DOCUMENT RESUME

ED 188 561 HE 012 922

AUTHOR Brown, Stephen; Nathenson, Michael
TITLE Designing Instructional Materials: Guesswork or Facts?
INSTITUTION Open Univ., Walton, Bletchley, Bucks (England). Inst. of Educational Technology.
PUB DATE Nov 78
NOTE 38p.

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Academic Ability; *Basic Skills; *External Degree Programs; Foreign Countries; Higher Education; *Instructional Materials; Instructional Systems; Introductory Courses; Language Skills; Mathematics Anxiety; *Science Programs; *Social Sciences; Technical Education
IDENTIFIERS *Open University (Great Britain)

ABSTRACT

A systematic study is reported of the mathematical skills and learning abilities of new students immediately prior to entry into the Open University's (England) foundation courses in technology and social sciences. The intent was to provide predictive information about potential student entry skills for the team preparing a new technology foundation course. Basic language and mathematical skills were assessed by a questionnaire-test given to a sample of applicants for the courses. It was found that mathematical skills were an area needing special attention, and changes in course materials and schedules are proposed to assist students in developing the skills in the course. It is concluded that such systematic evaluations of critical learner skills are needed as a prerequisite to the design of instructional material for other courses, both at the Open University and in other institutions. (MSE)

ABSTRACT

This is a report of a systematic study of the mathematical skills and learning capabilities of new students immediately prior to entry into T100 and D101, the Open University Foundation Courses in Technology and Social Sciences respectively. The aim of the Study was to provide predictive information about potential student entry skills for the Course Team preparing T101, the new Technology Foundation Course.

The report describes the method used in the study and explains how it forms part of an overall strategy for ensuring that the design of the instructional material to be used in T101 is based on the known learning capabilities and requirements of its likely students. The findings of the study are reported briefly and the problems and advantages of using this kind of approach to curriculum development are discussed.

Designing Instructional Materials:

Guesswork or Facts?

Stephen Brown

and

Michael Nathenson

The Open University

November 1978

BACKGROUND TO THE STUDY

Undergraduates of the Open University are normally required to take two foundation courses towards their degree. Each foundation course is considered to be the equivalent of six months full-time study or one year part-time. There are five foundation courses, one for each of the following faculties: Arts, Social Sciences, Science, Mathematics, Technology.

A major task for foundation courses is to bridge the gap between school and university level study in terms of students' study, communication and dialectical skills. The Open University was created to provide educational opportunities for people who have missed out for some reason on the education facilities available to them in earlier life. Consequently, Open University students come from a wide range of backgrounds, employment and education, and they can differ widely on entry in terms of age, skills and knowledge. A distinctive feature of foundation courses therefore must be their breadth of appeal and their ability to meet the educational requirements of an extremely diverse student population.

T101 is the code number of the new Open University Technology Foundation Course entitled "Living with Technology". It is planned to replace the existing course (T100: The Man-Made World) in 1980. T101 is a course about technology rather than in technology in the sense that it is concerned with the ways in which technology influences both our present way of life and our future. The team responsible for producing the course, the Course Team, believes that Living with Technology will be of vital interest and relevance to a broad spectrum of students, not just those with an interest in the engineering aspects of technology. Consequently, the Course Team wants to present the course in a way which will make it accessible to students whatever their previous background or skills.

A basic and, on the face of it self-evident, tenet of good teaching is that the teaching material should be matched to the skills and learning abilities of the students at whom it is directed. That is to say, the teaching material should begin at a level which corresponds to the skills of the students immediately prior to taking the course and it should proceed at a pace consonant with their abilities to assimilate the new material.

Despite the obvious common sense of this approach it is not always carried out in practive for a very good reason. At the time the teaching material is being prepared neither the entry skills nor the learning cabililities of the future students known.

In the case of T101, the target student population for the new Technology Foundation Course is broader than that currently registered for T100. Table 1 shows that only 11% of the applications from new students for foundation courses are for T100. If the Course Team is successful a much larger proportion of students who currently apply for other foundation courses in the University (i.e., in the Social Science, Science, Arts and Mathematics Faculties) will also apply for T101.

Table 1: Applications from new students for Foundation Courses averaged over 1977-1979. (Note the percentage figures quoted are approximate only to the nearest integer.)

Foundation Course	Applications %
Arts	34
Social Science	26
Science	16
Maths	14
Technology	11

Detailed information on student abilities prior to course commencement is not available. The only available institutional research data list student characteristics such as age, occupation, sex, previous qualifications, etc. or describe student performance on a particular course e.g., number of assignments passed, number of students taking the exam, average exam scores, etc. What these kinds of data do not tell the course designer is what skills the students are likely to possess at the beginning of the course, or how they will respond to different teaching strategies. In other words, the existing survey data are not sufficiently predictive.

To overcome these difficulties the Course Team has decided to adopt a three-part strategy aimed at ensuring that the course material is tailored as closely as possible to the learning requirements of its students.

The first part of the strategy is a skills survey aimed at providing quantitative information about the likely entry skills and learning abilities of T101 students. The intended function of this information is to provide some guidelines for setting standards in an area fraught with uncertainty, conflicting opinions and myths.

The second part is a scheme for developmentally testing the teaching material for the first six study weeks of the course in draft form. The first six study weeks are curcual to successful study of the entire course since they will lay the foundations of the basic numeracy and literacy skills in addition to introducing students to some important technological activity areas. The results obtained from the developmental testing will be used to ratify or revise as necessary the findings from the skills survey.

The third part of the strategy is a long-term course evaluation programme with the aim of assessing the effectiveness of the teaching in the course and retrospectively identifying learning difficulties encountered by the students. It is recognised that the previous two approaches (a pre-course skills survey and developmental testing of parts of the course) although useful for establishing reference points, are unlikely in themselves to enable the Course Team to produce the best possible course on a first attempt. It will be necessary to assess the effectiveness of the course as a whole in its final polished form and to make modifications to it. For this reason a Course Evaluation Team has been established with the responsibility for collecting feedback from students on all aspects of the course during its first year of presentation (1980). The resulting feedback data will be the basis for modifying the course as necessary during the second year (1981), and for re-presenting a revised course in the third year (1982). It is hoped that the revised course will be matched sufficiently closely to students' learning requirements for it to be able to run substantially unchanged for six years.

In due course reports will be produced discussing the results of the second and third parts of the Course Team strategy. This paper is concerned with the first part: the Skills Survey.

THE SURVEY METHOD

The aim of the survey

The two skills of literacy and numeracy referred to above were identified as being of importance to the study of technology. Of these, numeracy was felt to be a particularly important topic for investigation because the ability to solve problems numerically is considered to be one of the most important skills of technologists; it is also a skill which has caused difficulties for students on the current Technology Foundation Course. Moreover, within the Open University as a whole, mathematics seem to be a stumbling block for students in as much as courses with substantial mathematics have higher withdrawal rates than courses with little or none. More fundamental even than basic numeracy are the algorithmic skills required to carry out the computations involved once the problems have been appropriately expressed. The aim of the survey was to provide the Course Team with detailed useful information about students' entry level algorithmic skills and learning capabilities in areas relevant to the subject matter proposed for the beginning of the course:

(1) Basic Arithmetic, including addition, subtraction, multiplication and division, negative numbers, precedence of operators and brackets.

