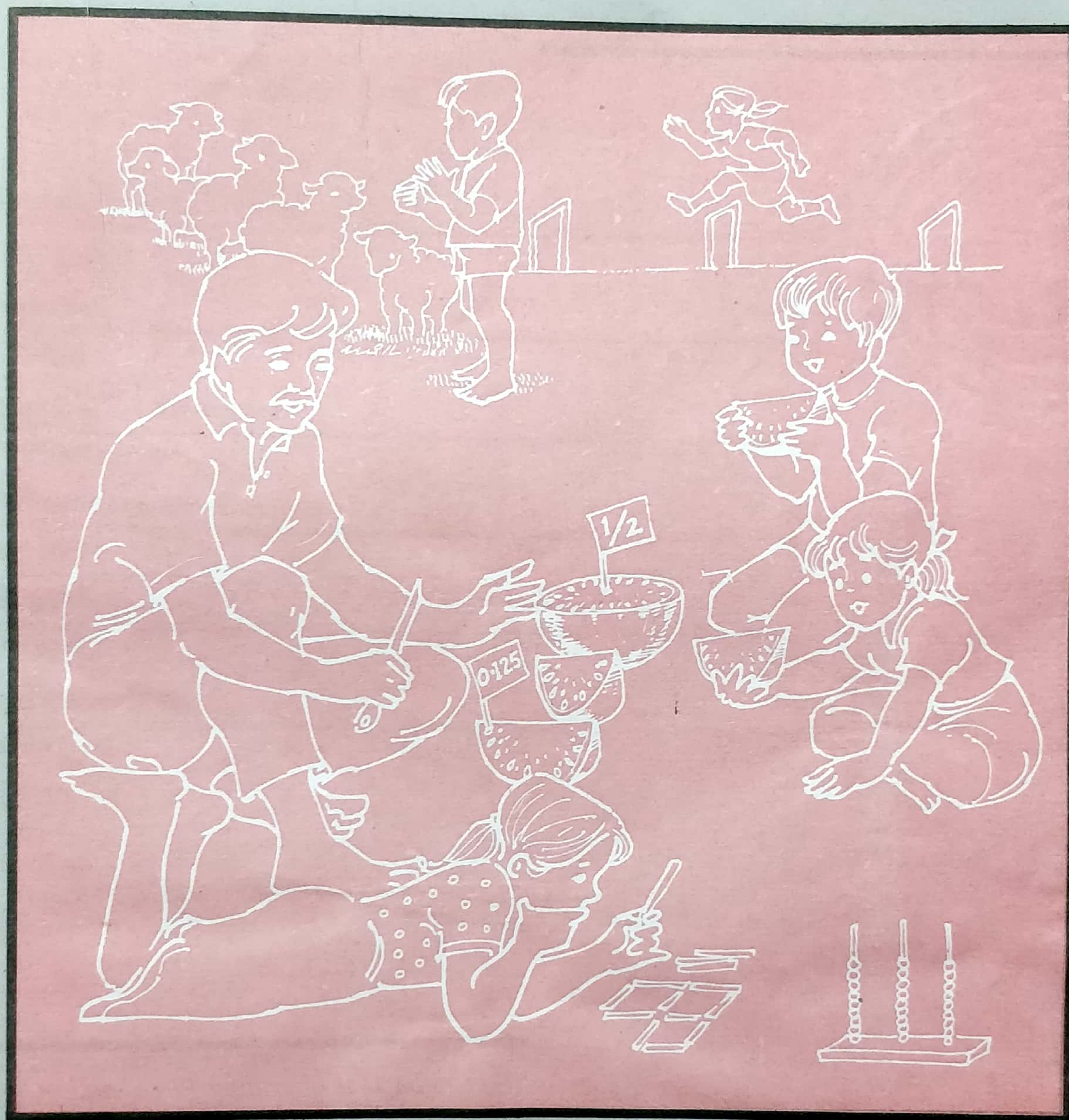




Indira Gandhi National Open University
School of Sciences

AMT-01
TEACHING OF
PRIMARY SCHOOL MATHEMATICS



PROJECT GUIDE

“शिक्षा मानव को बन्धनों से मुक्त करती है और आज के युग में तो यह लोकतंत्र की भावना का आधार भी है। जन्म तथा अन्य कारणों से उत्पन्न जाति एवं वर्गगत विषमताओं को दूर करते हुए मनुष्य को इन सबसे ऊपर उठाती है।”

—इन्दिरा गांधी

“Education is a liberating force, and in our age it is also a democratising force, cutting across the barriers of caste and class, smoothing out inequalities imposed by birth and other circumstances.”

