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A Study of Basic Numeracy Skills: Primary Education Student Teachers at the Institute of Education (Singapore)

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ABSTRACT

This study concerns the basic mathematical skills and attitudes of prospective primary school teachers at the Institute of Education, Singapore. The study was prompted by a concern for basic standards in mathematics education.

As these trainees are admitted to the Institute of Education on the basis of their overall Cambridge A-Level Examination results, it is conceivable that not all of them possess a strong mathematical background. At the Institute, they take a compulsory methodology course — Teaching Mathematics in the Primary School, preparing them to teach Mathematics in the Primary school. Despite the varying mathematical background, there is no optional or compulsory mathematics content course available in the curriculum to equip the needy and neither are they required to pass any mathematics test before graduating from their teacher training programme.

A test comprising 40 testing skills items adapted from the Primary Teacher Education program of the St George Institute of Education (SGIE) in Sydney was administered to 173 (15 male and 158 female) 2nd year Certificate-in-Education students at the Institute of Education in February 1990. At the SGIE, all students of the Primary Teacher Education Program are required to pass a basic skills test in mathematics at the 75% mastery level.

At the Institute of Education, 18.5% (or 32) of the students failed to obtain a pass at the 75% mastery level although the mean score for the sample was 33.68.

The study also shed light on the trainee teachers' perceptions of mathematics as a subject, and personal confidence in doing and teaching mathematics.

Numeracy skills, pre-service teachers

Introduction

This study concerns the basic mathematical skills and attitudes of prospective primary school teachers at the Institute of Education, Singapore. The study was prompted by a concern for basic standards in mathematics education and in particular, the ability of trainee teachers to handle basic primary mathematical skills which could reasonably be expected of primary education teachers.

A skills test based on 40 items, adapted from the Primary Teacher Education program of the St George Institute of Education (SGIE) in Sydney, was used for the study. A number of details relating to the students' backgrounds and attitudes were included on a cover sheet for the test. A copy of the test which includes both routine calculations and simple problems across a variety of content areas is included as an appendix.

At the SGIE, all students of the Primary Teacher Education Program are required to pass the basic skills test in mathematics at the 75% mastery level as part of their Primary Teacher Education program.

In Singapore, primary school teachers are non-graduates who have to teach English, Mathematics and Science among other subjects. These trainees are admitted to the Institute of Education on the basis of their overall Cambridge A-Level Examination results. Since all of them have to take a course on Teaching Mathematics in the Primary School, it is conceivable that not all of these trainees possess a strong mathematical background. Table 1 shows that only 21% of the total sample passed A-Level Mathematics,

although all of them have a pass in O-Level Mathematics. 76% of them did not have Mathematics at A-Level. English is the main language of instruction in Singapore schools. All students passed the O-Level English Language paper. Hence the students have no difficulty with the English Language.

TABLE 1: LEVEL OF MATHEMATICS

	O-Level Maths			A-Level Maths		
	Pass	Fail	Nil	Pass	Fail	Nil
All	100	–	–	21	3	76
Females	91	–	–	20	2	78
Males	9	–	–	33	13	54

Note: All figures are shown as percentages

In February 1990, all the second year Certificate-in-Education students taking the course on Teaching Mathematics in the Primary School were given the test which did not form part of their formal assessment.

Overall Results

The test questions were marked correct or incorrect with no part marks being awarded. The mean for the group of students is indicated in Table 2. The mean was slightly greater than the 75% mastery level required to pass the test.

TABLE 2

Mean = 33.68 (81.5%), Number = 173
Fail test = 32 (18.5%) i.e. < 30/40 correct

The distribution of scores on the test is presented in Table 3. Results show quite a widespread in results with considerable numbers of students at the high levels of the distribution. Of concern is the number of students who fall far below the 75% mastery level.

TABLE 3: SCORE DISTRIBUTION

Score	1-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40
Frequency	0	0	1	5	7	19	69	72

Analysis of Results by Content

The first 20 questions on the test concentrate on basic calculations involving whole numbers, traditional fractions as well as decimals and percentages. These questions presented fewer difficulties for students than the final 20 questions which involved simple problem solving situations. The test covered a range of different calculating skills. A number of areas of computational weaknesses were identified. These were

(a) arranging three fractions in order
(b) multiplying fractions
(c) finding prime factors
(d) multiplying decimals (including decimal point errors)
(e) conversion of different representations of fractions (e.g. fractions to decimals, decimals to fractions, percentages to decimals)

It could be argued that some of the skills above are not used very frequently and more so with the availability of the calculator but then, do not teachers require a broader background.

