



Teaching yourself in primary school

Report of a seminar
on self-instructional programs



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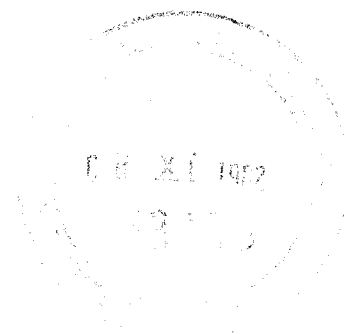
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Effectiveness of Learning Modules and Peer Tutors in Student Learning

In Solo, Indonesia, Project Pamong is an Impact-type project jointly supported by the federal government and the International Development Research Centre, Canada, with the U.S. Agency for International Development (AID) also providing financial support. The purpose of the project is to develop a prototype for effective and economic delivery of mass primary education, enabling a teacher to teach at least three times the usual number of students while maintaining outcomes at least at the level reached by students in the traditional schools.

Learning materials are presented in step-by-step modules so that they can be studied by students anytime and anywhere, with minimal help from teacher, and peer tutors are trained to do, as much as possible, the work teachers usually do in helping students to learn. The use of modules and peer tutors is referred to in Project Pamong as the mediated-learning strategy.

THE MODULE

The use of learning modules in schools is based on two concepts. The first is that "the learning of any behavior, no matter how complex, rests upon the learning of a sequence of less-complex component behaviors" (Skinner 1954). Theoretically, even the most complex skills can be learned if they are dismantled into a chain of component behaviours and each link in the chain is mastered (Block 1970).

Based on this concept, the organization of the learning modules in the Impact schools reflects the scope and level of complexity of the materials and follows the principles of self-instructional methods so that students master the materials.

The second concept is that "given enough time and appropriate types of help (tutorial help), all students can conceivably attain mastery of any learning task" (Bloom 1968).

The effectiveness of modules as a mode of delivery has been investigated in a number of studies. Merwin and Schneider, for example, reported that the module was effective in increasing students' test scores on a higher cognitive level, questioning strategies among secondary schoolteacher trainees. Lloyd et al. (1969) reported that self-instructional modules were superior to more conventional methods for developing concepts and skills essential to instruction for higher

cognitive processes. However, Hall et al. (1978) reported that listening combined with a visual aid was superior to reading as a means of learning some nursing skills. In other studies (Anderson 1976; Arlin 1973; Block 1970), programed instruction was used for students in grades 8-14 successfully. There is a possibility that modules, when designed properly, can accentuate the provision of cues, reinforcement, and feedback, and the promotion of practice.

THE PEER TUTOR

The concept of peer tutors as mediators in learning is based on the contemporary view that education is more a process of learning than a process of teaching and that effective learning is a result of productive interactions among learners. Previously, the teacher was universally regarded as central — the one person within instructional settings who can teach.

The teacher-centred educational system was founded on the belief that students are passive receivers of knowledge and teachers are givers. This traditional view of education is reflected in Locke and Hume's contention that "...at birth, man is essentially a 'blank slate', but as sensations are etched into the slate, he acquires knowledge of the world..." (Case 1973). The way in which knowledge is acquired from the "etcher" is essentially through associations: association of one set of sensations or stimuli with another.

In contrast, "Kant and Piaget assured that human beings are not blank slates which passively receive the world; rather, that they actively structure it" (Case 1973). Piaget contends that children have an innate drive to learn and actively act to fulfill their curiosity.

Questioning of the teacher-centred approach prompted various studies on the role of peer tutors as instructional agents. Most of the studies have found that under the guidance of teachers, peer tutors can be effective (Sarapee 1979; Klosterman 1970; Shaver and Nuhn 1968). Some other studies have reported that tutoring is beneficial not only for the tutees but for the tutors as well (Sarapee 1979). With guidance from professional teachers, peer tutors are capable of providing cues, reinforcement, and feedback for the tutees and systematically promoting practices.

In Project Pamong, the conceptual framework is put into operation through working manuals for teachers and peer tutors; these specify the jobs to be conducted in the self-instructional programs. The job descriptions are the basis for the mediated-learning strategy, which has been used in the Solo Pamong schools for a couple of years.

