3. QUESTIONNAIRE FOR STUDENTS

3.1. Instruments

In the student questionnaire for P.3, P.6, S.3, S.4 and S.6, students were requested to:

(a) indicate their gender, age, and medium of instruction in their mathematics class;

(b) indicate streaming (arts / science without additional mathematics / science with additional mathematics / commerce / others for S.4, and arts / science / commerce / others for S.6);

(c) rate the level of perceived difficulties of the topics they learned in the current academic year;

(d) respond to 30 questions [(2)] on their attitude towards and habits of learning mathematics;

(e) respond to 27 items on their conception of mathematics (for P.6, S.3, S.4 and S.6 only);

(f) respond to 13 items on their belief on mathematics (for S.3, S.4 and S.6 only);

(g) indicate the time they spent in the previous week on homework in general and mathematics homework in particular; and

(h) indicate whether they had private tutors (or attended tutorial classes).

For (c), the topics for response were taken from the mathematics syllabuses issued by the Curriculum Development Council (CDC, 1985, 1991a, 1991b, 1992a, 1992b, 1992c) for the secondary classes, and from popular textbooks for primary classes as the names of topics listed in the syllabuses are too technical for primary school students. At the end of this part, an open-ended question was also incorporated to solicit students' comments on the mathematics curriculum. The questionnaire items for all grades were set in Chinese, with English translations only for the topics in the mathematics syllabuses. The details for three other embedded subscales are as follows.

[(2)] One item was omitted in the P.6 questionnaire and 7 items were omitted in the P.3 questionnaire due to irrelevance of the items in their context (e.g. about formulae which do not appear in the P.3 syllabus). So the numbers of items in the P.3 and P.6 questionnaires in this part were 23 and 29 only.

3.1.1. Attitude towards mathematics and habits of learning

The subscale comprised 4 items on interest, 6 items on preference on understanding, 3 items on confidence, 4 items on competence, 5 items on textbooks and classroom learning and 3 items on outside-class learning, set in a 5-point Likert scale. It was supplemented by 5 items on habits of learning, set in a 4-point Likert scale.[(3)] These questionnaire items have been used in the local context before and arrived at fruitful results (Cheng & Wong, 1991; Wong & Cheng, 1991).

3.1.2. Conception of mathematics

The subscale was developed through a local, grounded research conducted by Wong, Lam, & Wong (1998)[(4)]. One item was deleted for statistical reason and the remaining 26 items consisted of 14 items on "mathematics as calculables", 6 items on "mathematics involves thinking" and 6 questions on "mathematics is useful". They were set in a 5-point Likert scale.

3.1.3. Beliefs in mathematics

Thirteen questions concerning students' beliefs on mathematics and school practice were adapted and translated from the questionnaire of Schoenfeld's (1985) problem-solving research project. These question items were set in a 5-point Likert scale and went through the process of translation and back-translation to ensure no distortion in meaning.

3.2. Pilot project

Pilot tests of the student questionnaire were performed with 540 students (62, 69, 208, 156 and 45 from P.3, P.6, S.3, S.4 and S.6 respectively) from 2 primary schools and 3 secondary schools. The Project Coordinator was on site at each pilot testing to observe the administration of student questionnaires in each class and was on site to read out the student questionnaire for P.3. The result of the pilot was, on the whole, satisfactory. Based on the feedback gathered from the pilot, a number of minor amendments and standardisation in procedures were made, namely, as follows:

(a) The mathematics teacher of the class was requested to help administer the questionnaire and to standardise the procedures of administering the student

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[(3)] Numbers of items for P.3 and P.6 were reduced for the same reason as stated in footnote (2).

[(4)] The research was supported by the Direct Grant for Research 1996-97 of the Social Science and Education Panel, The Chinese University of Hong Kong, and the research team (C.C. Lam, K.M. Wong, & N.Y. Wong) possesses the copyright of the scale.

questionnaires. An "Instruction To Teachers" sheet with suggested responses to frequently asked questions was also included.

(b) For P.3, the teachers were asked to read out the questions one by one, and a set of sample chapters of topics was included for showing to the students when they had difficulty recognizing certain topics.

(c) Items involving the term "formula" were deleted from the P.3 questionnaire, and items involving "calculators" were also deleted from both the P.3 and P.6 questionnaires since they were absent from their classroom learning experience at these grade levels. Some items were suitably re-shuffled too.

(d) A short teacher questionnaire was included in the batch to request teachers to indicate which of the topics were not yet taught in the class. This information had been useful in the statistics of students' perceived difficulties in various topics.

The finalised questionnaires are shown in Appendices 1 to 5.

3.3. Sampling and administration

The survey went through a two-step random sampling procedure. First, random sampling of 90 primary schools and 50 secondary schools out of all local schools was done. Then, in each chosen primary school, one P.3 and one P.6 classes were selected at random, and in each chosen secondary school, one S.3, one S.4 and two S.6 classes were selected at random. The questionnaire packages were then delivered to the sampled schools by courier services. Team members were made available to answer phone calls from schools and completed questionnaires were picked up from schools again by courier services. Details of the return rate are listed in Table 2. The overall return rate was 95%. There were individual schools which did not have the required grade levels and the actual figures of the classes participating in the survey are listed in Table 3. The characteristics of the sampled schools are given in Table 3 and those of the participants are given in Tables 4-5.

Table 2. Return rate of the questionnaire survey

Level	Packages sent out	Packages returned	Return rate (%)
Primary level	90	85	94.44%
Secondary level	50	48	96%

Table 3. Location of the sampled classes

	P.3	P.6	S.3	S.4	S.6
Hong Kong Island	15	15	13	13	25
Kowloon	24	24	11	12	23
New Territories	50	50	25	25	46
Total	89	89	49	50	94

Table 4. Gender of the participants

	P.3	P.6	S.3	S.4	S.6	Total
Male	1192	1401	852	711	1046	5202
Female	1037	1229	505	642	373	3786
Total	2229	2630	1357	1353	1419	8988

Table 5. Streams of the participants in senior secondary grades

	Arts	Science		Commerce
S.4	340	No Add Math	Add Math	207
		220	428	
S.6	561	1025		50

3.4. Results

3.4.1. Perceived difficulty of topics

Students rated the level of perceived difficulty of each of the mathematics topics they learned in the current academic year on a 5-point Likert scale, namely, 1 = very difficult, 2 = difficult, 3 = fairly easy, 4 = easy, and 5 = very easy. The results obtained for each grade level are as follows.

For P.3, students found no difficulty in all the topics (perceived difficulty levels ranging from 3.81 to 4.56, mean = 4.24). Topics which were perceived as relatively more difficult were “mixed manipulation with multiplication and division” (3.81), “factors and multiples” (3.82) and “kilometre and millimetre” (3.90). The easiest ones were “bar charts” (4.68), “addition and subtraction of fractions with the same denominator” (4.56), and “fractions” (4.54).

For P.6, the range of perceived difficulty levels widened, and the mean dropped sizably as compared with that of P.3 (2.99 to 4.62, mean = 3.80). Topics with the greatest perceived difficulty were “application of algebraic equations to solve algebraic problems” (2.99), “percentage and its application” (3.17), and “speed” (3.22). The easiest topics were “symmetry” (4.62), “curve stitching” (4.60), and “positive and negative numbers” (4.40). It is interesting to note that topics which did not involve “calculables” were perceived as easier.

In S.3, the range narrowed but the mean continued to drop sizably (2.71 to 3.47, mean = 3.15). In fact, no topic had a mean higher than 4. In other words, no topics were perceived as easy. The most difficult topics were "coordinate geometry of straight line" (2.71) and "common logarithm" (2.94), and the easiest topics were "percentages" (3.47) and "uses and abuses of statistics" (3.47).

For S.4 mathematics, the range continued to narrow down, with the mean dropping slightly (2.73 to 3.31, mean = 3.08). The most difficult topics were "application of trigonometry" (2.73) and "probability and statistics" (2.89), and the easiest ones were "quadratic equation in one unknown, surds" (3.31) and "proportion and variation" (3.23).

For S.4 Additional Mathematics, the mean dropped to 2.95 (ranging from 2.41 to 3.08). In other words, most of the topics were perceived by the students to be difficult. The most difficult topics were "integration" (2.41) and "trigonometry" (2.45) possibly because they involved tedious computations. The easiest ones were "mathematical induction" (3.08) and "quadratic equation and quadratic function" (2.79).

In the same vein, S.6 students also had a hard time with Pure Mathematics. The perceived difficulty levels ranged from 2.15 to 3.07, with a mean of only 2.62. "Complex numbers" (2.15) and "sequence, series and their limits" (2.24) were found to be the most difficult topics. It is interesting, however, to note that the students already had prior acquaintance with all these topics in Additional Mathematics. The easiest ones were "mathematical induction", (3.07) and "system of linear equations" (3.00). This is quite consistent with what has been found for Additional Mathematics.

As for Applied Mathematics, compared with students taking A Level, students taking AS Level found the topics more difficult, which was quite expected. For AS Level, the perceived difficulty ranged from 2.38 to 2.95, with a mean of 2.74. The most difficult ones were "probability" (2.38) and "vectors" (2.57) and the easiest ones were "fixed point iteration, Newton's and secant method" (2.95) and "lines of best fit" (2.92). As for A Level, the range widened to between 2.33 and 3.80 with a mean of 2.66. The most difficult topics included "simple harmonic motion" (2.33) and "motion of rigid body" (2.36), whereas the easiest ones were "interpolation" (exceptionally high: 3.80) and "basic statistical measures" (3.31).

Topics in Mathematics and Statistics were not perceived to be easy in general. The range was 2.00 to 3.00 with a mean of 2.66. The most difficult topics were "permutation and combination" (2.26) and "definite integral" (2.52), while "binomial expansion" (2.92) and "logarithm function" (2.79) were the easiest. However, the range was so narrow that there was in fact not much difference in the rating among these topics.

The detailed results are shown graphically in Appendices 6 to 10.

3.4.2. Students' attitudes towards mathematics

For this part, students rated their level of agreement with some given statements regarding the attitudes towards mathematics on a 5-point Likert scale, namely, 1 = most disagree, 2 = disagree, 3 = quite agree, 4 = agree, and 5 = most agree. The results obtained for each grade level are as follows.