The problem section of the test presented most difficulties for students. Experience has shown that while many students might have a knowledge of concepts such as area and perimeter, difficulties are experienced in applying the concepts in less routine situations especially where more than one concept or more than one step is involved. Difficulties are also experienced with volume, speed, proportion, costing and discounts.

Analysis of Results by Subject Area

Questions were also grouped according to broad subject areas to ascertain general areas of weaknesses. Subject areas include geometry, traditional fractions and decimals. This information is presented in Table 4. The areas of geometry and general problem solving were the poorest.

TABLE 4

ITEM	MEAN
Score (/40)	33.68
Geometry (/9)	7.03
Fractions (/10)	9.04
Decimals (/3)	2.82
Calculations (/20)	18.21
Problems (/20)	15.49

Student Attitudes

In addition to having the skills and knowledge for teaching Mathematics, the attitudes of teachers are very important in developing young children. Student attitude results are shown in Table 5. The values were measured on a five point scale with 3 being the 'neutral' point and 5 being the maximum. Values of 4.0 and higher are underlined to indicate positive scores.

TABLE 5 : MEANS FOR SEPARATE ITEMS

ITEM	MEAN SCORE
dislike/like	3.83
not important/important	<u>4.45</u>
boring/interesting	3.83
not/very confident	3.49
insecure/secure	3.80
bored/enthusiastic	<u>4.02</u>

SCORE DISTRIBUTION

ITEM - dislike/like

Score	1	2	3	4	5	Total
Frequency	2	11	44	74	42	173

ITEM - not important/important

Score	1	2	3	4	5	Total
Frequency	0	0	14	67	92	173

ITEM - boring/interesting

Score	1	2	3	4	5	Total
Frequency	2	11	46	70	44	173

ITEM - not/very confident

Score	1	2	3	4	5	Total
Frequency	3	9	72	78	11	173

ITEM - insecure/secure teaching

Score	1	2	3	4	5	Total
Frequency	1	10	50	73	39	173

ITEM - bored/enthusiastic

Score	1	2	3	4	5	Total
Frequency	0	3	37	86	47	173

Results may be summarised as follows:

(a) Most students felt Mathematics was important and were enthusiastic about teaching Mathematics.

(b) The attitudes of liking, interest, confidence, and security to teaching Mathematics did not rate highly although many students rated items as 4 or 5.

A table of correlation coefficients was constructed. This is shown below in Table 6.

TABLE 6 : CORRELATION COEFFICIENTS NO. OF STUDENTS = 173

Item (20=score)	21	22	23	24	25	26	27	28	29	30	31
20	0.31	0.23	0.23	0.27	0.22	0.44	0.44	0.19	0.05	0.06	0.62
21 like		0.40	0.79	0.68	0.64	0.57	0.19	0.18	0.10	0.17	0.27
22 importance			0.45	0.27	0.25	0.32	0.17	0.11	-0.09	0.12	0.23
23 interest				0.58	0.53	0.49	0.15	0.22	0.04	0.21	0.26
24 confidence					0.71	0.52	0.21	0.18	0.17	0.20	0.27
25 secure						0.63	0.16	0.14	0.12	0.19	0.24
26 enthusiastic							0.02	0.03	-0.05	-0.10	0.09
27 geometry								0.33	0.11	0.42	0.87
28 fractions									0.16	0.87	0.40
29 decimals										0.30	0.15
30 calculations											0.48
31 problems											

* Coefficients underlined are not significant at the 0.05 level.

The results may be summarised as follows:

(a) The correlation coefficients between the attitudinal results and the test scores are all relatively small (less than 0.45).
(b) The highest correlation linking attitude and performance was between enthusiasm in teaching and score (0.44).
(c) Confidence in doing Mathematics related highly with feeling secure teaching Mathematics (0.71) and liking the subject Mathematics (as may be expected) related highly with Mathematics being interesting (0.79).
(d) The correlation between the total test score and score on problems was reasonably high (0.62).

Conclusions

The purpose of the study was to examine the basic Mathematical skills and attitudes of prospective primary school teachers at the Institute of Education, Singapore.

(a) The study shows that the admission requirement of an O-Level pass in Mathematics for the Certificate-in-Education programme at the Institute of Education is a fairly accurate yardstick.
(b) There are a number of students at the Institute who need to improve their level of basic Mathematical skills before they become teachers. For such students, the availability of an optional Mathematics content course other than the compulsory methodology course — Teaching Mathematics in the Primary School, may be of help.
(c) Changes in the primary school curriculum have resulted in increased attention to problem solving and geometry (especially spatial thinking) which are shown by this study to be major areas of weakness. Due attention must be given to these two broad areas of mathematics in the compulsory methodology course.
(d) Although most students feel that Mathematics is important, the attitudes of many students to Mathematics need improving. After all, the attitudes of the teacher will be evident in the classroom.