(2) Fractions and Ratios, including addition, subtraction, multiplication and division of fractions and the conversion of fractions to ratios and vice-versa.

(3) Percentages, including calculating percentages, converting percentages to fractions and vice-versa and percentages to decimals and vice-versa.

(4) Decimals, including converting fractions to decimals and vice-versa, multiplication and division of decimals and rounding, truncating and significant figures.

(5) Areas and Volumes, including calculating the areas of rectangles, parallelograms, triangles and circles, the surface areas of simple solids and the volumes of simple solids.

(6) Graphs, including plotting and reading coordinates and plotting graphs.

Within each of these six areas the Course Team wanted answers to four questions:-

(1) What proportion of the sample target population are able to carry out simple calculations without any help from T101?

(2) What proportion of the sample are able to perform the calculations with only a 'brief reminder'?

(3) What proportion of the sample required detailed teaching in order to learn (or relearn) the algorithmic skills required to perform the calculations?

(4) How much time is spent studying the detailed teaching?

Design of the questionnaire

A separate questionnaire was prepared for each of the six areas and was divided into a number of blocks of calculations. Each block covered three or more subskills of the general skill being assessed.

For example, in the Basic Arithmetic questionnaire, the first block assessed simple addition, subtraction, multiplication, and division; the second assessed the use of 'negative numbers'; the third 'precedence of operators'; and the fourth block assessed the use of brackets.

Students were asked to tackle all the blocks of calculations at the beginning of a questionnaire, then to mark their answers to the first block. If they got them all right they proceeded to mark their answers to the second block. If they got any wrong or were unable to do any of the calculations in the first block they were directed to a brief reminder of how to do those kinds of calculations, then to another similar set of calculations to tackle. If they got all the calculations right after the brief reminder they were asked to proceed with marking their answers to the second block. Otherwise they were asked to study some detailed teaching and to attempt a further set of calculations. The detailed teaching material used was partly culled from a variety of existing OU and other sources and partly prepared especially for the survey where none of the existing material seemed suitable. After marking their answers to the third set of calculations they were asked to proceed with marking their answers to the next block. This procedure, which was repeated for each block in turn, is summarised in Figure 1.

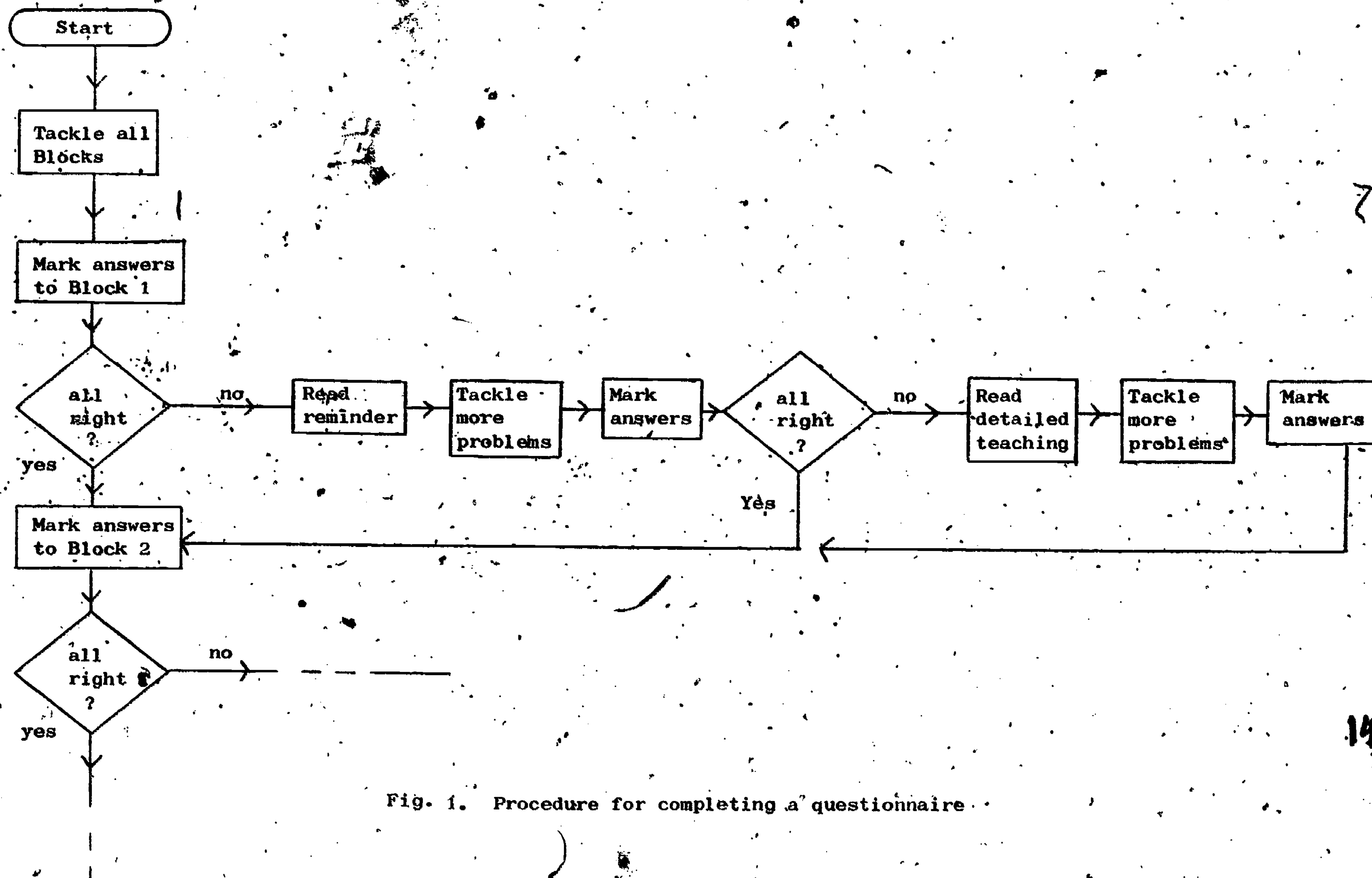

Fig. 1. Procedure for completing a questionnaire

13 14

Students were also asked to record the amount of time they spent studying the detailed teaching and answering the problems which followed it.

Selection of the sample population

There was, at the time of carrying out the survey, no pool of applicants for the course which could be sampled for their pre-course skills or learning capabilities. Such a pool will not be available until late 1979, i.e., when the course will be almost ready for presentation. Instead a sample population had to be defined which would be as representative as possible of the kinds of student T101 is intended to attract. The target student population was identified as the present range of students who apply for T100 plus a larger proportion than at present of students who are attracted to the Social Science Foundation Course, D101. This is not to say that the Course Team hope to lure students away from the Social Sciences but rather it is hoped that more students will take both a Social Science and a Technology Foundation Course. It was decided therefore to look at students who had been offered a place on either T100 or D101 and who were waiting for their course to begin. Only new students (i.e., those commencing their first year of study as Open University undergraduates) were regarded as relevant subjects for the study. This was because T101 will be oriented primarily towards the requirements of students with no previous experience of university

Table 2. Percentage Withdrawal of New Students from T100 at 31. 12. 77 by Educational Qualifications.