In the Pamong project, one major research question has been whether peer tutors and modules are effective mediators in a learning strategy. To answer this question, educators set up a microlevel experiment in Waru I, Waru II, Kebak II, and Kebak III primary schools in November 1980, incorporating a total 151 grade 6 students. Waru I and II schools acted as controls, using a nonmediated, traditional learning strategy; in Kebak II a module was used in the learning strategy; and in Kebak III peer tutors and a module were used. This experiment

provided a means of judging the effectiveness of modules and peer tutors as mediators in the learning strategy. The variables that were controlled were location of the schools, students' socioeconomic background, and school characteristics, such as the teachers' educational background and working experience.

PROCEDURES

The microlevel experiment lasted 3 days; on each day a more complex concept was introduced. Students' scores on tests in the subject matter (multiplication and division), the time it took them to learn (in minutes), and their need for remediation associated with each learning task were the criteria for comparison. These were used in calculations of the students' index of learning effectiveness (ILE).

The teachers in Waru I and II presented material, administered tests; corrected students' work sheets; provided remediation for those who did not attain 90% on the tests; and repeated the process.

The procedures in Kebak II were the same except that the material was not presented by the teachers; rather the students individually studied the material in a learning module. Remediation was undertaken by the teacher. In Kebak III, the procedure was the same as in Kebak II, except that correcting students' work sheets and remediation were conducted by peer tutors.

Data collected were the students' time for original learning or the time needed to present the material; students' test scores; their remediation times; and frequency of remediation.

THE EFFECTIVENESS MEASURE

The ILE, developed in this study, assumes that effectiveness can be measured in the amount of time and frequency of remediation required by students to attain a satisfactory score or a set of sequential scores. The development of this measure was to overcome the shortcomings of the use of test scores and learning times as separate measures of effectiveness. For example, in Waru I one student attained a score of 90 on the first test; his time to learn was 45 minutes, no remediation. A second student attained a score of 100, but his time to learn was 73 minutes with two remediations. Using the two students' scores as the sole measure of learning effectiveness indicates that the second student more effectively learned the material. The use of time to learn alone as a measure neglects frequency of remediation. In Waru I, for instance, one student required 58 minutes to attain the score of 90, with one remediation. Whereas another student required 58 minutes to attain the score of 90 with two remediations. Even though they took the same amount of time, the two were not equal in effectiveness.

The mathematical formula to compute each student's ILE was

$$\sum_{i=1}^{r+1} (X_i e - \lambda_i) / r + 1$$

where X_i = the average of his or her test scores; e = Napier's number, exponential function; λ_i = the total time a student needed to achieve original learning minus 20 minutes, the shortest time possible for effective learning of the task; and r = frequency of remediation ranging from zero to two. The empirical data obtained through the experiment were the basis for the constant.

The peer tutors and modules were to be considered effective mediators if the students' ILEs in Kebak II and III were not markedly lower than students' ILEs in Waru I and II. This approach assumes that traditional methods of teaching-learning (in Waru I and II) reflect standard effectiveness as reported in a large number of studies (Anderson 1976; Block 1971; Burrows and Okey 1975; Glasnapp et al. 1975).

RESULTS

The data indicated that the module was an effective mediator during preremediation (or initial) learning. The preremediation ILE (PRILE) was computed on the basis of a student's preremediation score (PRS) and preremediation time to learn (PRT), with frequency of remediation (FR) being zero. The difference in PRILE from students at Waru I/II and Kebak II is regarded as attributable to use of the module. The PRS, PRT, and PRILE in Waru I/II were 62.88, 41.17 minutes, and 50.7 respectively, whereas in Kebak II they were 70.43, 46.15 minutes, and 54.03. Although the students using the module took longer to learn, their preremediation score was 7.55 points higher than students under the traditional method.

Peer tutors were effective in remediation but not during the preremediation teaching-learning stage. The students' (average) PRS, PRT, and PRILE in Kebak II 70.43, 46.15 minutes, and 54.03 compared with 56.02, 34.72 minutes, and 47.24 in Kebak III. The difference of PRILE between Kebak II and Kebak III could be thought of as attributable to the peer tutors. Thus, the use of peer tutors in Kebak III made it possible for the students to complete preremediation in a shorter time than Kebak II students but with an average score on the initial test that was 14.41 points lower.

This finding indicates that peer tutors are not capable of helping others to learn information that they are, themselves, just learning. In this study, the peer tutors were unfamiliar with the subject matter, but in some self-instructional programs they would be versed in the material before attempting to provide assistance. Thus, although the peer tutors in this study were ineffective in providing information during the original learning process, they may in fact be quite effective under circumstances where they are familiar with the concepts. This experiment was conducted at the end of the July-October trimester, and it used the learning tasks to be studied at the beginning of the November-March trimester. No student had studied the module that was used in the experiment, even though in the Impact experimental schools student learning was self-paced. In this situation, while the teacher was available to help (and in some cases he did help on request), most students felt more comfortable seeking help from their (peer) tutors.