For P.3, the three statements that students agreed most were "I hope that the textbook could have more pictures so that I can understand better" (mean = 4.16: those who agreed exceed those who did not by 65%), "I have confidence in numerical computations" (mean = 4.02, difference = 64%), and "I have interest in mathematical calculations" (3.91, 57%). On the other hand, those statements they disagreed most were "Understanding the content is unimportant, knowing how to calculate suffices in coping with examinations" (2.00, 59%), "Reading the textbook is redundant, the teacher will explain everything" (2.27, 42%), and "I seldom try those problems not required by the teacher" (2.61, 25%). It is obvious therefore that their responses were unanimously positive with regard to their attitude towards the subject.

For P.6, the three most agreed statements were "I have confidence in purely numerical computations" (3.73, 46%), "I hope that the textbook could have more pictures so that I can understand better" (3.64, 39%), and "If I understand the concept concerned, I can always find a means to calculate the problems" (3.58, 38%). Though the responses were still relatively positive, they began to diversify slightly. The most disagreed statements were "I often take part in mathematics extracurricular activities" (2.14, 60%), "Understanding the content is unimportant, knowing how to calculate suffices in coping with examinations" (2.16, 58%) and "Reading the textbook is redundant, the teacher will explain everything" (2.20, 57%).

For S.3, the three most agreed statements were "I would use calculators for numerical calculations" (3.77, 51%), "If I understand the concept concerned, I can always find a means to calculate the problems" (3.47, 32%) and "Though I know how to calculate, sometimes I don't know why this is so" (3.38, 26%). While the second statement depicted a positive attitude towards mathematics, it was superceded by one which concerned mere technicalities of mathematics. Moreover, the mean rating of the second statement dropped a bit from 3.58 to 3.47. On the other hand, the apparent contradiction between the second and the third statements precisely showed the discrepancy between "preference" and "reality". Students did realise the importance of understanding, but it was not often that they did understand. The three most disagreed statements were "I often take part in mathematics extracurricular activities" (1.72, 87%; an almost unanimous response), "I often read mathematics 'outside readers'" (1.84, 79%; again quite unanimously) and "Reading the textbook is redundant, the teacher will explain everything" (2.25, 59%). This might indicate a strong textbook-dependence of mathematics learning.

As for S.4, "I would use calculators for numerical calculations" (3.80, 56%), "Though I know how to calculate, sometimes I don't know why this is so" (3.42, 38%) and "If I understand the concept concerned, I can always find a means to calculate the problems" (3.38, 26%) remained to be the most agreed statements, though their order changed a bit. On the other extreme, "I often take part in mathematics extracurricular activities" (1.74, 83%), and "I often read mathematics 'outside readers'" (1.79, 81%) remained the two statements most disagreed. And the third was replaced by "I have confidence in word problems" (2.26, 58%). In fact, this statement was the 4th most disagreed statement for S.3 (and only the 8th for P.6). It showed that more negative attitude towards learning mathematics began to set in.

In S.6, "I would use calculators for numerical calculations" (3.93, 61%) and "Though I know how to calculate, sometimes I don't know why this is so" (3.49, 34%) continued to be the most agreed statements. The third was replaced by the very positive statement "When learning a new topic, I wish that I could think for me first and not having the teacher telling me everything" (3.33, 21%). Though those agreed exceeded those not by 21% only, this presumably indicated the students' wished to opt for deeper understanding. As mentioned above, whether students were really competent to do so is but another question. In general, sixth-formers were more mature in learning mathematics when compared with their junior counterparts. On the other hand, "I often read mathematics 'outside readers'" (1.67, 87%), and "I often take part in mathematics extracurricular

activities" (1.69, 86%) remained the two most disagreed ones. The third was "Reading the textbook is redundant, the teacher will explain everything" (2.04, 74%) while "I have confidence in word problems" became the 4th most disagreed statement.

The detailed results are shown graphically in appendices 12 to 16.

3.4.3. Students' attitude: trends

To indicate the trends of students' responses to these statements on attitude towards learning mathematics from P.3 (P.6 or S.3 for some statements) to S.6, broken line graphs showing the mean ratings at each grade level are drawn below for the statements grouped under specific themes.

3.4.3.1. Interest

1. I love solving mathematical problems: dropped substantially at P.6 but all above the mid-value 3 (Figure 2).
5. My interest in attending mathematics classes is high: again dropped sizably at P.6 from 3.86 to 2.99 and remained below the mid-value afterwards (Figure 3).
9. I have interest in mathematical calculations: again dropped sizably at P.6 and rose slightly after S.3 (Figure 4).
22. I seldom try those problems not required by the teacher: increased sizably at P.6 and remained above the mid-score afterwards (except for S.4 Additional Mathematics and S.6 Pure Mathematics classes) (Figure 5).

3.4.3.2. Option for understanding

15. Reading the explanations in the textbook is not necessary, we can learn just by reading the formulas: basically disagreed, but more agreed at S.4 (Figure 6).
17. When learning a new topic, I wish that the teacher could tell us the formula right away and not ask us to discover: basically disagreed (Figure 7).
18. When learning a new topic, I wish that I could think for it first and not having the teacher telling me everything: strongly agreed, though not quite so for S.4 (Figure 8).
19. Understanding the content is unimportant, knowing how to calculate suffices in coping with examinations: basically disagreed, more so for higher grade levels (Figure 9).
20. If I understand the concept concerned, I can always find a means to calculate the problems: strongly agreed, but less so when moving up grade levels (Figure 10).

24. In learning a new topic, I am not concerned with how the formulas come about, I only care how the formulas are applied in solving problems: basically disagreed (Figure 11).

3.4.3.3. Confidence

3. I have confidence in problems that involve substituting numbers into formulas: basically agreed (Figure 12).
7. I have confidence in purely numerical computations: dropped continuously but still remained at a high score (Figure 13).
11. I have confidence in solving word problems: dropped sizably from P.3 up to S.4 and rose slightly after S.4 (Figure 14).

3.4.3.4. Competence

2. I fully understand the content in the mathematics class: dropped continuously from 3.61 in P.3 to below the mid-value of 2.97 in P.6 and then down to 2.38 at S.6 (Figure 15).
6. Usually I fully understand word problems: again dropped sizably till S.4 (Figure 16).
10. I have difficulty in solving word problems: strongly agreed for most of the grade levels except for S.3 and S.4 (Figure 17).
21. Though I know how to calculate, sometimes I don't know why this is so: strongly agreed and more so when moving up the grade levels (Figure 18).

3.4.3.5. Textbooks and classroom learning

13. Usually I won't confine to reading the formulas of the textbook but the explanations in it: not quite agreed and least so at S.4 (Figure 19).
14. Teachers often ask us to read the explanation in the textbooks: dropped from 3.49 at P.3 to below the mid-value of 2.61 at S.6 (Figure 20).
16. Reading the textbook is redundant, the teacher will explain everything: generally disagreed (Figure 21).
23. I hope that the textbook could have more pictures, so that I can understand better: strongly agreed though this wish dropped across grade levels (Figure 22).
25. I hope that I could have less homework: basically disagreed except for P.6 (Figure 23).

3.4.3.6. Outside class learning

4. I would use calculators for numerical calculations: strongly agreed (Figure 24).

8. I often read mathematics "outside readers": strongly disagreed in general and increasingly so on moving up the grade levels (Figure 25).
12. I often take part in mathematics extracurricular activities: strongly disagreed in general, all mean ratings below the mid-value, and increasingly so on moving up the grade levels (Figure 26).

3.4.4. Beliefs in mathematics

Two inventories containing 4 subscales were used to tap students' belief in mathematics. The first consisted of the three subscales of "mathematics as calculables", "mathematics involves thinking" and "mathematics is useful", whereas the second concerned the "traditional" mathematics classroom culture where mathematics is perceived as a rigid body of knowledge and learning of it is a kind of transmission. Results revealed that the general perception was really so. The scores of all grade levels were above mid-value. Those of S.3 and S.4 were as high as 3.15 and 3.16. Likewise, "mathematics as calculables" was very strongly agreed, ranging from 3.21 to 3.38. The perception that "mathematics involves thinking" was even stronger, from 3.90 to 4.04, increasing monotonously from P.6 to S.6. As for usefulness of mathematics, in general, students perceived mathematics as a useful subject except we had a relatively low score at S.4 (2.99) (Figure 27-30)

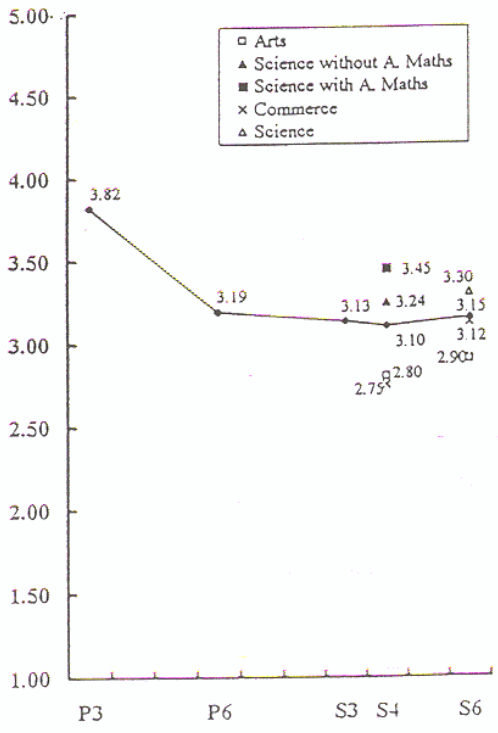


Fig. 2 "I love solving mathematical problem."

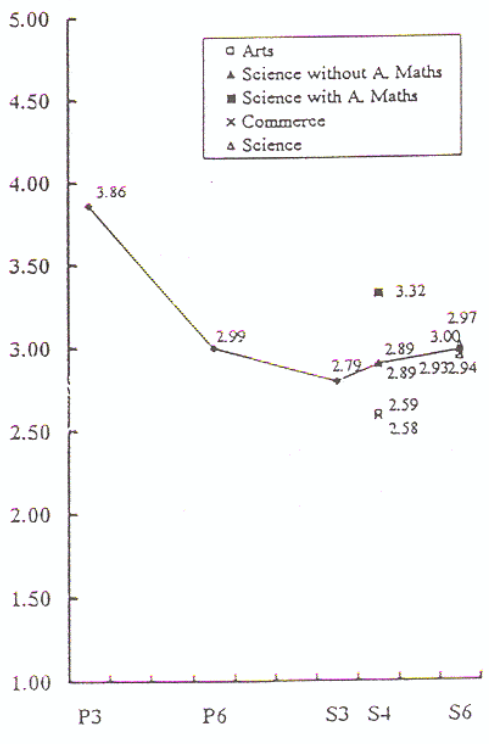


Fig. 3 "My interest in attending mathematics classes is high."