Educational Qualifications	Percentage of students in this category who have withdrawn from the course
No formal	45
CSE/RSA	50
'O' level 1-4	30
'O' level 5+	28
'A' level 1	22
'A' 2+	22
ONC or OND	24
HNC or HND	16
Teachers Cert.	13
Univ. Diploma	15
Univ. Degree	17
No data	11

level study. Consequently, it is necessary to base the design of the teaching materials on the skills and capabilities of new students rather than those already in the Open University learning system.

It was decided not to survey the whole body of new students registered for both T100 and D101 since many of those can be expected to possess quite sophisticated numeracy skills. The aim of the study was to identify the lowest likely levels of entry skills and learning capabilities of potential T101 students in order to determine the starting level and learning gradient for such skills in the course. Applicants for Open University courses are asked to indicate which of a number of educational qualification categories they fit into on entry. Table 2 lists these educational categories in the left-hand column.

The Table shows the proportion of new students who had withdrawn from T100 in 1977 by the end of the course expressed as a percentage of the total number of new students who had paid their course fees. From this Table it can be seen that there is a tendency for students with few educational qualifications to withdraw from T100 in greater proportions than those with rather more qualifications.

It was decided to include students in the lowest three categories only in the sample. The sample population therefore was all 2279 of the new students who had registered for either T100 or D101 in 1978 and who fell into one of the following three educational categories:

(1) Students with no formal educational qualifications.

(2) Students having a CSE, RSA or school leaving certificate in one or more subjects.

(3) Students with GCE 'O' level, CSE 'O' grade, school certificate or equivalent in 1-4 subjects.

Table 3 shows the proportions of students in each of these categories as a percentage of the total intake of newly registered students to both T100 and D101 in 1977. It is apparent from the Table that the proportions were approximately the same for both cases.

Table 3. Proportions of Newly Registered Student Intake in 1977 in Different Educational Categories.

Educational Qualifications	COURSES	
	T100	D101
No formal	11%	10%
CSE/RSA	4%	4%
1-4 'O' levels	13%	10%
Total	28%	24%

Administration of the survey

It was decided that it would be impracticable to ask any student to attempt more than one questionnaire because of the amount of time required to answer each one. Pilot tests indicated that, for those students who had to work through all the detailed teaching and the accompanying problems, each questionnaire required approximately 2½ hours study time to complete. Accordingly, the sample population was split into six equally sized groups, each group receiving a different questionnaire. Within each group the three educational categories sampled were represented in the same proportions as in the sample population as a whole. Each questionnaire was accompanied by a covering letter which explained the aims of the survey. It also invited the recepient to return the questionnaire blank if they were unable to complete it for some reason, but to specify what those reasons were. No inducement to respond was offered other than an appeal to their altruism.

The first two questionnaires were mailed to students in November 1977 and the remainder were sent as soon as they were ready. The last one was despatched at the beginning of February 1978.

THE SURVEY RESULTS

Response rate

The response rate for completed returned questionnaires declined gradually from 66% to 57% with a mean response rate of approximately 62%. This decline can probably be explained by the fact that foundation courses begin in early February and in addition to the actual course texts, students receive a large volume of material from their regional office and other OU sources. Consequently, the later questionnaires would have been in increasing competition with other more pressing material for the students' attention.

Of the 38% who did not return a completed questionnaire, some responded to our invitation to return it blank with an explanation. These responses were bolstered by additional comments volunteered by students who had returned completed questionnaires. The interpretation and classification of such open-ended feedback was to a large extent arbitrary. Many responses contained multiple reasons for non-return. However the following four categories emerged as the major relevant ones:-

(1) Those who regarded the exercises as too daunting to attempt and those who attempted them anyway and wrote to us telling us how difficult they were (28 responses).

(2) Those who for personal reasons such as illness, changing job, moving home, etc. were unable to find the time to complete the questionnaire (21 responses).

(3) Those who did not understand what they had been asked to do (9 responses).

(4) Those who regarded the exercises set as too trivial to be worthy of an attempt and those who attempted them anyway but wrote to us telling us how easy they were (7 responses).

The misunderstandings referred to in category 3 above were almost entirely due to the fact that the D101 students who received a questionnaire assumed that we had sent it to them by mistake. Many of these respondents told us that their difficulties with mathematics had contributed to their decision never to take a technology course. This is interesting because such students are precisely the kind we are trying to encourage to study T101.

Fig. 2. Performance Differences Associated with Course Preference

Performance differences associated with course preference

Differences between the T100 and D101 students are shown in Figure 2. It can be seen from the figure that on average about 15% more T100 students than D101 students got all the problems right on their first try. In most cases this difference was reduced to about 9% by the reminder and further reduced to about 6% by the detailed teaching. The two exceptions to this trend were the Fractions and Ratios questionnaire and the Percentages questionnaire. On the Fractions and Ratios questionnaire, the initial difference between T100 and D101 students was fairly small (8%) and it showed little change after either the reminder or the detailed teaching. On the Percentages questionnaire, a larger initial difference of 21% was reduced to 16% by the reminder and to 11% by the detailed teaching.

Performance differences associated with educational qualifications

Performance differences associated with differences in educational qualifications are shown in Figure 3. On four of the six questionnaires, a larger proportion of respondents in the 1-4 'O' level category got all the answers right on their first try than did respondents in either of the other two categories; on the Graphs questionnaire, the difference between the 1-4 'O' levels and the "no qualifications" category was only 1%. On the two questionnaires where the performance of the 1-4 'O' levels group was not the best, Decimals and Areas and Volumes, the differences between all three categories were less than 3%. Surprisingly, respondents with no formal qualifications did slightly better than students in the CSE/RSA category on the first try in five of the six questionnaires.