Table 1. Overall effectiveness of the module and peer tutors as mediators of learning.

School	Mean FS	Mean FT	Mean FR	Mean ILE
Waru I/II	89.75	48.84	0.88	59.28
Kebak II	89.45	53.20	1.10	59.70
Kebak III	89.03	46.74	1.39	58.27

The peer tutors were effective in giving remedial help as measured by their ability to pull up students' test scores, to shorten the time involved, to cut down the frequency of remediation, and to increase students' ILE. Thus, the peer tutors in Kebak III accounted for final scores as much as 13.99 points higher than in Kebak II, remediation as much as 4.97 minutes longer and 0.29 times more frequent, and a final ILE as much as 5.36 points higher.

Considering that ILE is the most dependable measure of learning effectiveness (because it considers test scores — preresolution score (PRS) as well as final score (FS) — frequency and time of remediation simultaneously), the findings indicated that the peer tutors were effective in providing remedial help in the self-teaching programs.

It is noteworthy that, after a student attained a score of 90% on the test, he or she did not take the test again or undertake remediation. Rather, the same test score was used in calculation of averages for subsequent tests. As the students who attained the criterion level early were never remediated, the inclusion of their scores in average scores did not affect the analysis of remedial power. However, it did affect the analysis of average scores.

The data confirmed that modules and peer tutors were effective mediators of learning when students' ILE was used as a measure of learning effectiveness (Table 1).

Even though the differences in time and frequency of remediation were statistically significant at 95% and 99% confidence levels, the differences in final scores and ILE were not significant. Considering that ILE is the most dependable measure of learning effectiveness, one may assume that the use of a module in Kebak II and peer tutors in Kebak III did not give students a lower index of learning effectiveness than did the traditional approach in Waru I and II.

RESPONSE TO INCREASING DIFFICULTY IN SUBJECT MATTER

One question that has not been answered is how effective was the mediated-learning strategy in responding to increasingly difficult learning materials in the 3 consecutive days of experiment. One way to answer this question is to measure the rates of change of the parameters of effectiveness during the 3 consecutive days.

The students' PRS, PRT, and FR in day 1 can be thought of as the result of the original (preresolution) teaching-learning process in day 1, whereas each subsequent score reflects the learning that takes place between tests — the sum of any remediation given and teaching-learning of new concepts. For example, the rates of change of PRS, PRT, and FR between days 1 and 2 can be attributed to the effectiveness

Table 2. The rates of change of PRS, PRT, FR, FS, and ILE from day 1 to day 2 (in %).

School	PRS	PRT	FR	FS	ILE
Waru I/II	34.75	5.88	-37.69	0.69	18.61
Kebak II	32.98	-29.98	-54.32	-0.39	6.18
Kebak III	38.47	15.14	-18.42	0.73	19.27

of the remediation based on day 1 and the original teaching-learning in day 2.

The students' FS and ILE in day 1 can be thought of as the result of the original teaching-learning process and remediation in day 1. Subsequent scores are the sum of all teaching-learning of new concepts and remediation up to that time. Thus, the rates of change of FS and ILE between days 1 and 2 can be attributed to the effectiveness of the teaching-learning of new material in day 2 as well as the remediation in day 2 (Table 2 and 3).

The conclusions that can be derived from the results are that:

- In Waru I and II, teaching-learning and remediation in days 2 and 3 combined were more effective than in days 1 and 2 combined in shortening students' FT and in cutting down students' FR, under conditions of increasing difficulty in the learning materials.
- In Kebak II, teaching-learning and remediation in days 2 and 3 combined were less effective than in days 1 and 2 combined in all measures, under conditions of increasing difficulty in the learning materials.
- In Kebak III, teaching-learning and remediation in days 2 and 3 combined were more effective than in days 1 and 2 combined in increasing students' PRS and FS, in shortening students' FT, and in cutting down students' FR.
- And in all schools, teaching-learning and remediation in days 2 and 3 were less effective than in days 1 and 2 combined in increasing students' ILE under conditions of increasing difficulty of learning materials.

Therefore, the mediated-learning strategy as represented in Kebak III is most effective in responding to the increasing difficulty in learning materials.