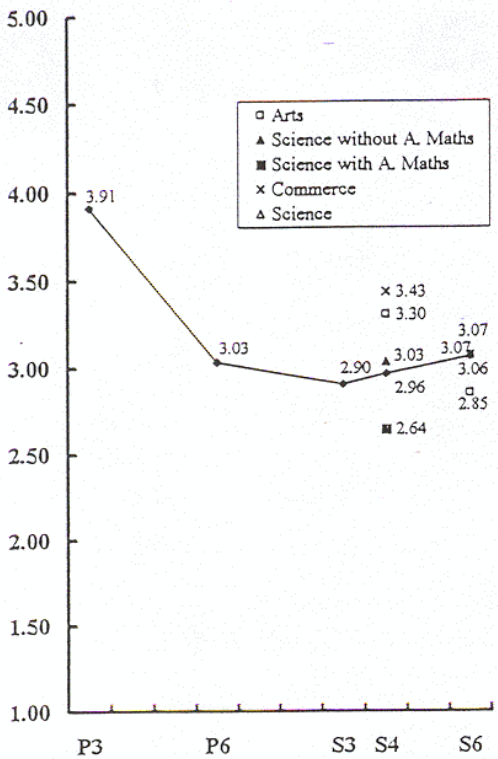


Fig. 4 "I have interest in mathematical calculations."

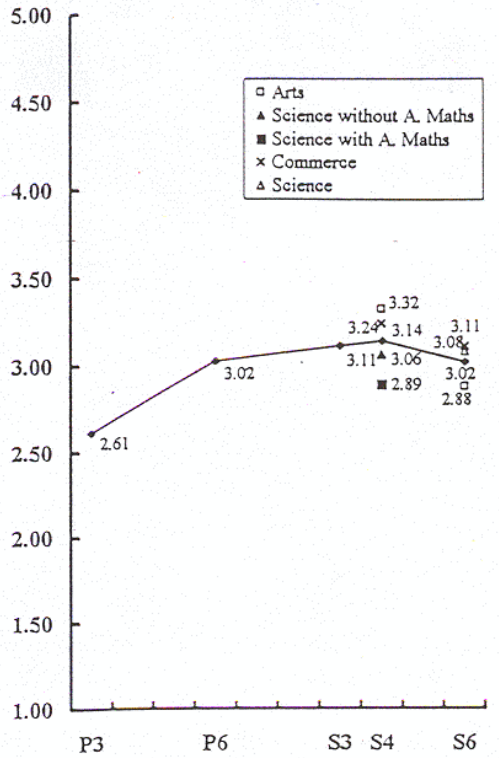


Fig. 5 "I seldom tried those problems not required by the teacher"

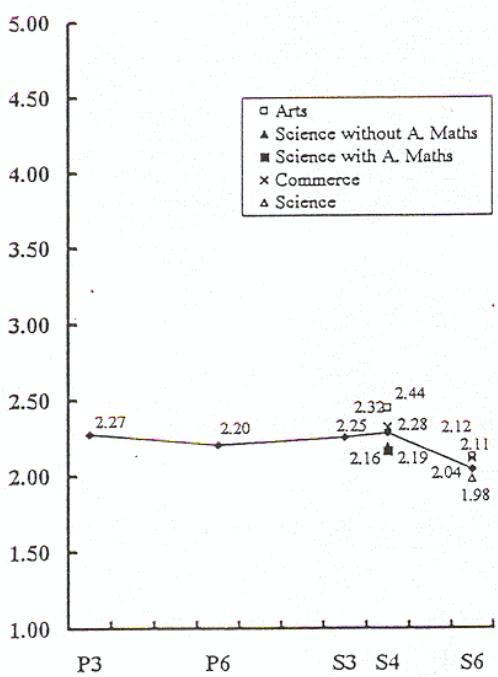


Fig. 6 "Reading the explanations in the textbook is not necessary, we can learn just by reading the formulae."

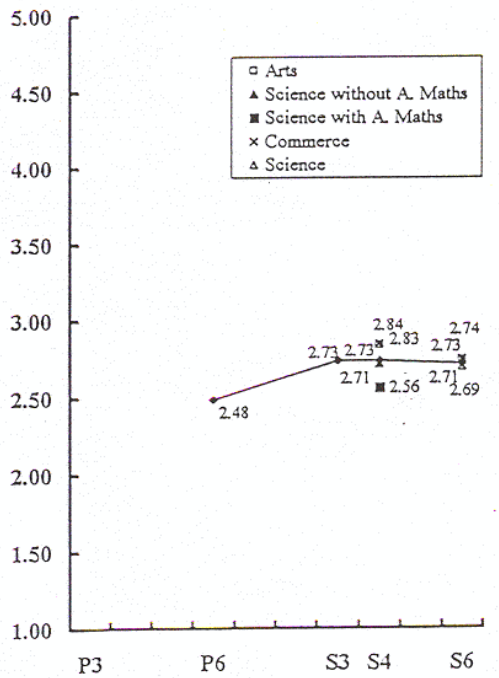


Fig. 7 "When learning a new topic, I wish that the teacher could tell us the formula right away and not ask us to discover."

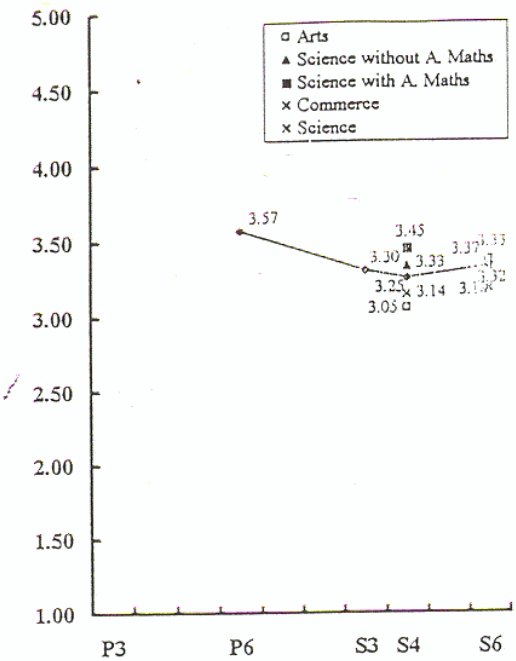


Fig. 8 "When learning new topic, I wish that I could think for it first and not having the teacher telling me everything."

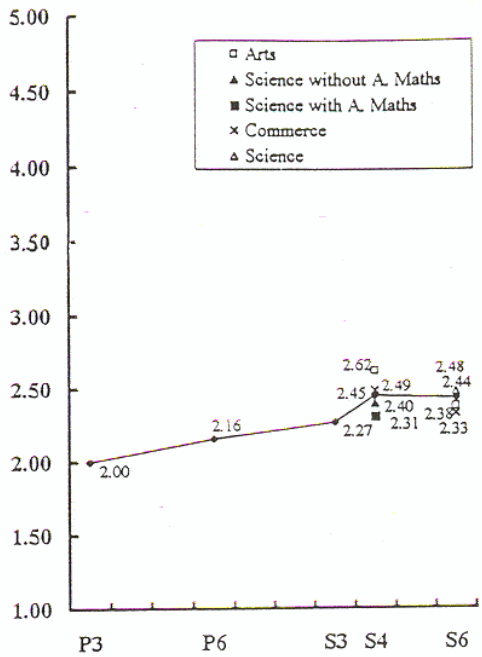


Fig. 9 "Understanding the content is unimportant, knowing how to calculate suffices in coping with examinations."

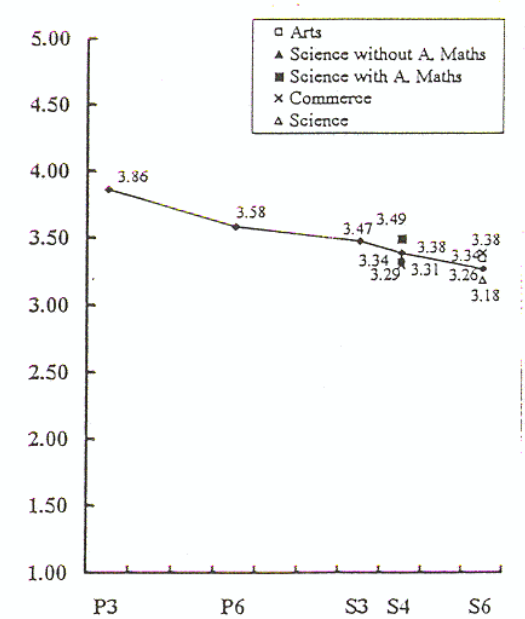


Fig. 10 "If I understand the concept, I can always find a means to calculate the problems."

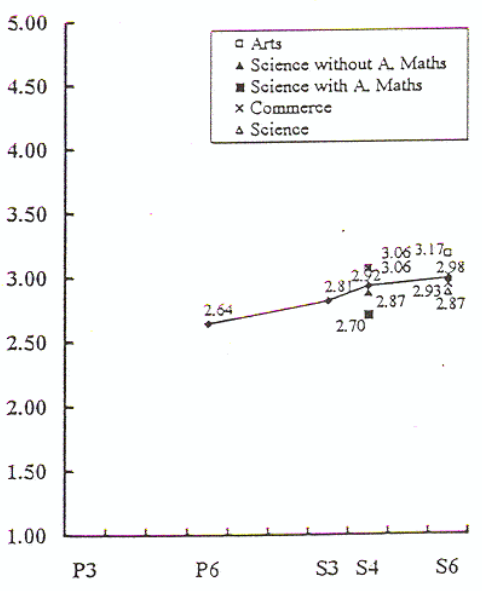


Fig. 11 "In learning a new topic, I am not concerned with how the formulae come about, I only care how the formulae are applied in solving problems."