There was some tendency for performance differences between

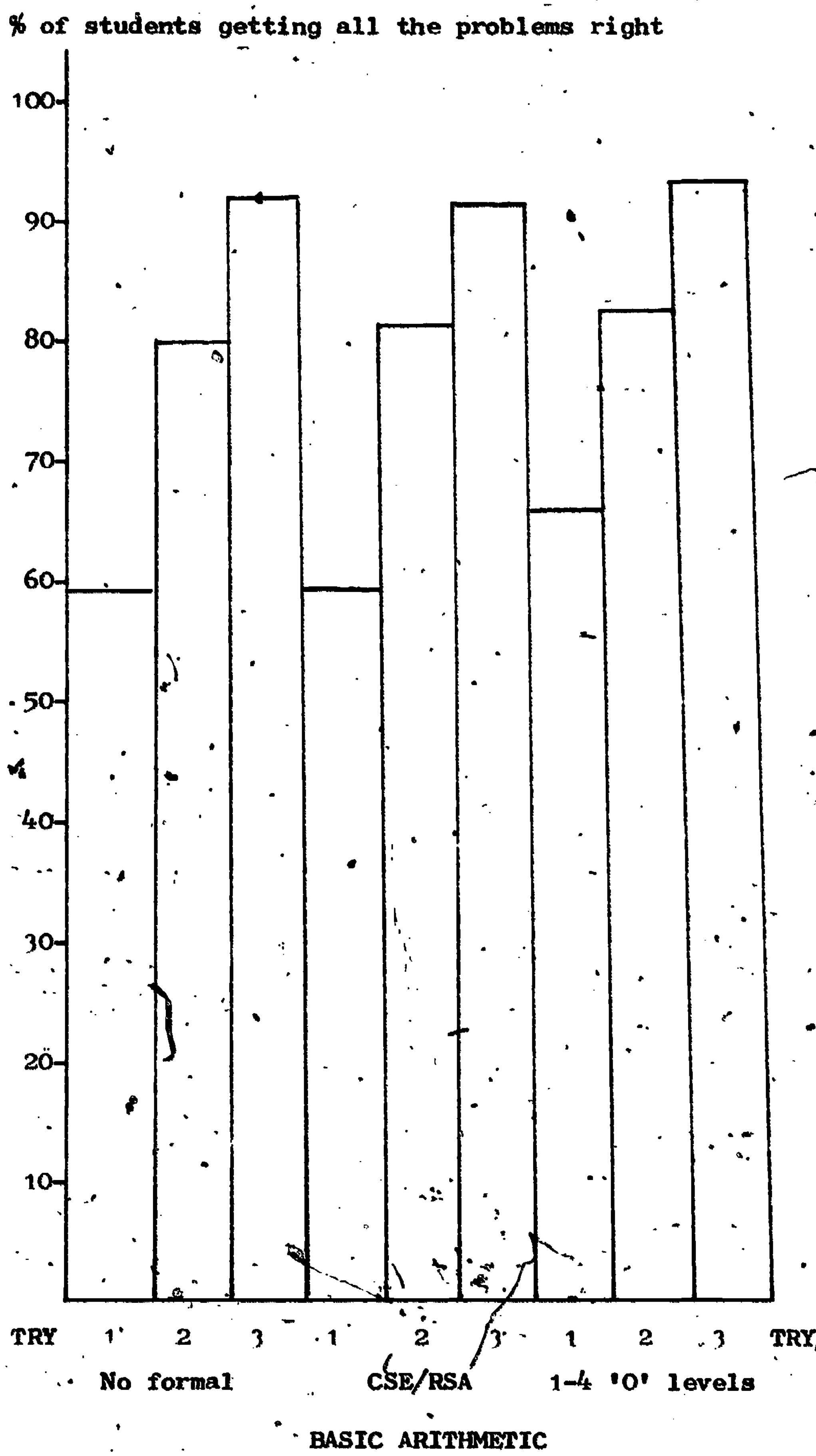

Fig. 3. Performance Differences Associated with Educational Qualifications.

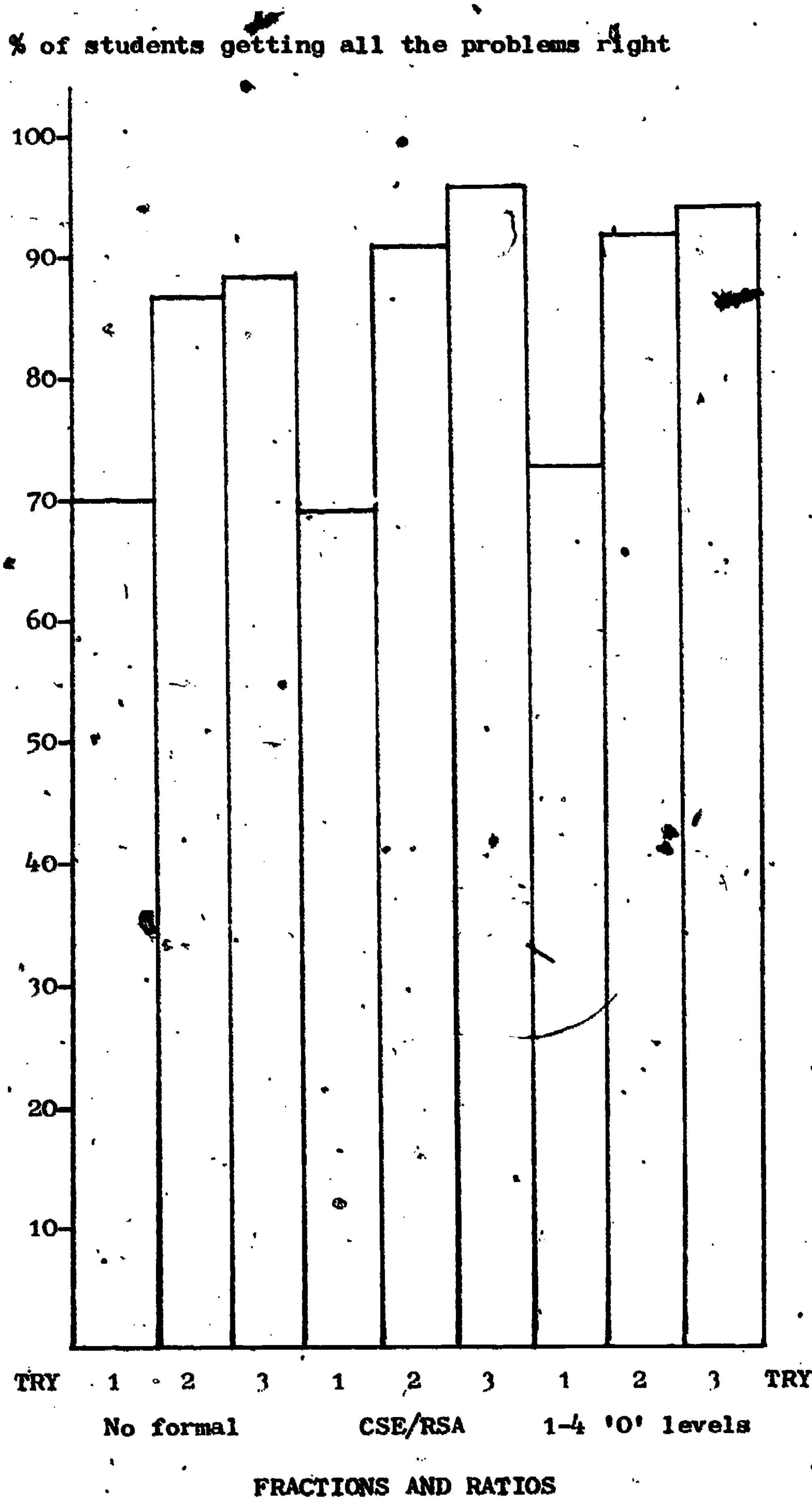
% of students getting all the problems right
100
90
80
70
60
50
40
30
20
10
TRY
1
2
3
1
2
3
1
2
3
TRY
No formal
CSE/RSA
1-4 'O' levels
FRACTIONS AND RATIOS

Fig. 3 (Cont.)