The effectiveness of the mediated strategy in responding to the increasing difficulty largely depends on the effectiveness of the mediators in the prerediation (original) and postremediation teaching-learning processes. Whereas, in this study, peer tutors were effective mediators in the postremediation teaching-learning process, they were

Table 3. The rates of change of PRS, PRT, FR, FS, and ILE from day 2 to day 3 (in %).

School	PRS	PRT	FR	FS	ILE
Waru I/II	13.13	- 2.50	-38.27	0.07	6.48
Kebak II	32.98	-22.33	31.08	-0.86	-15.46
Kebak III	38.47	-17.11	-54.19	1.27	13.74

not effective in the preremediation teaching-learning process. Although the module made it possible for Kebak II students to start with high PRS and PRILE, the intervention of the teacher in remediation was not effective enough to make the students end up with the highest FS and (F)ILE in the shortest FT and fewest FR possible. Conversely, while the preremediation teaching-learning did not allow the students in Kebak III to start with high PRS and PRILE, the remediation (by peer tutors) was effective enough to make them end up with FS and (F)ILE that were not too far apart from those in Kebak II and Waru I and II. Further improvements of peer tutors' skills to remediate may improve the effectiveness of the mediated strategy in responding to increasing difficulty, even when measured in terms of ILE.

THEORETICAL AND OPERATIONAL IMPLICATIONS

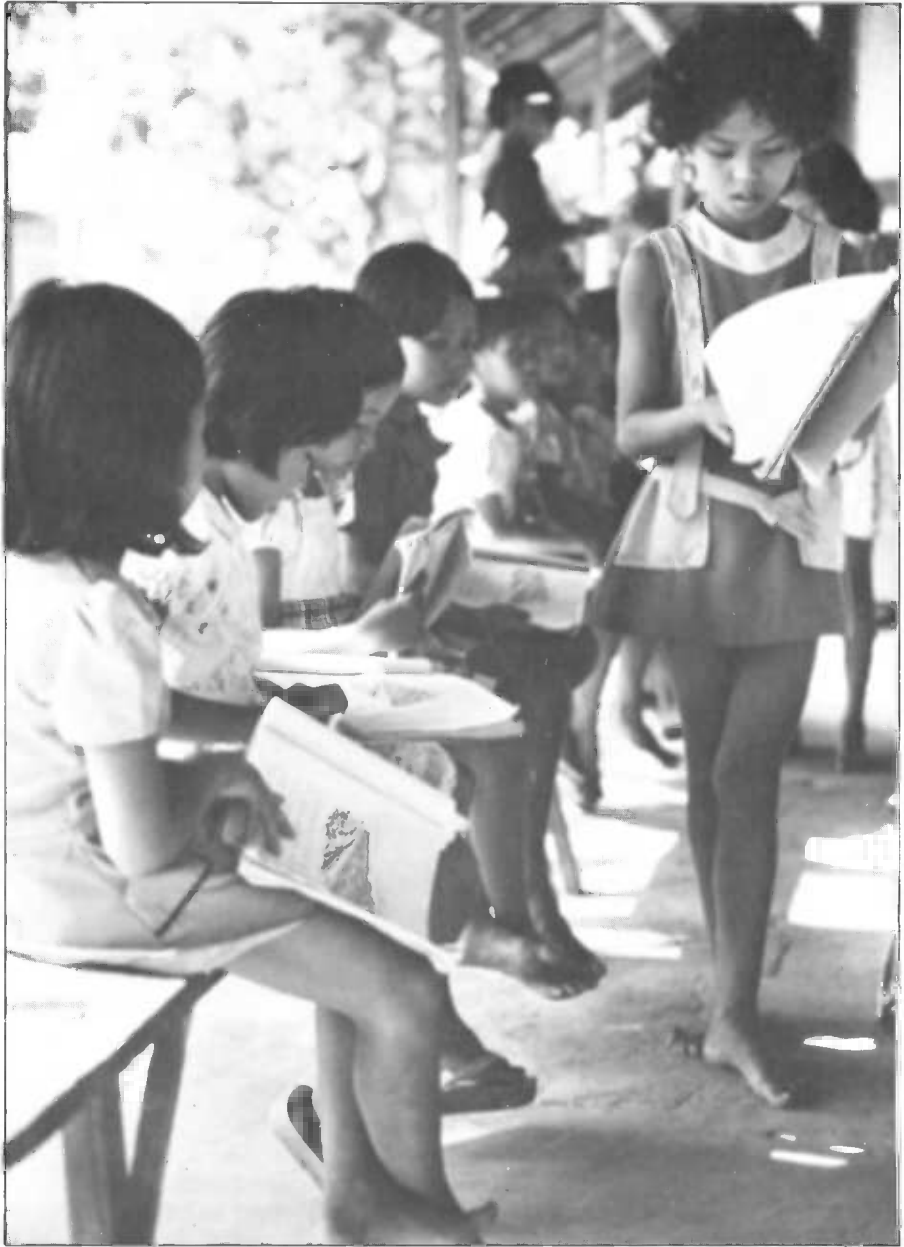
The effectiveness of the mediated mastery learning strategy as represented by Kebak III suggests that the shift from the concept of education as a process of teaching to a process of learning is feasible. In addition, the findings in this study also imply that mastery learning can be accomplished in ways other than the traditional teacher-centred approach.