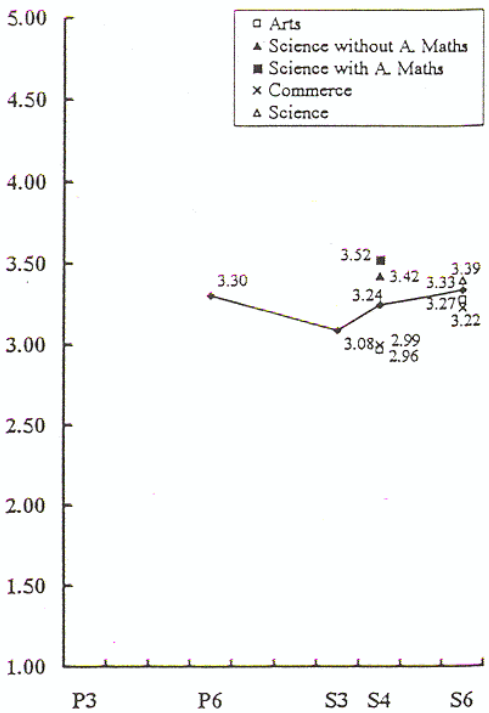


Fig. 12 "I have confidence in problems that involve substituting numbers into formulae."

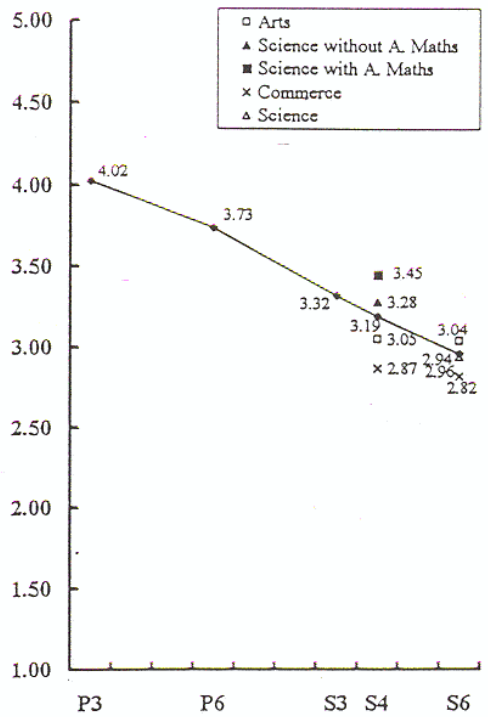


Fig. 13 "I have confidence in purely numerical computations."

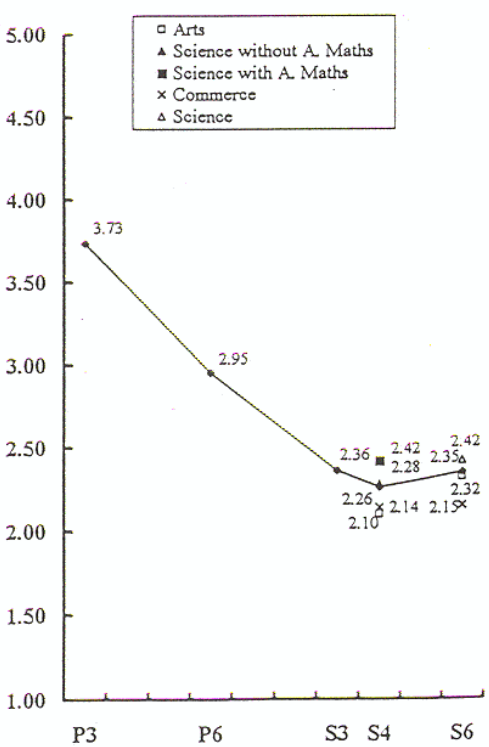


Fig. 14 "I have confidence in solving word problems."

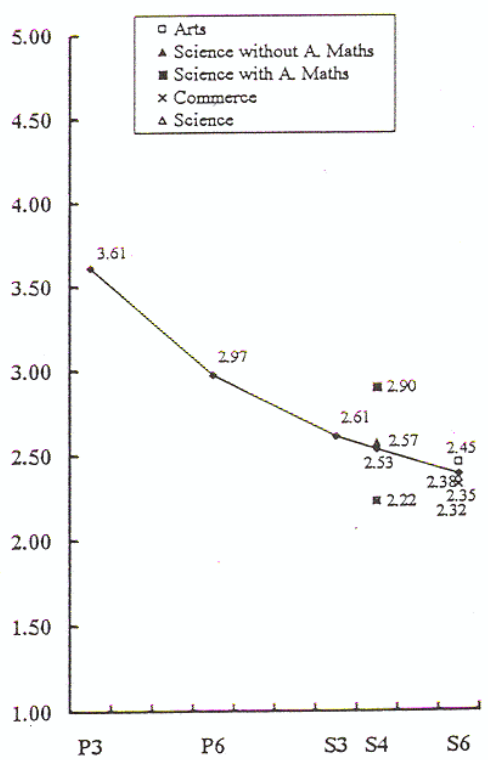


Fig. 15 "I fully understand the content in the mathematics class."

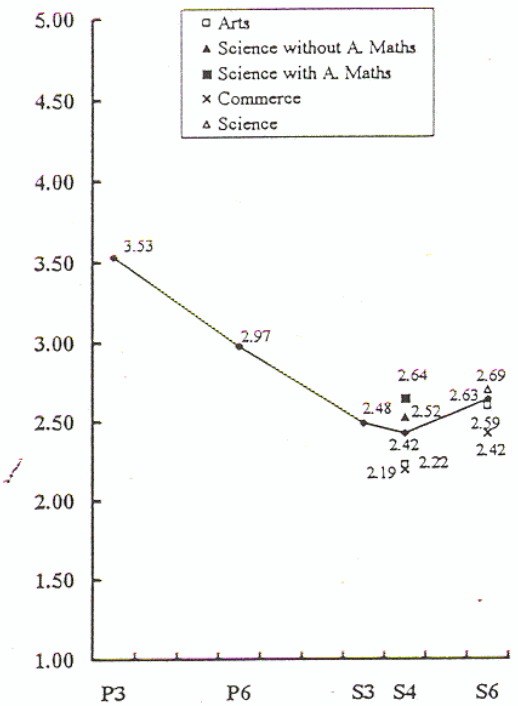


Fig. 16 "Usually I fully understand word problems."

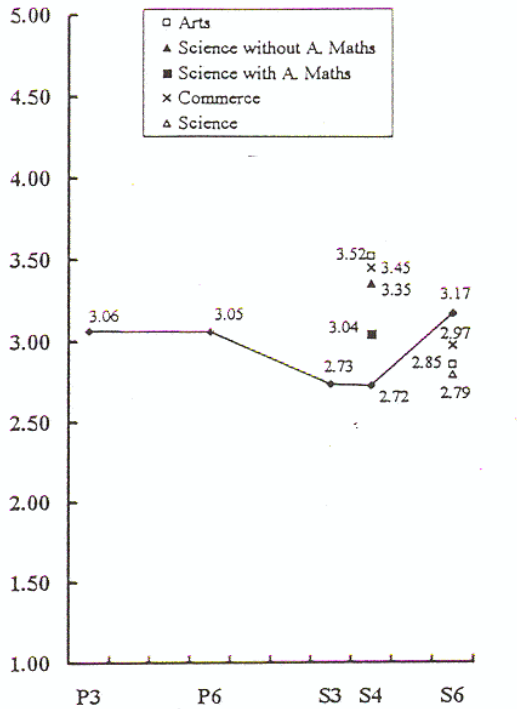


Fig. 17 "I have difficulty in solving word problems."

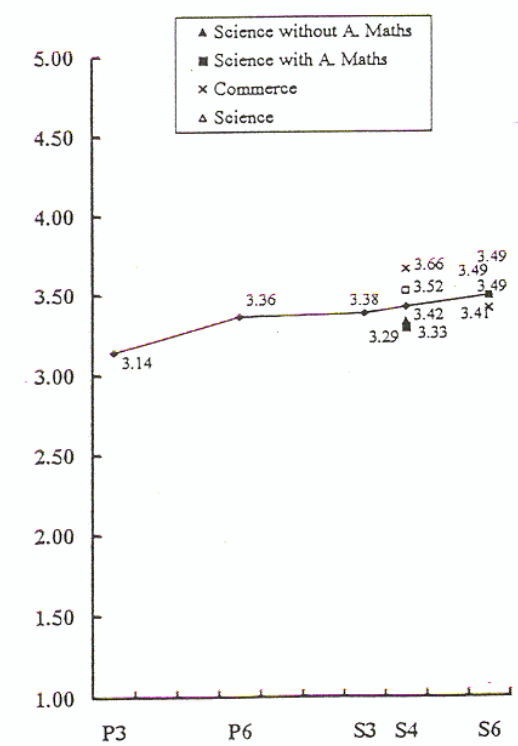


Fig. 18 "Though I know how to calculate, sometimes I do not know why this is so."

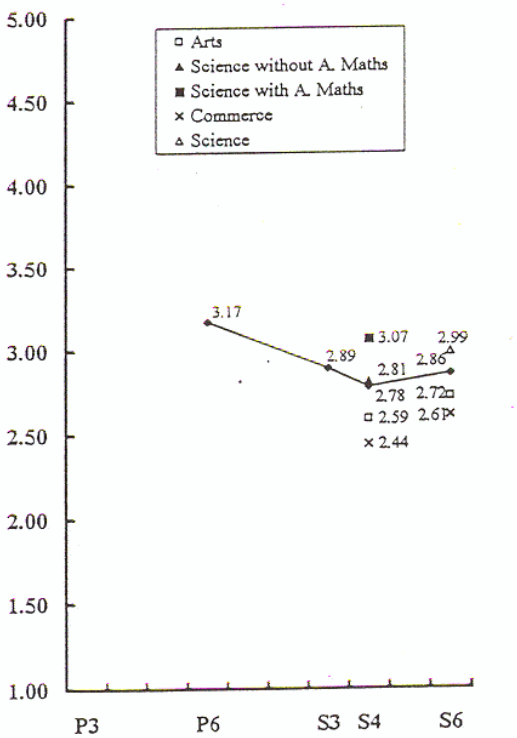


Fig. 19 "Usually I will not confine to reading the formulae of the textbook but the explanations in it."

