samples in this study somewhat reflects the national distribution of students into different ability groups (number of EM2 students > number of EM1 students > number of gifted students).

716
Table 1. Distribution of Samples

<table>
<thead>
<tr>
<th>Gender</th>
<th>Stream or Academic Ability</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EM2</td>
<td>EM1</td>
</tr>
<tr>
<td>Boys</td>
<td>141</td>
<td>103</td>
</tr>
<tr>
<td>Girls</td>
<td>145</td>
<td>142</td>
</tr>
<tr>
<td>Total</td>
<td>286</td>
<td>245</td>
</tr>
</tbody>
</table>

In Singapore, mainstream students are grouped into different academic abilities or learning strands based on their performance in a national examination, this being termed as streaming. Each stream comprised students of comparable abilities or attainments, which is believed to be useful in ensuring that all students in a given stream will learn at a similar pace. At the time of this study, upper primary students were being channeled into three language streams (see endnote): EMI, EM2 and EM3. Those who scored at least 85% in all of the three subjects covered in the national streaming examination given at the end of Primary Four level (Mathematics, English and Mother Tongue) are directed to the EM1 stream; those who scored at least 50% in any two of the three subjects covered are directed to the EM2 stream; and those who did not qualify in the requirements for the first two streams are directed to the EM3 stream (Singapore Ministry of Education, 2004a). Parents have the final decision regarding the stream in which their children will be assigned, but certain minimum requirements at the end of Primary Five must be met to remain in a given stream. It can be inferred that, in general, EM1 and EM2 students are composed of students with above average and average academic abilities respectively.

Intellectually gifted students, on the other hand, are selected at the end of Primary Three (Singapore Ministry of Education, 2004b). The top 3,000 pupils of the Primary Three cohort sit for a selection test covering English language and Mathematics. The top 1% of this cohort is invited to join the Gifted Education Program (GEP), which is characterized by a highly individualized and enriched curriculum. Currently, there are nine primary schools in Singapore that offer GEP, three of which agreed to participate in this study.

Data Gathering
The slightly modified ASI was given to the subjects before they participated in the enrichment programs of Snow City. The data collection for fifth-grade students took place towards the end of school year 2003 while that for sixth-grade students took place at the beginning of school year 2004.

Data Analysis
Multivariate analysis of variance (MANOVA) was used with ability (comprising three levels: EM2, EM1 and gifted) and gender (with two levels: boy and girl) as fixed factors. Before MANOVA was conducted, relevant assumptions (e.g. normality, multicollinearity and homogeneity of variance) were evaluated. No serious violation of these assumptions was found. A few outliers were found, though. When trial MANOVA was carried out with and without outliers, the results generated were identical. It was then considered acceptable to present the results without removing the outlying cases. Two versions of the data analysis would be presented: one involving the full sample and another focusing only on Primary 6 students. It was presumed that the three-month time gap in the data gathering
for the 2003 and 2004 cohorts might have an effect on the results, hence the decision to segregate the results for sixth-grade students in the second part of the analysis.

**Results and Discussion**

**Full Sample**

MANOVA results, as indicated by Pillai's statistic, showed that the effects of gender ($F(3,645)=6.46$, $p<0.0001$), ability ($F(6,1292)=9.78$, $p<0.0001$) and their interaction ($F(6,1292)=3.62$, $p<0.001$) on overall attitude towards science were all significant. Inspection of Table 2 and Figure 1 reveals that average ability students (EM2) had the least positive attitudes while the EM1 and gifted students appears to have similar attitude scores. Boys generally reported more positive attitudes towards science than girls, regardless of ability.