APPENDIX

Institute of Education
Statistical Information
Cert Ed II (July 1988 intake)

Name : _____ Group : _____

Sex : _____ Age (months) : _____

Write down the grade and year of taking the following subjects.

Subject		Grade	Year
English (O-Level)			
L2 (O-Level)			
O-Level	E Maths		
	Add Maths		
A-Level	AO Maths		
	Maths		
Other	Maths		

How do you feel about mathematics as a subject? (Please circle one number for each description.)

Dislike	1	2	3	4	5	Like
Not Important	1	2	3	4	5	Important
Boring	1	2	3	4	5	Interesting

How confident do you feel about doing mathematics?

Not Confident	1	2	3	4	5	Very Confident

How do you feel about teaching mathematics?

Insecure	1	2	3	4	5	Secure
Bored	1	2	3	4	5	Enthusiastic

Mathematics Skills Test

Time allowed: 1 hour **ATTEMPT ALL QUESTIONS**

Write all answers in the space provided. Show all essential workings. **Calculator is NOT allowed.**

1. Write as a numeral: forty five thousand and thirty six _____
2. Arrange the following fractions in order from smallest to largest:
   1/3 3/8 5/16 _____
3. 437 + 649 + 79 + 2135 _____
4. 78 X 642 _____
5. 8042 – 963 _____
6. 1218 divided by 14 _____

In questions 7 to 9 express the answers as mixed numbers:

7. $7\frac{4}{5} + 2\frac{9}{10}$ _____
8. $4\frac{5}{8} - 2\frac{3}{4}$ _____
9. $3\frac{1}{4} \times 1\frac{1}{8}$ _____
10. Express 360 as the product of its prime factors. _____
11. 3.028 + 1.765 _____
12. 4.05 – 3.675 _____
13. 1.675 X 0.19 _____
14. Convert 5/9 to a decimal. _____
15. Convert 0.875 to a fraction in its simplest form. _____
16. Find 15% of $9.00. _____
17. Convert 35% to a fraction in its simplest form. _____
18. Convert 7/20 to a percentage. _____
19. Convert 4.7% to a decimal. _____
20. What is the average of the numbers 57, 67, 59 and 84? _____

Questions 21 to 26 refer to the following information.

A rectangular garden plot 5 m by 6 m has a concrete path 1 m wide around it. The concrete in the path is 10 cm thick.

21. What is the area of the garden plot? _____
22. What is the perimeter of the garden plot? _____
23. What is the outer perimeter of the path? _____
24. What is the area of the concrete path? _____
25. How many cubic metres of concrete are in the path? _____
26. What is the cost of concreting the path if concrete costs \$20 per cubic metre with a delivery charge of \$15 per load? _____

Questions 27 to 30 refer to the following information.

A car leaves Singapore at 8.15 am and travels to Malaysia for three and a half hours covering a distance of 300 km.

27. At what time did the car arrive at its destination? _____
28. What was the average speed for the journey? _____
29. How long would it take to cover the same distance if the average speed was 80 km/h? _____
30. If the car used 25 litres of petrol for the trip, what was the petrol consumption in km/litre? _____
31. A concrete mix is made by volume 3 parts gravel, 2 parts sand and one part cement. In 18 cubic metres what is the volume of (a) cement? (b) sand?

    (a) _____

    (b) _____
32. The diagram shows a shape made of a rectangle 3m by 2m with a semicircle at the top.

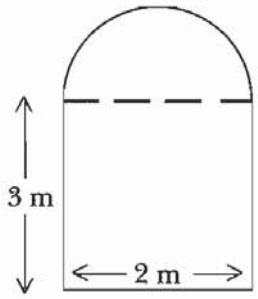
    Find

    (a) the perimeter

    (b) the area

    of the shape.

    Take π to be 3.14



    (a) _____

    (b) _____
33. A rectangle is twice as long as it is wide. If the perimeter is 36m, what is its (a) length (b) area?

    (a) _____

    (b) _____

Questions 34 to 37 refer to the following information.

A parking station charges 50 cents for the first hour and 30 cents for each additional hour or part thereof. If a motorist enters the car park at 8.15 a.m. and leaves at 2.45 p.m.,

34. How long was the car in the parking station? _____
35. How much was the motorist charged for parking? _____

36. What would be the charge for a 9 a.m. to 5 p.m. day, if 10% discount is offered? _____

37. If a person parks 9 a.m. to 5 p.m. for a five day week and pays a special weekly fee of $10, how much is saved on the normal daily discount rate? _____