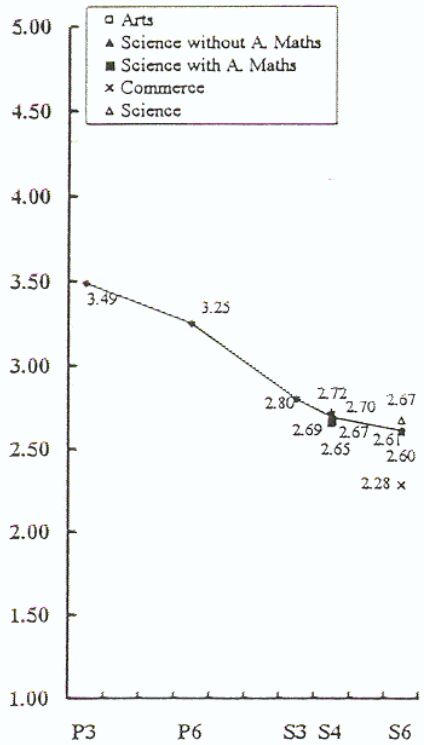


Fig. 20 "Teachers often ask us to read the explanation in the textbooks."

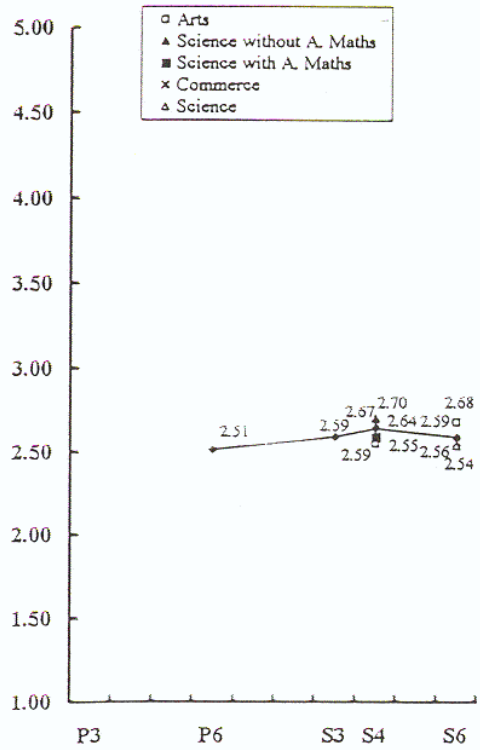


Fig. 21 "Reading the textbook is redundant, the teacher will explain everything."

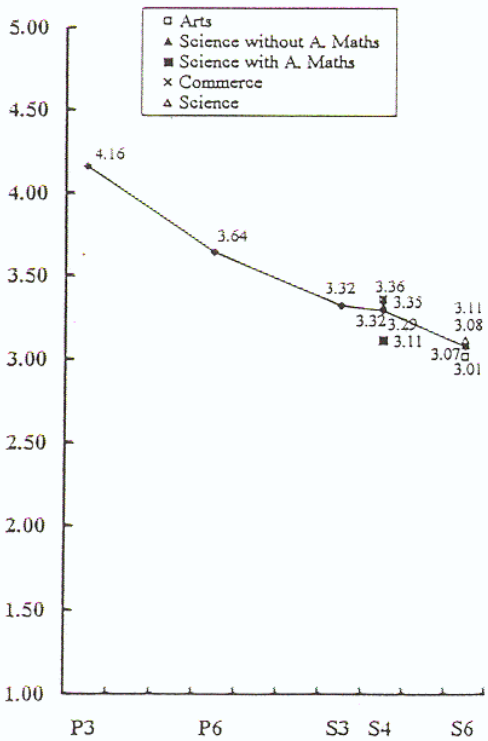


Fig. 22 "I hope that the textbook could have more pictures, so that I can understand better."

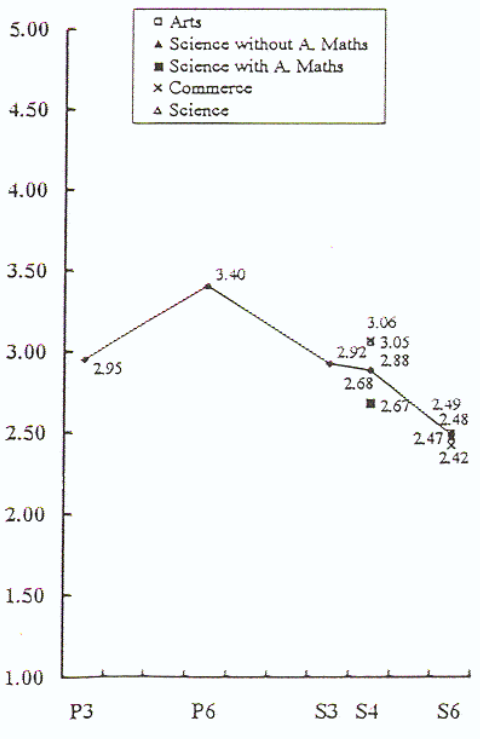


Fig. 23 "I hope that I could have less homeworks."

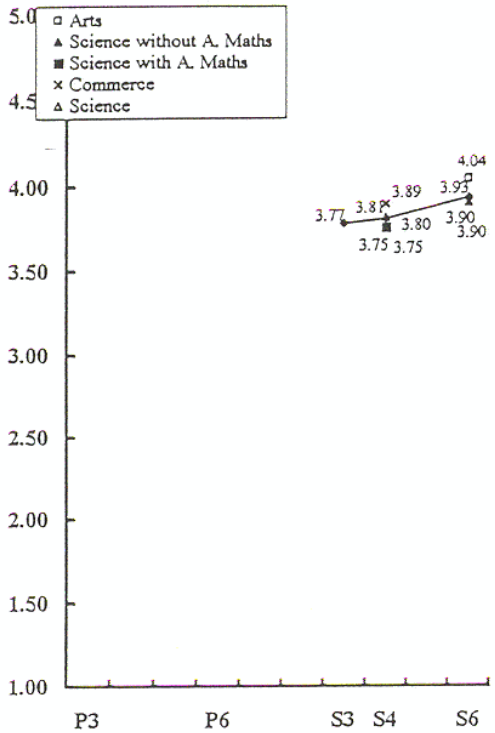


Fig. 24 "I would use calculators for numerical calculations."

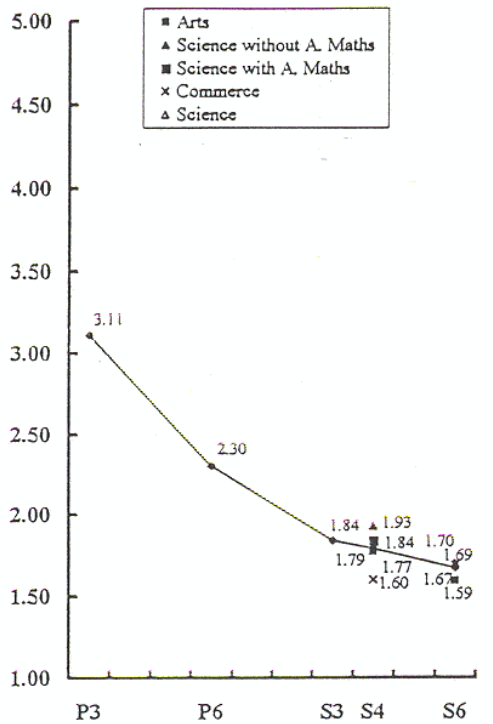


Fig. 25 "I often read mathematics 'outside readers'".

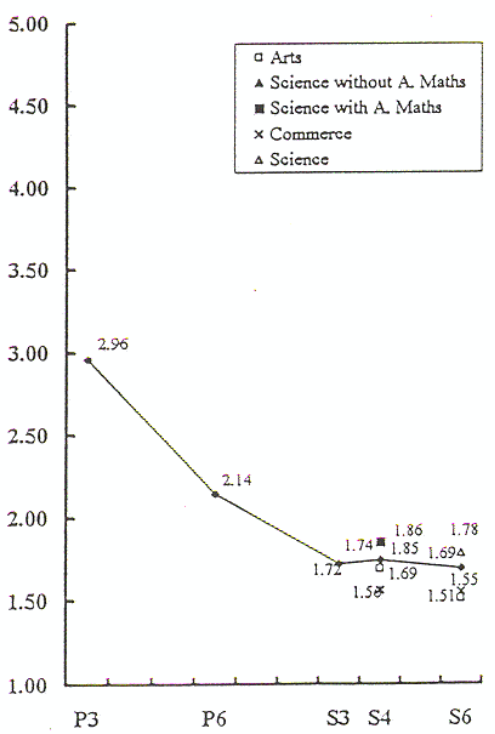


Fig. 26 "I often take part in mathematics extracurricular activities."

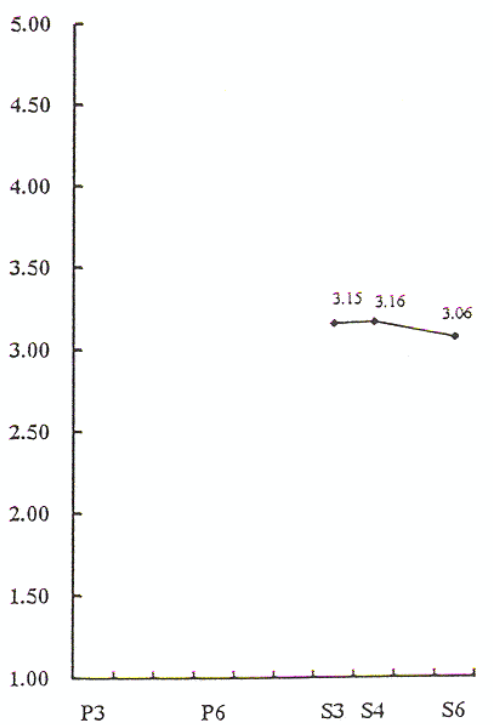


Fig. 27 Math as a rigid body of knowledge.