Properly trained, peer tutors and well-designed modules can do much of the work teachers usually do to implement mastery learning. Because the work for managing learning is assisted by the mediators (the peer tutors and the modules) and, in a sense, by the students themselves who are functioning as active learners, the teacher has more time to manage other aspects of learning. He or she can supervise education and administration, encourage students' learning motivation, etc. — tasks that "...are believed by many scholars to affect school learning..." (Bloom 1976). The shift of the primary task of teacher from managing learning to managing learners was a shift from what had been considered the "central issue" to the "peripheral issue" of learning. My feeling is that the "peripheral issues" of the traditional school learning are not peripheral and can receive prominence in self-instructional programs.

Shulman (1976) pointed out that the traditional mastery learning approach relies primarily on "human beings (teachers and students) for its success rather than on...technological devices..." This study indicates that self-instructional programs rely for their success more heavily on students, peer tutors, and modules, than on teachers.

It is evident that reliance on educational technology (modules and self-instructional materials) is one of the important characteristics of the mediated-learning strategies. This study suggests that such materials do not endanger students' learning achievement.

Cloward (1967) and Gartner (1971) reported that the peer tutors profited from the socialization provided by the experience: the students' academic motivation, sense of responsibility, and the feeling of being useful and needed all improved. For the "bright" students, to be tutor means to have an opportunity to accelerate their process of socializa-



Peer tutors in Project Pamong are compensated for their efforts through greater self-reliance and confidence as well as increased opportunities for cooperation.

tion. For the "less bright" students, to be tutor means to have an opportunity to "eliminate" the barriers of socialization they normally encounter. An ancient dictum *Qui docet discit* (or, the one who teaches, learns) is quite true for students who assume the role as tutor. They learn more, and they have to learn more because the role of tutor demands it.

As reported in a number of mastery learning studies, mastery strategies require greater student study time than nonmastery strategies (Block 1972; Jones 1974; Wentling 1973). One of the sources of the additional time for applying a mastery learning strategy has been the teachers themselves. To "pay" the cost, teachers have been prompted to prepare and organize their mastery instructional plans, procedures, and materials outside the class and before the instruction begins, or outside their working time at home.

Because peer tutors are trained to help teachers in managing the learning, the teachers have more time during school to manage the learners and aspects of the management of learning that the peer tutors are not able to do. In other words, the use of peer tutors makes it possible for teachers to "pay" the cost of additional time for applying mastery learning without bringing extra work home. In most developing countries, where teachers cannot live on their salary, they need to do extra work at home (like farming) to have some additional income for their family.

The mediated-learning strategy offers flexibility in terms of time and place of learning, most particularly to primary school dropouts who have decided to return to school. The flexibility is signified by the freedom for the students to take the module from the learning posts, to study it elsewhere, and to take tests whenever they like. This flexibility means that the Impact strategy potentially offers multiple entries and exits for students who, for one reason or another, are not capable of coming regularly to school.

Mediated mastery learning makes it possible for a teacher to manage at least 70 learners so this learning system is potentially economic. At present, 80-90% of educational costs are those associated with teachers' salaries (Coombs and Hallak 1972). The higher teacher: student ratios in the mediated-learning strategy could lower teacher costs per student and, thus, lower educational costs per student. Roughly 60-70% of the costs for producing modules at the experimental stage are those associated with development, such as module writers' salaries and training, and small-scale operations. The high developmental costs, on the one hand, and the small production for experimental purposes, on the other, account for the high module costs per student. Developmental costs per student should be reduced when modules have been standardized and are produced on a massive scale.