**Table 2. Mean$^a$ and Standard Deviation$^b$ of Attitudes Towards Science by Gender and Stream**

<table>
<thead>
<tr>
<th></th>
<th>Enjoyment of Science$^c$</th>
<th>Career Preference$^c$</th>
<th>Social Implications$^c$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EM2 (N=286)</td>
<td>EM1 (N=245)</td>
<td>Gifted (N=122)</td>
</tr>
<tr>
<td>(N=321)</td>
<td>(4.87)</td>
<td>(4.46)</td>
<td>(3.81)</td>
</tr>
<tr>
<td>(N=332)</td>
<td>(3.94)</td>
<td>(3.95)</td>
<td>(3.95)</td>
</tr>
<tr>
<td>(N=653)</td>
<td>(4.41)</td>
<td>(4.88)</td>
<td></td>
</tr>
</tbody>
</table>

$^a$Means are in the upper portion without parentheses, $^b$SD in parentheses

**Table 3. Results of Follow-up Univariate Tests on Each Attitude Subscale Score (N=653)**

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Gender F</th>
<th>MSE</th>
<th>$\eta^2$</th>
<th>F</th>
<th>Ability MSE</th>
<th>$\eta^2$</th>
<th>Gender by Ability F</th>
<th>MSE</th>
<th>$\eta^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enjoyment of Science</td>
<td>13.24***</td>
<td>18.52</td>
<td>6.62**</td>
<td>122.58</td>
<td>6.18**</td>
<td>114.48</td>
<td>0.02</td>
<td></td>
<td>114.48</td>
</tr>
<tr>
<td>Science Preference</td>
<td>396.08***</td>
<td>22.35</td>
<td>10.46***</td>
<td>233.75</td>
<td>1.71</td>
<td>38.15</td>
<td>0.005</td>
<td></td>
<td>38.15</td>
</tr>
<tr>
<td>for Science Careers</td>
<td>9.16**</td>
<td>9.66</td>
<td>88.50</td>
<td>27.41**</td>
<td>3.65*</td>
<td>35.27</td>
<td>0.01</td>
<td></td>
<td>35.27</td>
</tr>
</tbody>
</table>

Follow-up univariate analyses suggested that the effect of gender and ability were significant in all subscales, with small to moderate effect size. The joint effect of ability and gender was significant only for enjoyment of science and social implications of science subscales, with modest effect size (see Table 3). Concerning career preference for science, boys generally had higher scores than girls. Scheffé test shows that there is no significant difference between the career preference scores of EM1 and gifted students. The differences between
the career preference scores of gifted and EM2 students (mean difference = 1.88, p < 0.01) and EM1 and EM2 (mean difference = 1.50, p < 0.01) were both significant.

Before exploring the significant interaction effect of gender and ability on enjoyment of science and social implications of science subscales, the two factors were combined to form six gender-ability groups: 1- EM2 boys; 2- EM2 girls; 3- EM1 boys; 4- EM1 girls; 5- gifted boys; and 6- gifted girls. Scheffe test was then conducted to determine which groups differed significantly.

It was found that EM2 boys had the lowest level of enjoyment level in science among all boy-groups (mean difference = 2.35 to 2.39, p < 0.01); however, the scores of EM2 boys were comparable with the girls' enjoyment of science scores (p > 0.05). All of the girls from different ability groups had similar enjoyment levels in science. Gifted boys and EM1 boys had comparable enjoyment of science scores (p > 0.05), which were significantly higher than those of EM2 boys, as well as EM1 and EM2 girls (mean difference = 2.22 to 2.49, p < 0.05). Gifted girls reported less enjoyment in science than gifted and EM1 boys, but the difference was not significant. The gender gap in enjoyment of science is prominent only between above-average ability groups, with EM1 boys reporting higher levels of enjoyment in science than EM1 girls. On average, EM1 and gifted students reported similar enjoyment of science levels, which means that their interests in out-of-school science activities are comparable.

Focusing on the students' perception of the importance of science in society, the mean subscale score of EM1 boys was found significantly higher than that of EM2 boys (mean difference = 2.63, p < 0.001), EM1 girls (mean difference = 1.71, p < 0.01), and EM2 girls (mean difference = 3.08, p < 0.001), but comparable with scores of gifted boys and girls (p > 0.05). EM1 girls and gifted boys had significantly higher scores than EM2 girls (mean difference = 1.35 to 1.83, p < 0.05). The social implications scores of EM2 girls and boys appeared to be the lowest, yet not too far from the scores of other gender-ability groups except when compared with EM1 boys. Just like in the other two subscales, EM1 and gifted students expressed similar views on the social implications of science subscale.
Reduced Sample

To reduce the effect of the time of data gathering on the findings, data analysis was carried involving only the 2004 cohort (the group which involves gifted students but not EM2 students). The relevant descriptive statistics are shown in Table 4; subscale means are illustrated in Figure 2.