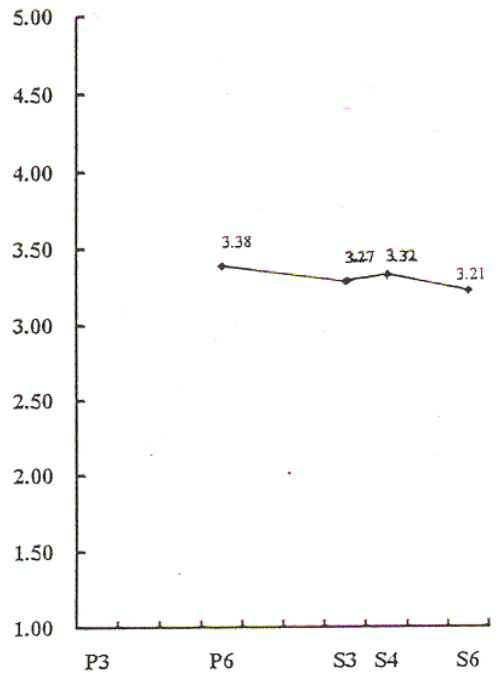


Fig. 28 "Mathematics is calculable."

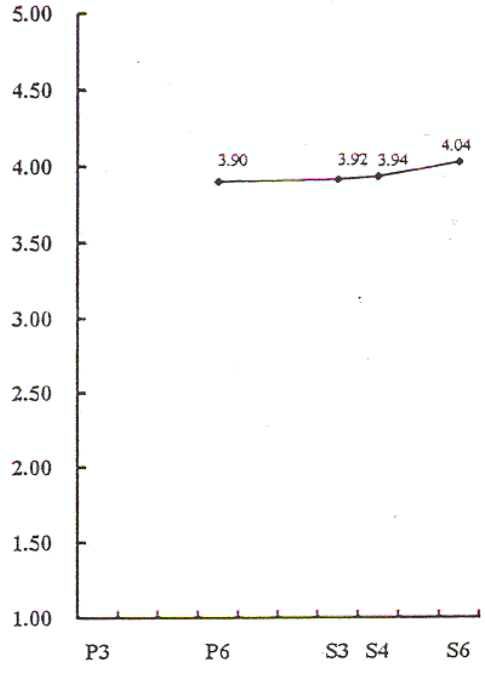


Fig. 29 "Mathematics involves thinking."

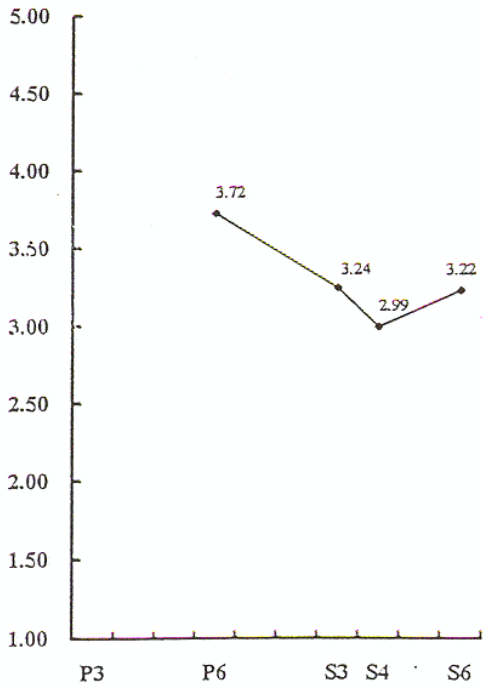


Fig. 30 "Mathematics is useful."

3.4.5. Learning habits

As far as the part on students' learning habits in the questionnaire indicated, on encountering learning difficulties, most P.3 students went for positive ways such as consulting the teacher and felt reluctant to give up. This habit shifted at P.6 when the intention to consult the teacher dropped notably. They began to opt for consulting their classmates. The rate of choosing to give up was still low. This could be easily explained as peer influence begins to take over at the age of adolescence. The attitude towards learning difficulties of S.4 students was most worrying as they had the highest rate of opting for giving up (Figure 31).

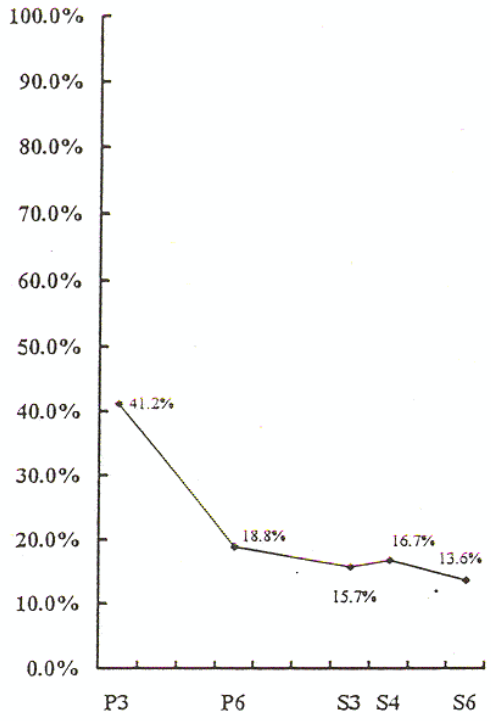
Similar results were found for the case when they could not tackle a mathematics problem, but tendencies to give up set in earlier at P.6. It is also at this grade level where we found the most students not minding copying the work of others and over 40% relied on others to get the solution (Figure 32).

Most of the students did not know how the mathematics they learned could be applied, and the extent they encountered difficulty in learning mathematics increased monotonously up the grade levels. The same was also true for the extent of mathematics topics they did not understand (Figure 33).

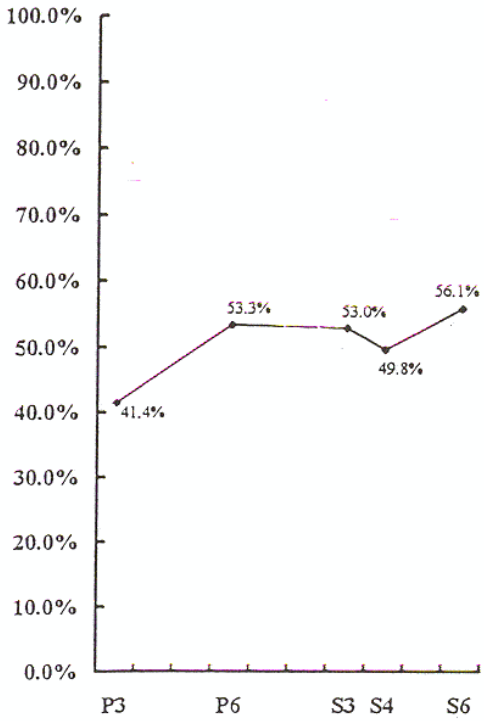
As reported by the students, they used, on the average, 8.13 hours per week on homework, and 2.45 hours per week on mathematics homework. The proportion of mathematics homework was around 30% which was consistent with the figures obtained in prior studies. The highest percentages occurred at grade levels of S.3 and S.4 (Figure 34). Furthermore, over 30% of the students had either private tutors or joined tutorial classes. The case was most serious at P.6, but it is surprising that this percentage rose appreciably again at S.6 (Figure 35).

3.4.6. Responses to open-ended questions

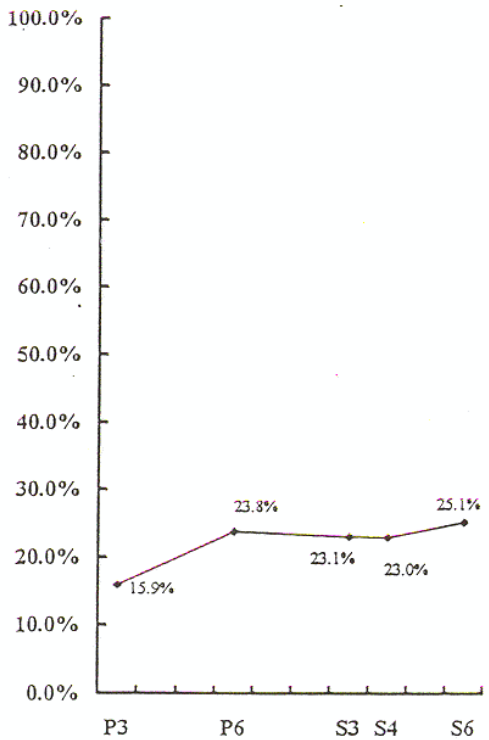
Students' views on the current mathematics curriculum were basically very positive among primary school students, but some S.3 students began to find it difficult. As for S.4, some mentioned specific topics such as trigonometry, circles, polynomials, proportion and variation, inequality and three-dimensional problems as more difficult. The majority of those responses coming from students taking Additional Mathematics considered the subject as difficult. Generally, both S.3 and S.4 students found the curriculum too packed. The coordination between the Mathematics and Additional Mathematics curricula was queried.



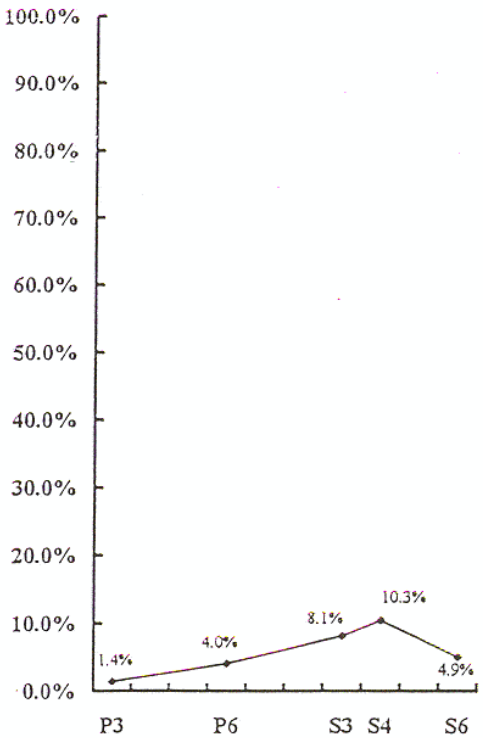
(a) Consult the teacher.