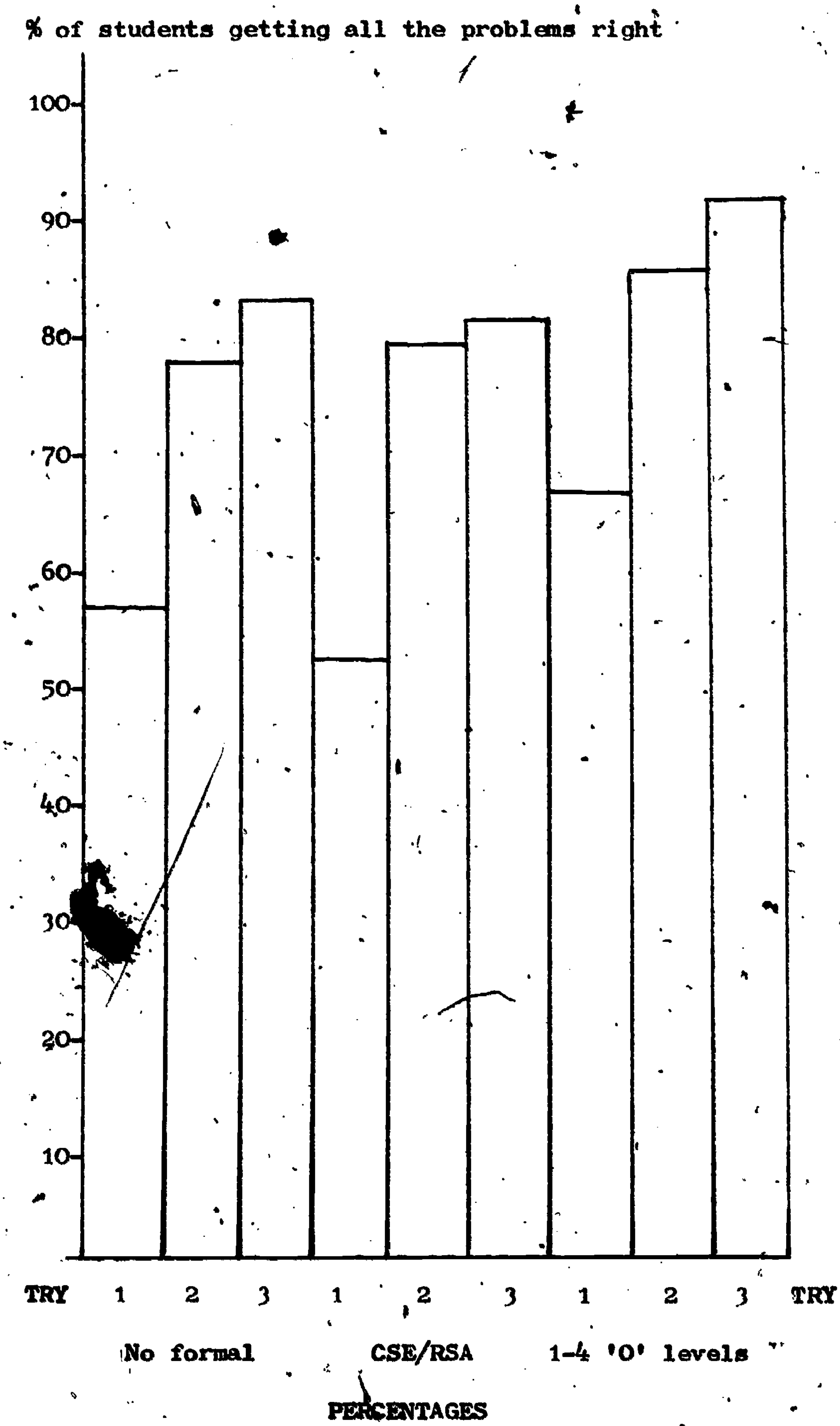
% of students getting all the problems right
100
90
80
70
60
50
40
30
20
10
TRY
1
2
3
1
2
3
1
2
3
TRY
No formal
CSE/RSA
1-4 'O' levels
PERCENTAGES

Fig. 3. (Cont.)

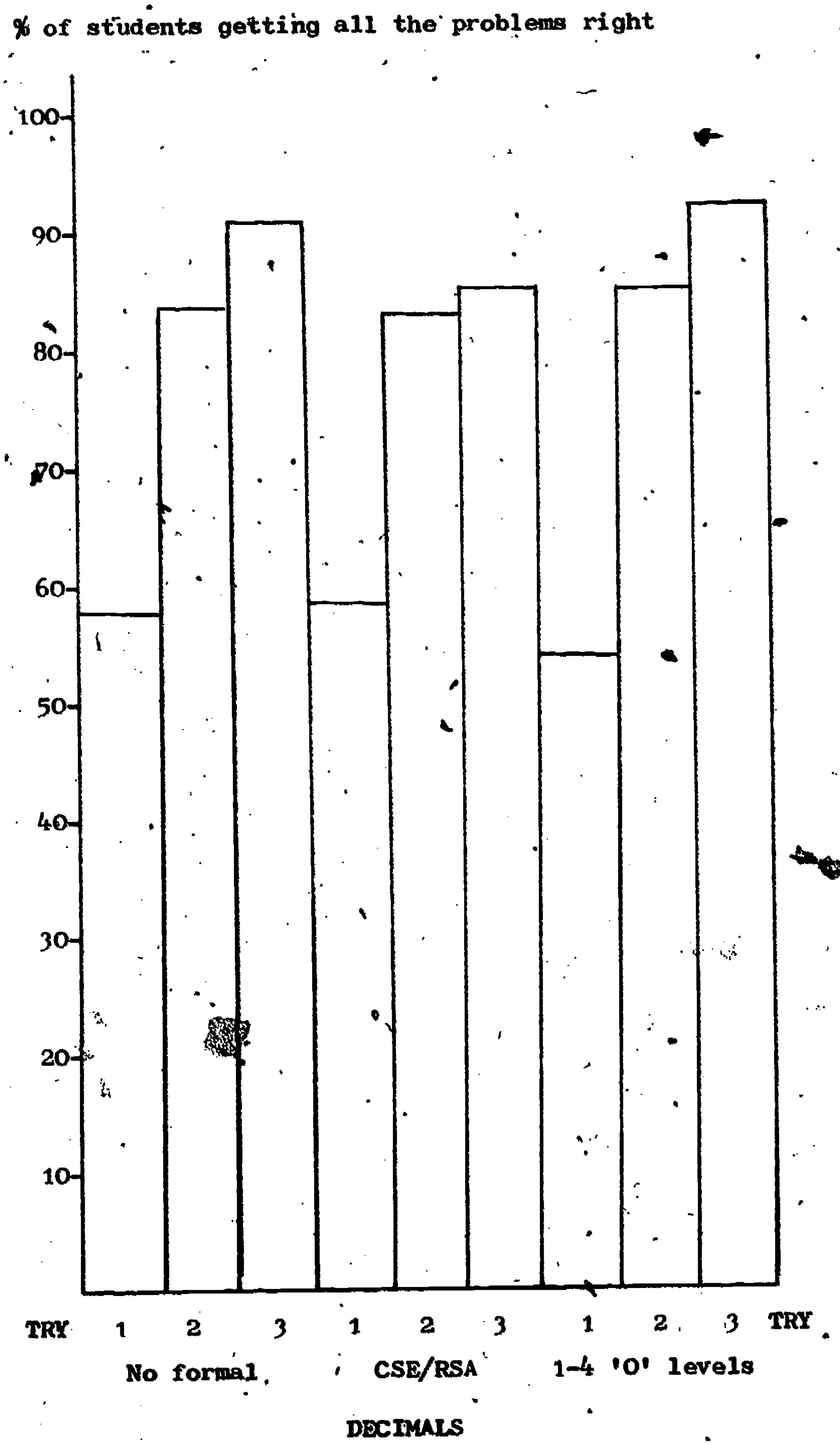
% of students getting all the problems right
100
90
80
70
60
50
40
30
20
10
TRY 1 2 3 1 2 3 1 2 3 TRY
No formal
CSE/RSA
1-4 'O' levels
DECIMALS

Fig. 3. (Cont.)