Table 4. Mean* and Standard Deviationb of Attitudes Towards Science by Gender and Stream

<table>
<thead>
<tr>
<th>Enjoyment of Sciencec</th>
<th>Career Preferencec</th>
<th>Social Implicationsd</th>
</tr>
</thead>
<tbody>
<tr>
<td>EM1 (N=76)</td>
<td>Gifted (N=77)</td>
<td>EM1 (N=76)</td>
</tr>
<tr>
<td>By Gender</td>
<td>By Gender</td>
<td>Gifted (N=77)</td>
</tr>
<tr>
<td>Gender</td>
<td>Gender</td>
<td>By Gender</td>
</tr>
<tr>
<td>Boys</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(N=153)</td>
<td></td>
<td>(N=172)</td>
</tr>
<tr>
<td>(22.14) (4.64)</td>
<td>(22.06) (3.81)</td>
<td>(22.10) (4.23)</td>
</tr>
<tr>
<td>Girls</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(N=141)</td>
<td></td>
<td>(N=172)</td>
</tr>
<tr>
<td>(19.74) (4.42)</td>
<td>(20.27) (3.95)</td>
<td>(21.05) (4.38)</td>
</tr>
<tr>
<td>By</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(20.80) (4.66)</td>
<td>(21.40) (3.94)</td>
<td>(20.28) (4.38)</td>
</tr>
<tr>
<td>Overall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(N=294)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(21.05) (4.38)</td>
<td>(22.06) (4.63)</td>
<td>(20.28) (2.81)</td>
</tr>
</tbody>
</table>

*Means are in the upper portion without parentheses; SDs are in parentheses

**Maximum score is 30; maximum score is 25

Figure 2. Graph of attitude subscale means for Primary Six EM1 and gifted students by gender

MANOVA results, as given by Pillai’s statistic, yielded significant effects of gender \(F(3,288)=5.81, p<0.0001\) and ability \(F(3,288)=3.15, p<0.05\) but not of their interaction \(F(6,1292)=3.62, p<0.01\) on overall attitude towards science. Visual inspection of Table 4 and Figure 1 revealed that above-average ability students (EM1) had slightly more positive overall attitude towards science as compared to gifted students. Boys by and large had more positive overall attitude towards science than girls.
Follow-up univariate analysis of variance (ANOVA) produced the results in Table 5. Boys and girls significantly differed in their degree of enjoyment in science, enthusiasm to pursue science-related careers and views on the social implications of science: Boys expressed more positive attitudes than girls. The effect of gender was weakest on social implications and strongest on enjoyment subscales. On the other hand, the difference among the attitudes of the two ability groups occurred only on the social implications subscale. The difference was small, though, with EM1 students showing more positive perceptions of the importance of science in society than gifted students.

Table 5. Results of Follow-up Univariate Tests on Each Attitude Subscale Score (N=294)

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Gender</th>
<th>Ability</th>
<th>MSE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>MS</td>
<td>n²</td>
</tr>
<tr>
<td>Enjoyment of Science</td>
<td>16.57***</td>
<td>300.57</td>
<td>0.05</td>
</tr>
<tr>
<td>Preference for Science Careers</td>
<td>11.81**</td>
<td>241.35</td>
<td>0.04</td>
</tr>
<tr>
<td>Social Implications</td>
<td>6.34*</td>
<td>48.04</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Note: df=1; error df=290; *p<0.05; **p<0.01, *** p<0.0001

In general, the findings for the reduced sample are similar to those of the full sample: both results indicated comparable enjoyment and career preference scores between gifted and above-average students; and significantly higher attitude scores of boys than those of girls. A slight discrepancy occurred only for the social subscale scores, results for the full sample indicated similar social scores for EM1 and gifted students; results for reduced sample showed a small difference, in favour of above-average ability group. This suggests that the effect of time on data gathering is not significant, at least for EM1 and gifted students.

Conclusions and Implications of the Study

The overall attitudes towards science of gifted and above-average students were found comparable. Average students tended to have less positive attitudes towards science than higher ability groups. Such findings partly deviated from those reported by Harty and Beall (1984), yet conformed to the findings of Barrington and Hendricks (1988). The deviation of Harty and Beall’s findings from those derived from this study and from the study of Barrington and Hendricks, can be due to the failure of the former researchers to separate average from above-average learners. Cultural influences could also have caused the discrepancies in the findings, albeit slightly, as both previous studies cited were carried out in the US.