(b) Discuss with classmates

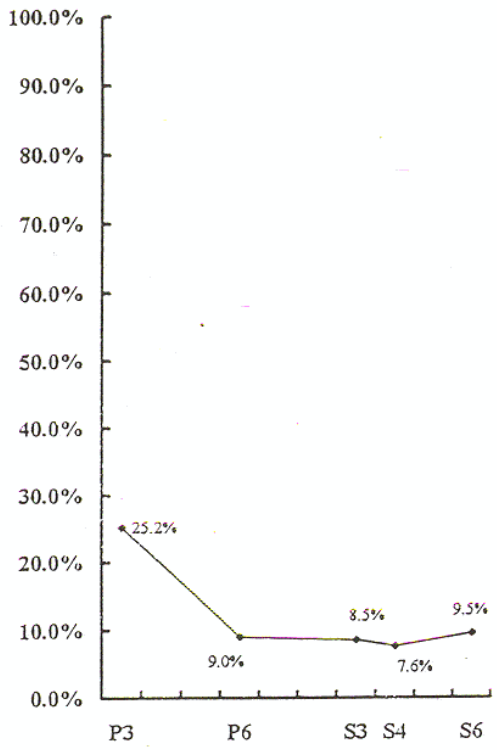


(c) Search for reference.

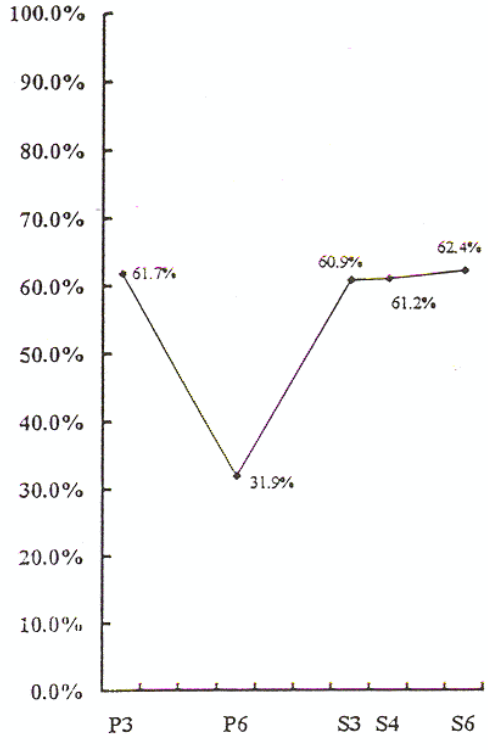


(d) Give up.

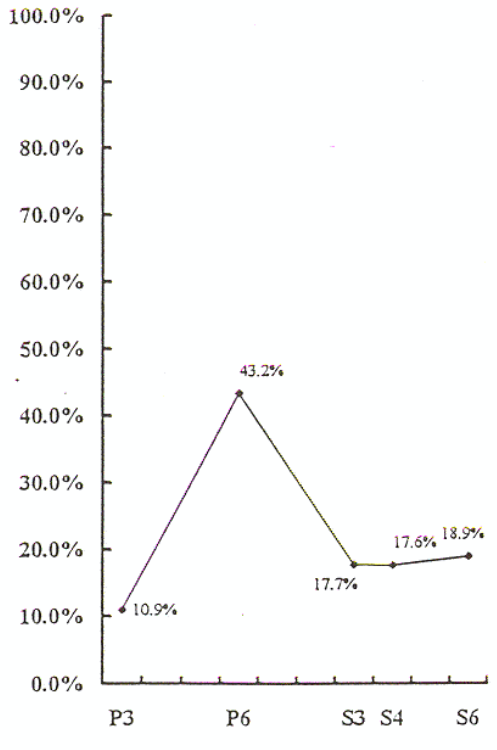
Fig. 31 Seeking help when difficulty found.



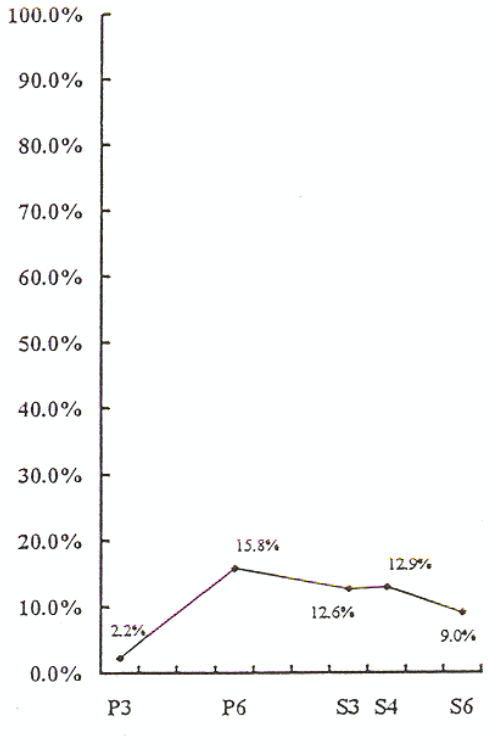
(a) Insist working out by one self.



(b) Accept others' hint.



(c) Accept others' assistance.



(d) Don't mind copying others' work.

Fig. 32 Seeking help when unable to sove a problem.

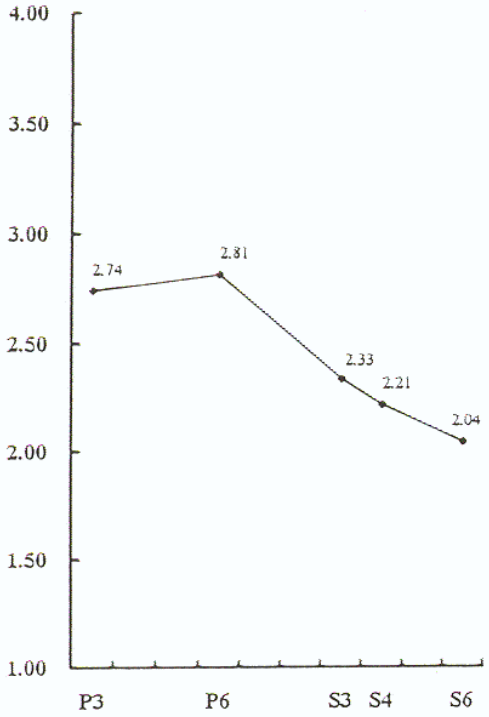


Fig. 33 The extent of topic not knowing their applications

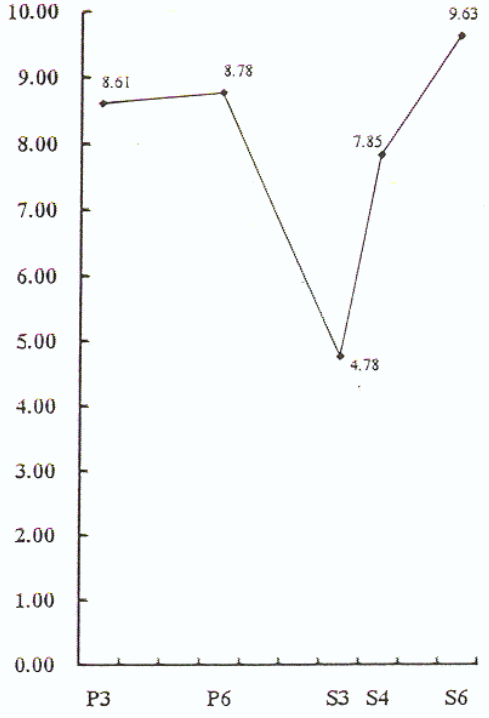


Fig. 34(a) Number of hours spent in week on homework.

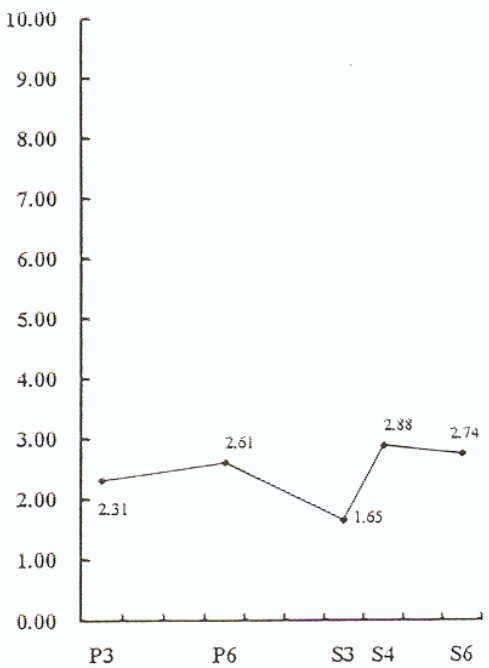


Fig. 34(b) number of hours spent in week on Mathematics homework.

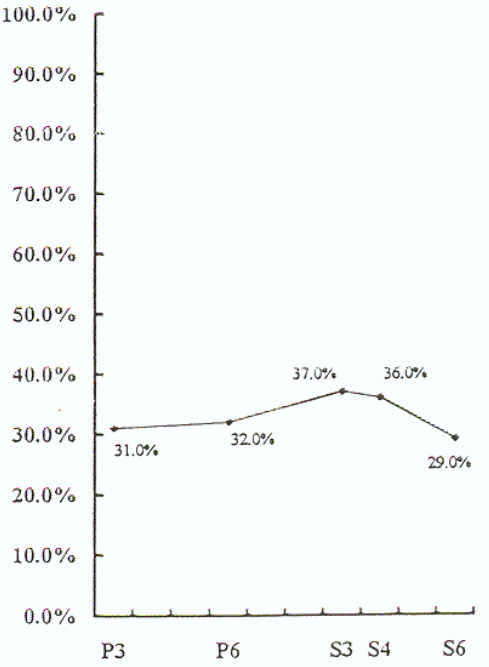


Fig. 34(c) Percentage of hours spent on Mathematics homework.