The peer tutors are unpaid. This strategy is based on consideration that tutors who anticipate an external reward, such as money, will perform less effectively than those who do not expect any reward. This is confirmed by some studies such as one conducted by Garbarino (1975). The functioning of peer tutors, which makes it possible for a teacher to manage a larger number of learners, indirectly lowers the educational costs per student.

LIMITATIONS AND IMPLICATIONS OF THE STUDY

What is the current status of the Impact experiment? What are the contributions of the findings in this study?

The limitations of the findings in this study were that:

- The experimental time was probably too short to produce a convincing picture about the effectiveness of modules and peer tutors as mediators of the Impact strategy, when Waru I and II were used as control schools.
- In their day-to-day operations, Waru I and II were traditional schools. The teachers in the schools had only a day training on mastery learning before they participated in this experiment.
- The other four main subjects (natural sciences, social sciences, civics, and Indonesian language) were not presented in the micro-level experiment. Peer tutor and module effectiveness in one subject may not represent the effectiveness in other subjects.
- Self-teaching programs are being implemented in Indonesia in grades 1-6. The microlevel experiment only dealt with grade 6 students. Peer tutors and modules may be effective for children in grade 6 but not for other grades.
- Although the students in self-teaching programs include out-of-school students (primary school dropouts who come back to school), the present study was only concerned with regular, in-school students. The effectiveness reported here may not hold for the out-of-school students.
- There are many aspects other than teaching-learning that were not covered in the study, such as community participation, management information systems, monitoring and evaluation, etc. An effective teaching-learning does not necessarily mean that other aspects of the Impact primary school system are effective.

Within the limits of these constraints, the present study confirmed the effectiveness of peer tutors and modules as mediators of learning.

THE CURRENT STATUS OF THE IMPACT EXPERIMENT

The prototype model for Impact, which the Solo project is seeking to develop, consists of three main elements: the module, the personnel manuals, and the actual operation of the self-instructional school system, which is (potentially) massive, effective, and economic. The findings of this study show that the Impact module, despite its imperfections, is sufficiently effective to aid students in attaining a high average of pre-remediation (original) learning with minimal help from teacher or peer tutor. Monitoring for further module improvement is being done. A separate study is now being done by the Solo Impact microstudy team to ascertain the extent to which the Solo Impact manuals are actually being implemented by field personnel in Solo as well as in Gianyar, Bali, under conditions of normal (routine) supervision.

All these activities are to ensure that an Impact primary school model will be developed in due time. An effort is even under way to identify places in Indonesia where the model can be implemented for educational development purposes. There is a strong possibility that the self-instructional primary school model will be integrated with other primary education models as a basis for an integrated universal primary school program in Indonesia. The plan for integrating the models is

being prepared and will be communicated to educational personnel in Gianyar, Bali, for immediate implementation.

This study shows that preremediation learning and postremediation learning are both important for students to attain a higher index of learning effectiveness. In the mediated-learning strategy, the module has an important role in helping students attain high preremediation scores and preremediation ILE. To improve the effectiveness of the module in postremediation learning or to improve the role of module as remediator, one may:

- Make the module being studied available for students during the remediation process. If the module were available to the students, they could reread it and study it during the remediation process.
- Make other modules that are relevant to the learning materials being studied available during the remediation process. This is necessary because a problem is often rooted in a poor understanding of concepts presented in earlier learning materials.

The effectiveness of peer tutors in preremediation learning may be improved by means of intensifying of the teacher's supervision.

QUESTIONS FOR FURTHER STUDIES

Many questions about Impact still need to be answered, and some could be addressed by microlevel experiments. For example:

- Is the Impact-mediated mastery learning strategy effective under conditions of high (1:70 or more) teacher:student ratios?
- Is the Impact-mediated mastery learning strategy economic in terms of teacher:student ratios, developmental and operational costs associated with module production, training costs, and backup research?
- How much different is the work load of teachers who implement the mediated strategy from that of those who implement the nonmediated mastery learning strategy and from that of those who implement the nonmastery learning strategy?
- How do teachers pay the extra time-cost that is needed to implement the mastery learning strategy?
- How do dropouts pay the time-cost or the extra time-cost to learn under the mediated-learning strategy, a strategy that claims to offer a multiple entry and exit system to them?
- How could the self-instructional primary school model be integrated with other existing primary education models within a universal primary school program?