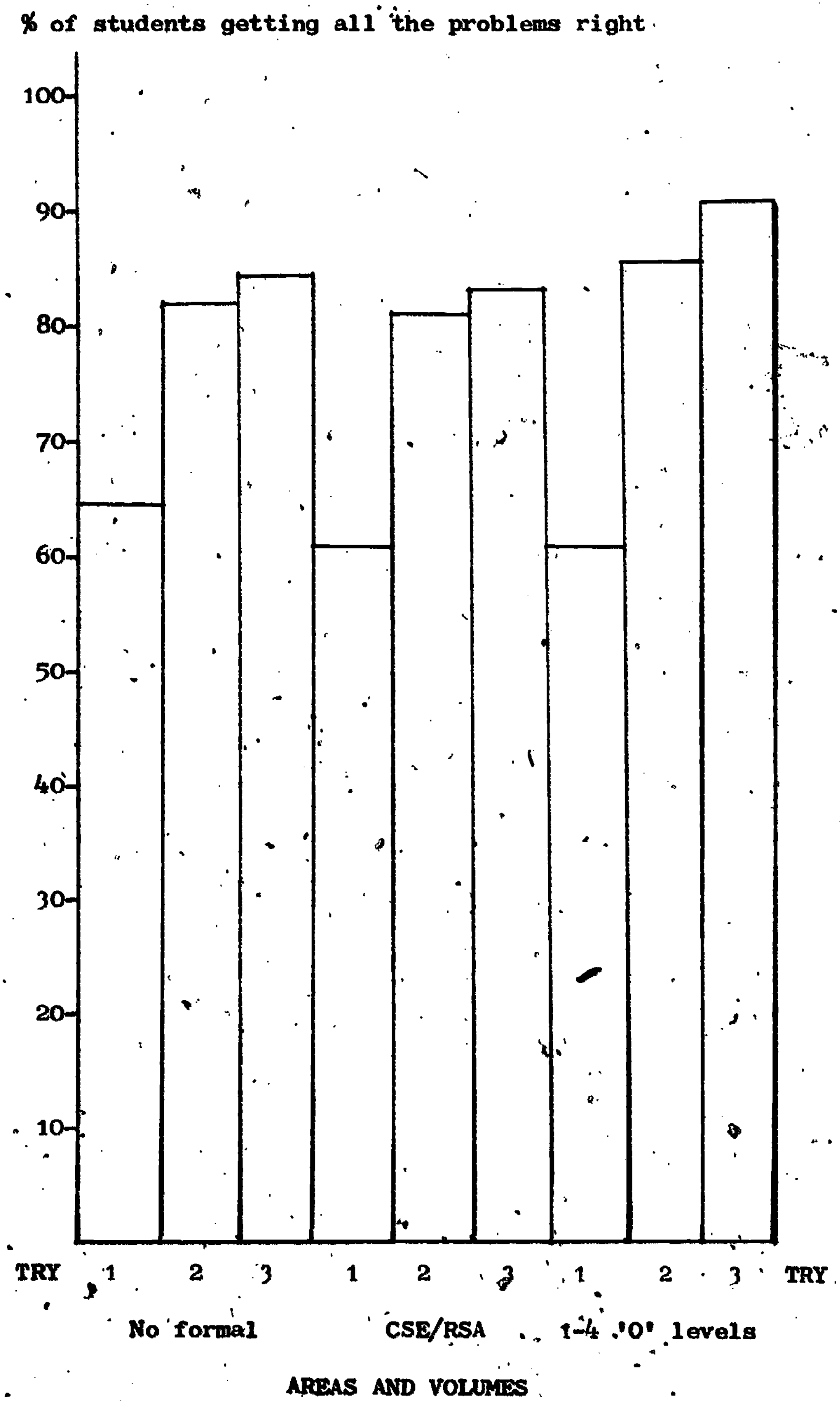
% of students getting all the problems right
100
90
80
70
60
50
40
30
20
10
TRY
1
2
3
1
2
3
1
2
3
TRY
No formal
CSE/RSA
1-4 'O' levels
AREAS AND VOLUMES

Fig. 3. (Cont.)

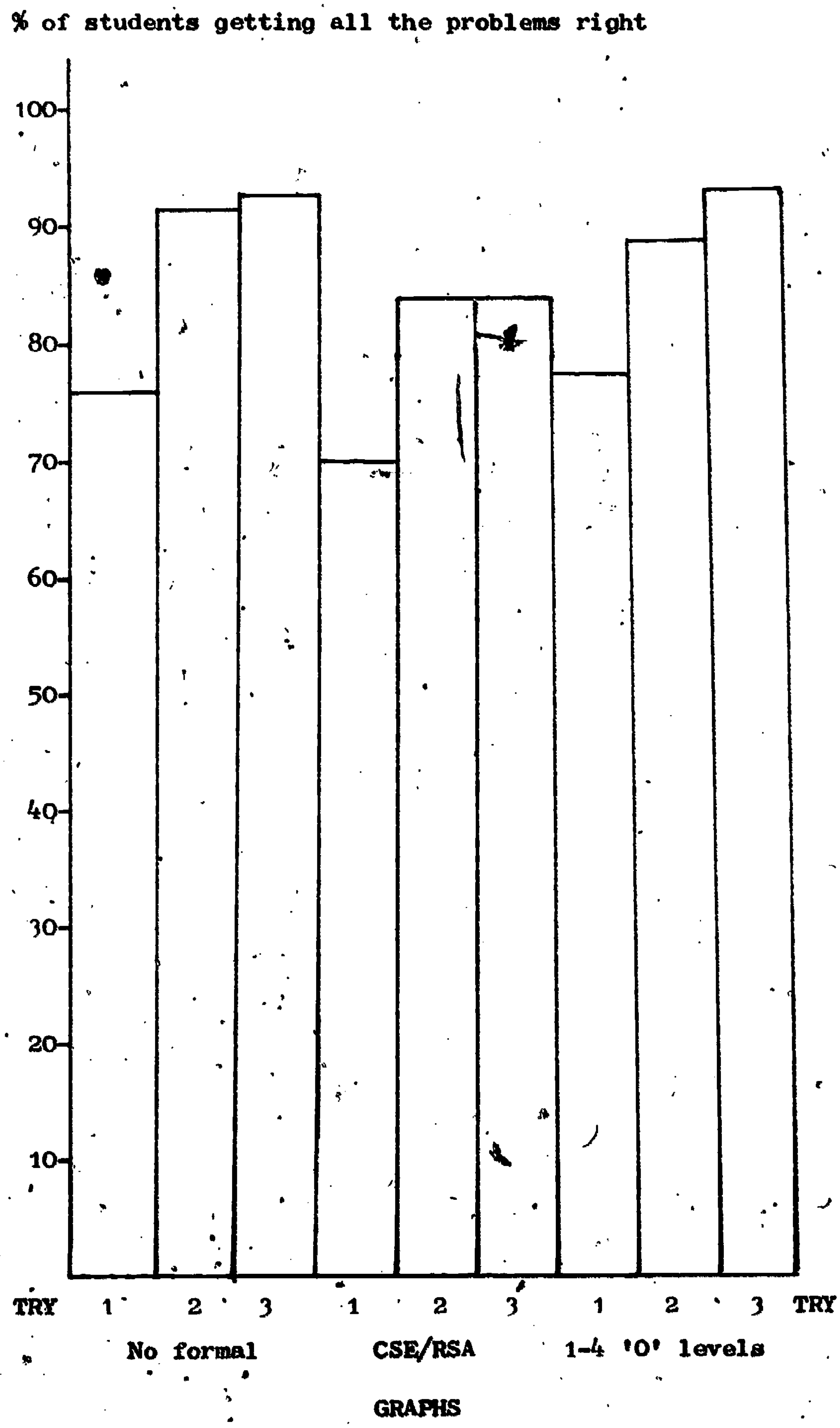
% of students getting all the problems right
100
90
80
70
60
50
40
30
20
10
TRY 1 2 3 1 2 3 1 2 3 TRY
No formal
CSE/RSA
1-4 'O' levels
GRAPHS