With average students seemingly left behind by those of higher academic ability in terms of attitude towards science, a connection between attitude and performance in science or between attitude and learning ability can be surmised. The possible difficulties that average students encounter in dealing with their science classes might have been one reason why they have weaker affinity for science or it could be the other way around. Irrespective of
whichever of the two causal links is dominant, efforts need be made to foster more positive attitudes towards science among average students so as to maximize their potential.

The results also showed that both gender and ability had significant effects on all the attitude areas covered in this study, but gender and ability interaction was significant only on enjoyment and social implications of science subscales. The results also identified boys as the ones more inclined to pursue science careers than girls. EM1 and gifted students had comparable motivations for science-related careers in the future, and this is greater than those reported by EM2 students. Gifted and EM1 boys viewed science as more enjoyable and as having more importance in society than EM2 students. Girls from different ability groups had similar views on enjoyment of science, but differences on the perceptions of the social implications of science were prominent between EM1 and EM2 girls.

Boys generally reported more positive attitudes than girls: the gender gap was widest for above-average ability group and less pronounced for average and gifted students. The first part of the given finding conforms to the results of several studies on gender gap involving mainstream students (Lim, 1986; Power, 1981; Weinburgh, 1995; Martin et al., 1999; Simpson & Oliver, 1985; Simpson & Oliver, 1990; Kotte, 1992) but differed from that of a study involving a sample of gifted and non-gifted fifth-grade students (Harty & Beall (1984). The second part of the finding is somewhat perplexing and a good starting point to reflect on the present attempts to reduce gender gap. It could be speculated, following the reasoning of Cannon and Simpson (1985, p. 135), that educators are currently focusing greater efforts on the extreme ability groups that those who are in the middle ground are somewhat left out, especially above-average girls.

The finding that high-ability students, particularly the gifted group, have attitudes that fall in the positive end of the attitude continuum is promising. There is a good chance that budding Einsteins and Newtons will emerge from this group. There is, however, still more which can be done in terms of fostering positive attitudes on the students. Current efforts to improve attitudes to science should be maintained or, better, be escalated, with greater focus on girls.

Researchers have suggested some possible steps towards enhancing positive attitudes towards science and in reducing the affective gender gap in science. Kotte (1992) proposed that moves to reduce the factors that lead to gender differences should preferably begin at the primary level, the point where critical attitude change among students can manifest. Enrichment activities, which are strong in the affective domain, can be utilized as a "leveling field" for the existing gender gap in science. Enhancing the science experience of girls can lead to improvement in their attitude towards science (Kahle, et al., 1985; Stake & Mares, 2001; Moore, 2001). In addition, encouragement should be given to children to engage in science hobbies as these have been found to be strong predictors of better attitudes towards science and science careers in the future, especially for girls (Thomas, 1986; Joyce & Farenga, 1999).

This study has provided a glimpse on the attitudes towards science of upper primary gifted and non-gifted students in Singapore. Being the first such study done in Singapore, as well
as in the Asian context, it is hoped that the current results could serve as a springboard and benchmark for future investigation on the attitudes towards science of gifted students, using samples that are randomly selected and coming from other grade levels.

Endnote
Effective 9 January 2004, EM1 and EM2 streams were merged. The new batch of Primary Five students would only be directed to two streams: EM1/EM2 and EM3 (Ministry of Education, 2004a).

References


Pell, T, and Jarvis, T. (2001). Developing attitude to science scales for use with children of ages from five to eleven years. *International Journal of Science Education, 23*(8), 847-862


**Appendix**

Example of ASI Items

<table>
<thead>
<tr>
<th>Statements</th>
<th>☹️</th>
<th>😞</th>
<th>😞</th>
<th>😄</th>
<th>😄</th>
<th>😄</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I would like to work as a scientist.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
<td></td>
</tr>
<tr>
<td>2. I like reading newspaper articles about science.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
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</tr>
<tr>
<td>3. Science is doing more good than harm.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
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</tr>
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