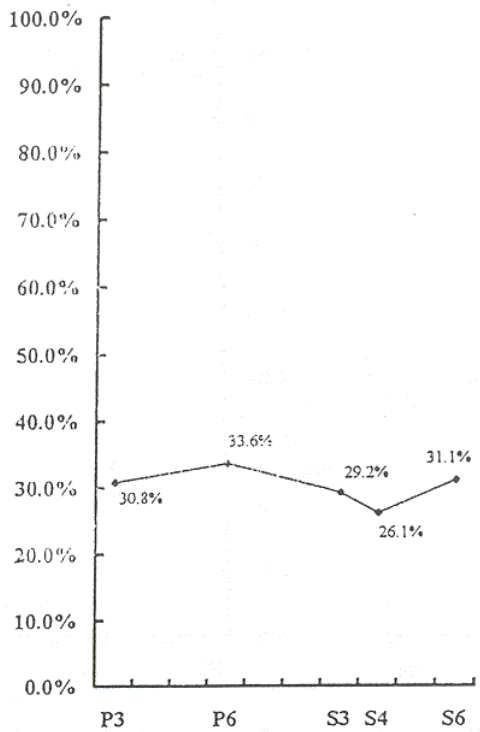


Fig. 35 Having tutors or tutorial classes.

The most salient point that stood out from the responses of P.3 students was that many of them wanted more liveliness and fun in mathematics learning. A number of suggestions were evidenced in students' answers concerning how to make mathematics learning more lively and interesting. More activities, more pictures, clear and detailed explanation, more practices that provoke thinking, a broader and more challenging curriculum were some of their suggestions. Their favourite topics included symmetry and fractions. Paper folding was unpopular. Their opinions on the four rules of arithmetic were quite split. Quite a number of students reflected that they liked it, while a comparable number reflected that they did not.

At P.6, students started to look at the practicality of the mathematics curriculum. This concern persisted through the secondary years, though the focus shifted more to their future career rather than daily life on moving up the grade levels. "Impractical" topics as perceived by P.6 students included figural numbers (number patterns), Roman and Chinese numerals, symmetry and graphs of curves.

Students thought that these topics could be removed from the curriculum. Equation was also among the most unpopular topics, and many students urged for the removal of figural numbers from the curriculum. On the other hand, P.6 students began to feel the need of getting prepared for S.1 studies, and at the same time, a pressure of homework. The demand for effective teaching increased. Liveliness, light classroom atmosphere, good questions that provoke thinking, use of teaching aids, teachers' clear, step-by-step and detailed explanations were seen as conducive to better learning. These demands were in fact shared by the secondary school students.

Apart from the responses common to other grade levels, continuation in the curriculum was one of the main concerns among S.3 students. Some found the S.1 curriculum easy, but the S.2 curriculum difficult, because the latter consisted entirely of new topics. While some students found the S.3 curriculum more like a revision of previously learned topics (except for the new topics of logarithms, pyramid, sphere, and probability), others found the S.3 curriculum much more difficult than the S.2 one. In either case, students thought the S.2 and S.3 curricula should have better linkages. The inadequacy in the enhancement of thinking abilities was also reflected.

The demand for good teaching got stronger in the responses of S.3 students. The fast teaching pace was seen as disadvantageous to conceptual understanding. Some said that examples used by the teacher in class demonstration were far too easy which were incomparable to those that they had to tackle on their own. Language barrier was cited, a new issue that was not common to primary school students.

On top of the various demands on teaching already expressed by students at lower grade levels, S.4 students wanted their teachers to make things manageable for them, to use more examples in demonstration, to treat each topic in greater depth, to show them different ways of approaching problems, and to provide more guidance in the interpretation of problems. They found that fast teaching pace and boring presentation would affect learning in a negative way. The anticipation for quality mathematics textbooks began to emerge at S.4, probably because students began to read textbooks on their own as they were more mature in learning. Most of the students were not satisfied with their current textbooks in which they wanted more examples, examples of different levels of difficulty, relevant and practical materials, more practice exercises, solution guides at the back, and more pictures and

diagrams. Some students found it hard to read textbooks in English and suggested switching to textbooks written in Chinese.

Students from S.6 made additional comments on specific mathematics curricula besides the general comments above. On the whole, they found the subject Mathematics and Statistics difficult and boring. They felt a bridging problem between the subject and the mathematics they learned in S.5. The practicality of the subject was also doubted. They found the subject difficult to comprehend, partially because of the tight teaching schedule needed for this bulky curriculum. This lack of time for thorough understanding might lead to rote memorisation, especially when the "how to" aspect was stressed over the "why" aspect. The great extent in the use of English in word problems made the situation worse, and teachers' knowledge in the subject was also doubted.

Pure Mathematics was generally perceived as a difficult and abstract subject. The issues emerging from the analysis of the responses of S.6 Pure Mathematics students bear a strong similarity to those found in the responses among S.6 Mathematics and Statistics students. On top of the common issues, the great range of variations in the mathematical problems involved brought about great learning difficulties for them.

There were a number of positive comments on the practicality of the Applied Mathematics curriculum, though some students regarded Applied Mathematics as impractical and boring as it looked more like physics than mathematics.

On the whole, a general decline in interest in mathematics from P.3 to S.4 was observed. Students generally strived for understanding in mathematics. Students at lower grade levels looked for liveliness in teaching and the use of teaching aids. Those at higher grade levels demanded for more practicality and relevancy, and they were concerned about getting more help and guidance from the teachers.

3.5. Summary

Generally, students showed interest in mathematics at P.3 but then the interest dropped substantially afterwards, especially at P.6. The interest in attending mathematics lessons was not as intense as that in mathematics itself. They also possessed a very positive attitude towards mathematics, opting for deep understanding rather than rote learning. Items in this aspect were mostly rated as

strongly agreed. The unanimous agreement with the statement "When learning a new topic, I wish that I could think for me first and not having the teacher telling me everything" and strong disagreement with the opposite statement "When learning a new topic, I wish that the teacher could tell us the formula right away and not asking us to discover" may surprise many of our mathematics teachers, though a strong preference for deep learning among Asians is cited in research literature (Watkins & Biggs, 1996). The fact that Asian students realise that understanding is a better way than (and can replace) rote memorisation (Marton, 1997) is again reflected in the present study. The students responses reflected that they were not only concerned how the formulas are applied to solve problems but how the formulas come about. They tended to believe that if one understands the concept concerned, one can always find a means to solve problems.

In addition, the students showed confidence in solving problems, especially numerical and routine problems. However, they had trouble with word problems. Their confidence with word problems dropped as they moved up grade levels, except for S.6. There is indication that students had difficulty with non-routine problems and it is possible that competence in language (English, in most of the cases) might have obscured performance in solving mathematical problems.

However, this does not mean that students did not encounter problems in learning mathematics. They faced real (actual) learning problems. As mentioned above, this could be the discrepancy between what one hopes for and what one can really do. This could be the source of frustration and helplessness. The strong agreement with "Though I know how to calculate, sometimes I don't know why this is so" may show this feeling lurking behind.

When we look at the perceived difficulty levels of topics, we get a pessimistic picture. On moving up the grade levels, students' attitude towards mathematics learning became more and more negative and they perceived greater difficulty in the topics learned. There are a number of speculations. Mathematics is an "accumulative" subject. Decreasing interest and accumulating learning problems at junior forms may grow up into major learning difficulties in senior forms, especially when the content becomes more abstract and requires more conceptual understanding.

If our students have a basic interest in mathematics and have a high regard for mathematics, their declining performance could be attributed not only to their

competence, but also to the mismatch of the curriculum in a broader sense. We should reflect upon whether our intended curriculum (curriculum documents, textbooks) and our implemented curriculum (including classroom teaching and teaching style) could cope with the needs and maintain the interests of our students. The strong hope for more pictures in the textbooks could be an indication of the urge for liveliness in teaching and teaching materials. The lack of participation in mathematics extracurricular activities (including "outside readers") as students' responses indicated lends more support to this speculation. Whether the problem lies in the lack of provision (of extracurricular activities), lack of enthusiasm in participation or lack of time due to heavy homework needs further investigation and is beyond the scope of this research.

Two grade levels appear to be more crucial in our research. Interest dropped prominently at P.6, and P.6 was the only grade level that students hoped for less homework. We are not sure from this questionnaire study whether this was a consequence of the "AAT (Academic Aptitude Test) - syndrome" or not. But definitely, over-drilling can hamper understanding. Understanding may need both room and leisure. Disinterest in reading mathematics textbooks, reluctance to understand explanations (etc.) were particularly found at S.4. Also, S.4 was the only grade level at which students perceived mathematics as not such a useful subject. The rate of opting for giving up (when facing learning difficulties) was highest at this grade level too. The cause might be dated back to the year P.6 at which most students relied entirely on others' help in completing their mathematical problems. They even did not mind copying the works of others. A possible explanation why it was so serious at S.4 could be that, basically, students became more and more negative towards mathematics on moving up the grade levels from P.6 to S.5. Apparently, there was a turn-back at S.6 which might be due to a screening (of around 30% of students) based on academic achievement from S.5 to S.6. Those who could remain in the school system were therefore more academically motivated.

It is not easy (and may not be desirable too) to summarise a trend of topics which students found the most difficult (or the easiest). But it seems that topics that involve technical (if not tedious) manipulations were least welcome by the students whereas those with visual and hands-on experiences were students' favourites. Apparent difficulty and impracticality were also some of their concerns.

Responses from the open-ended questions basically revealed similar results. Liveliness and clear explanations of the teachers were students' sole concerns. The decline of interest in the subject on moving up the grade levels was salient. Students began to feel the pressure of homework at P.6. They were also concerned with the disruption in learning that originated from the preparation for the Academic Aptitude Test. Students at S.3 found the junior secondary mathematics fragmented. The repetition of S.1 mathematics topics already learned at primary levels and recurring topics at junior secondary had allegedly distracted the students from seeing the trunk progression of the curriculum. The greatest percentage of students tending to give up mathematics occurred at S.4. Senior secondary students in general felt that the current Mathematics/Additional Mathematics curriculum structure could not cater for their individual needs, in particular, for those studying in the Arts stream. Students at S.6 had similar problems, saying that Pure Mathematics was too abstract and the other two subjects (Mathematics & Statistics and Applied Mathematics) were too impractical. Continuation and connection between sixth-form mathematics and senior secondary mathematics were queried as well.

There were a number of topics the student wanted to remove from the curriculum, as they were perceived as either difficult or impractical (irrelevant). Examples are paper-folding (at P.3), equations (at P.6; too difficult), and figural numbers (at P.6; impractical). While S.3 students regarded coordinate geometry of straight line, common logarithm, probability and statistics, and inequalities as difficult, S.4 students mentioned, in this connection, trigonometry, circles, polynomials, proportion and variation, inequalities, and 3-dimensional problems.

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