Fig. 3. (Cont.)

categories to be reduced on successive tries, most notably in the Basic Arithmetic questionnaire. It is important to note, however, that in the Percentages questionnaire, the initial 10% lead established by the 1-4 'O' levels group was barely diminished despite the fact that the other two groups converged. Similarly in the Graphs questionnaire, the 1-4 'O' levels and the no qualifications groups began with an approximately 6% lead over the CSE/RSA group, a lead which they retained throughout successive tries.

Overall performance results

Figure 4 summarises the overall performance results of the study. For each questionnaire, it shows the proportion of respondents who got all of the problems right on the first try, after the reminder, and following the detailed teaching.

It can be seen from Figure 4 that the reminders were in all cases effective, producing on average, a 20% increase in the proportion of respondents able to get all the problems right on their second try. The effects of the detailed teaching were less clear. Although moderately effective on the Basic Arithmetic and Decimals questionnaires, the overall increase in the proportion of students able to get all the problems right after the detailed teaching, was on average, less than 5%. This left some 10% of the respondents still unable to answer the problems correctly even after being exposed to the detailed teaching.

Overall approximately 35% of the respondents did not get all the

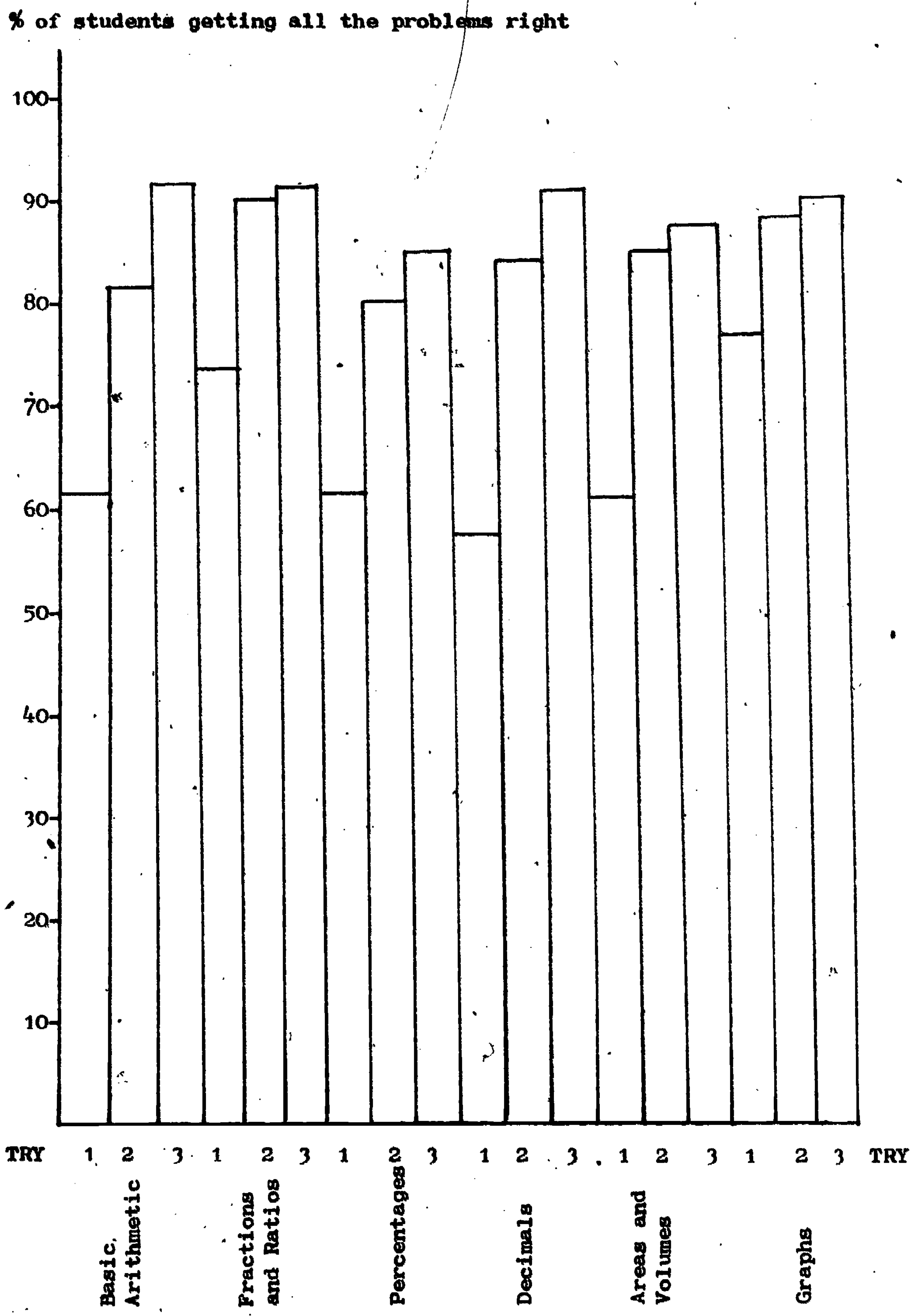

Fig. 4. Performance on Each Questionnaire on Successive Tries.

problems right on their first try. Assuming the respondents to be representative of the sample population, this suggests that 35% of all new T100 and D101 students in the three educational categories sampled need some help with the kinds of problems set. From Table 3 it can be seen that students in the educational categories sampled constitute 26% of the combined intake of new students to T100 and D101. Thus the proportion of new students entering these courses who need help with basic mathematical skills is 35% of 26% or just over 9% of the total intake of new students into T100 and D101.

DISCUSSION OF THE RESULTS

In general the results of the study indicate that the algorithmic skills present difficulties for a significant proportion of students in the categories sampled, particularly for those with few or no academic qualifications and those who have indicated a preference for social science rather than technology courses. The fact that some (38%) of the students selected for the survey sample did not respond obviously has implications for the representativeness of the results obtained and for the validity of any conclusions drawn from those results. Although meagre, the open-ended feedback suggests that a major reason for non-response to the survey was a desire by individuals not to reveal their lack of numeracy skills. The feedback also suggests that students with numeracy problems deliberately avoid the present Technology Foundation Course precisely because of this weakness. In other words, the performance of those students who responded is probably better on average than the actual mean performance capability of the whole sample. In addition, it seems reasonable to suppose that numeracy problems are not confined to students in the categories sampled and that the problem is even greater than indicated by the survey results. For example, students with only one 'A' level or even a degree in an area not requiring numeracy may have problems with mathematics. Similarly, students who currently register for the Arts Foundation Course may do so partly because they are reassured by its essentially non-mathematical syllabus.

The ineffectiveness of the detailed teaching used in the survey is of particular concern to curriculum designers. As stated in the introduction, the material was drawn partly from a range of Open University sources and partly generated especially for the survey. One obvious problem with the detailed teaching was the absence of practise exercises. Several respondents remarked that they believed they could have done better given more time to practice the skills being taught. Others actually told us that they had borrowed "Teach Yourself Mathematics" types of books and set themselves practise exercises.

Applying a 90% criterion-level to the results it has been possible to make firm recommendations to the Course Team about the level of teaching which should be provided in T101 for each of the skills surveyed. These recommendations correspond to the three levels of teaching provided in the questionnaires: none; a brief reminder; detailed teaching. Thus if 90% or more of the respondents got all of the problems in a particular block right on the first try then the recommendation for providing no teaching was made. If less than 90% got all the problems in a block right on the first try then the recommendation was for the provision of a brief reminder. Similarly if less than 90% of the respondents who tried the problems after the reminder got them all right then a recommendation was made to the Course Team for detailed teaching of the skill covered in that block.

In the light of the survey finding that on average 10% of the respondents were still unable to get all the problems right after the detailed teaching, four further recommendations have been made:-

(1) Numeracy teaching should be integrated into the course material in a meaningful way. Because the course is designed to be issue and problem oriented, the need for calculations will arise naturally from topics discussed, concepts taught, and evidence evaluated. It is anticipated that this integration will be more motivating, than for example, the kind of preparatory mathematics booklets used on other Foundation Courses.

(2) Mathematical topics should be taught via the use of a calculator. This will allow students to tackle problems using realistic data right from the start without having to go through the tedious process of long computations. It is self-evident that students will have to be taught how to use the calculator in a sensible manner.

(3) The first six weeks worth of course work which contains the bulk of the basic numeracy teaching should be mailed to students early, so that instead of six weeks new students will have the option of spending two to three months practising and consolidating their basic numeracy skills.

(4) Optional practise exercises should be provided for the minority

of students who still have difficulty after the detailed teaching but it should be stressed that these are additional to the course workload. That is to say, the Course Team shoul not take the learning requirements of these students as its baseline for developing numeracy skills but it should provide extra optional help for the few who need it.

A number of important assumptions underlie the way in which the Numeracy Study has been carried out. These concern the representativeness of the sample selected, the extent to which the material used in the questionnaires is likely to correspond to the teaching material used in the course, the validity of the comparisons drawn between different groups within the sample and the reliability of the data obtained.

It has been assumed that the selected sample is representative of the future student intake into the new course. There is of course an unavoidable conflict built into this approach. On the one hand, it was our intention to establish what the skills and learning capabilities of future T101 students will be <u>immediately prior to their entry into the course</u>. On the other hand, we wanted the information sufficiently far in advance of the commencement of the course for it to be useful in the preparation of the instructional material to be used in the course. In practice this meant that the study had to be carried out two years before the course is due to be presented to the first students. Any attempt to base the design of new instructional material on the known skills and abilities of future students seems likely to encounter this problem unless the candidates are carefully selected for their suitability to undertake the course. This latter approach is quite common, but it is arguable that students are then being matched to the teaching material - an approach which is quite antithetical to the spirit and aims of the Open University.

The problems posed and the teaching material provided in the questionnaires were each presented in a pure, abstract form divorced from any practical application. But technologists use mathematics as a tool for tackling real problems. Consequently, in T101 mathematics will be introduced and taught in the context of practical applications. On the one hand it may make it easier for students to learn the basic numeracy skills if they can see their relevance and usefulness and apply them to concrete examples. Alternatively, students may encounter additional difficulties as a result of having to learn how to interpret and remodel problems so that they can be handled mathematically. Consequently, the findings of the Numeracy Study can only be taken as a very rough guide to the likely performance capabilities and learning difficulties of students actually studying the course.

It has been assumed that the student groups tackling the various questionnaires were evenly matched in terms of their skills and learning abilities and that comparisons between groups are thus valid. It is impossible to be certain that the groups are matched unless individuals are assigned to them on the basis of their known skills and abilities. Since these are what we wish to measure and to do so we have to divide the students into groups first there is clearly a conflict here. The best we can do is assume that within each of the three educational categories identified, students have approximately equal capabilities and skills. They can then be assigned randomly to groups in such a way as to ensure that the relative proporitons of students from each category are the same in all groups.

Finally, it has been assumed that the responses obtained are honest and accurate. It is conceivable that some students may have cheated by looking up the answers and filling these in instead of working through the problems set themselves. Some may believe that, despite our assurance to the contrary, a high score would favourably influence their future assessment record in the University.

Each of these four assumptions can be regarded as a weakness of the method used in the study in that they cast doubt on the reliability of the data obtained and the validity of the conclusions drawn there from. However, before passing judgement, the method has to be reviewed in the context in which it was devised. The aim of the study was to obtain only a first approximation of the likely skills and learning capabilities of potential T101 students. The findings are intended to supplement the Course Team's teaching experiences in an area beset by anecdote, hearsay and prejudice. As explained in the Introduction, the Numeracy Study is one part of a three part strategy for ensuring the coordination of students' needs with course production. The other two parts, developmental testing and complete course evaluation, will provide the necessary checks on the findings of the Numeracy Study. The strength of the Numeracy Study is that it is predictive. It provides information about students' likely learning needs sufficiently far in advance to be useful in the preparation of the course. The other two methods are necessarily post hoc in their orientation. They can only provide information about the suitability of material which has already been prepared.

In conclusion, we believe that the findings of the Numeracy Study demonstrate the importance of carrying out a systematic evaluation of critical learner skills as a pre-requisite to the design of instructional material. Without the knowledge generated by the study, the T101 Course Team would have been in great danger of selecting an initial skill level and subsequent learning gradient which would be too great for at least 9% of the new students for whom the course is being prepared. It is hoped that other course designers at the Open University and elsewhere will be encouraged to undertake similar types of investigations.

COURSE DEVELOPMENT GROUP PAPERS

CD1 NOTES ON THE EARLY STAGES OF COURSE PLANNING
by Phillipe Duchastel, Roger Harrison, Euan Henderson, Barbara Hodgson, Adrian Kirkwood, Robert Zimmer.

CD2 HOW TO USE CONSULTANTS SUCCESSFULLY
by Judith Riley

CD3 DISCUSSING AND EVALUATING DRAFTS
by Judith Riley

CD4 ASSESSMENT
by Judith Riley

CD5 INTRODUCING NEW FACULTY MEMBERS TO COURSE PRODUCTION
by Phillipe Duchastel and Roger Harrison

CD6 BRIDGING THE GAP BETWEEN TEACHING AND LEARNING AT A DISTANCE
by Michael Nathenson

CD7 COLLECTING FEEDBACK DURING COURSE PRESENTATION
by Fred Lockwood