—Indira Gandhi



Indira Gandhi
National Open University
School of Sciences

AMT-01

Teaching of Primary School Mathematics

PROJECT GUIDE

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The project report will be accepted by SR&E Division only in April and October of every year.

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1 INTRODUCTION

A course on ways of teaching mathematics to children is meaningful only if the learners actually interact with children in this context. This is why, as part of the course, you need to undertake a 2-credit project related to the objectives of this course. You would have already done several activities while going through the blocks of the course. These were 'small' ones, in that they wouldn't have taken much time to do. The project component of this course is nothing but a larger activity or a set of activities which take a total of 60 hours to complete. This gives you an opportunity to practise the ideas that you have come across in this course, and those that you may have evolved while studying it.

In this booklet, we will discuss what project work involves — carrying out sustained activity, gathering and analysing your observations, and then drawing conclusions. In Section 2 we will clearly write out the different broad stages that you would need to go through while doing your project — right from the beginning, up to the submission of your project report. In Section 3 we will talk about what kind of help you can expect from your academic counsellors while designing and conducting your project work.

Section 4 is small, but important. In it we have discussed various points that the examiner will keep in mind while assessing your project report. In this context, please note that to complete the course successfully, you will have to separately pass in this component of the course as well as in the 6-credit theoretical component.

In the next section, Section 5, we shall give you some detailed examples of projects that can be undertaken. These examples are only suggestive. You are welcome to think of other kinds of projects. In fact, you can get a few extra marks if you do a good project which is not of the type we have listed.

Finally, in the appendix, you will find copies of the different forms that you will have to fill (or get filled) and send us at different stages — when sending the approved proposal, and when submitting your project report.

Please go through this guide carefully before getting into your project. Otherwise you may skip some of its important aspects.

2 PROJECT WORK — FROM A TO Z

Many of us, when faced with doing a project, immediately get worried, and wonder — HOW? In this section we aim to answer this question by listing the different steps that are involved in the whole process.

A) Choosing a topic :

The first thing to do is to pick an area that you want to work on. (We have listed some areas in Section 5.) While choosing your topic remember that

- the area should be related to the teaching / learning of mathematics,
- you should be able to complete all the stages listed in this section in approximately 60 hours. (60 hours does not mean a continuous stretch of 2½ days. You should only consider the actual time you take on the project. For instance, if you work on it thrice a week for 3 hours a day, then you should be able to finish it in about 6-7 weeks.)

Discuss your choice with your counsellor, or with anyone else who you feel has the relevant experience. This may help you to clarify your ideas about your choice of project, and how you should proceed.

B) Preparing the project proposal :

The next step is to prepare a proposal of about 300 words. In this you should clearly give

- your name, enrolment number and study centre code;

STEP I

STEP II

- ii) the precise aim of your study;
- iii) the broad plan of your project;
- iv) broadly, the kind of people you would work with (e.g., children of which age group/class/background, and/or teachers of which class,);
- v) the kind of places you would conduct your studies in (in your neighbourhood, and/or home, and/or in a school, ...).

STEP III

C) Submitting the proposal:

You should submit the project proposal to your approved counsellor. He/she will go through it and either suggest changes or approve it by filling **Form A** (see Appendix). Once approved, you should give the proposal and Form A to your study centre coordinator.

Upto now you should have spent **about 10 hours** of the 60 hours meant for the project.

After submitting the proposal to your coordinator, please start the actual work on your project.

STEP IV

D) Conducting the project work:

This stage is the one in which you will be taking the most time. For example, if your project involves surveys and gathering data, then you would firstly need to identify the children or adults you will get the data from. You would also need to choose your target group and your instruments of survey (e.g., questionnaires, interviews, collection from written sources, etc.). Then you would carry out the surveys, gather and classify the data or your observations, analyse them, and arrive at your conclusions.

Throughout this period please maintain a project diary. You should enter your project-related activities in it regularly. For instance, if you are trying an activity with some children, you can note this down, and all your observations alongside.

Also, at various points you may find that the conduct or outcome of an activity is not going according to your expectations. This should not worry you. You should honestly record your findings, and try to see why the activity didn't work.

If, at any point of time, you feel that you need to alter your project objectives, please do so. At the same time, you should note this down in your diary, writing down your reasons too.

(e.g., you may begin with wanting to try out and assess a new teaching strategy for communicating the concept of fractions and operations on them to Class 3 and 4 learners. After about 15 hours of work you may realise that this is too big a project for 60 hours. So, you may choose to restrict your attention to just communicating the concept of proper fractions. You should write all this down in your diary – your worry about not completing the project, therefore altering the aim, and therefore what other modifications come into the project. This should be recorded on the date that you feel this way.)

Any other ideas/thoughts related to your project that you get should also be written in this diary. Doing so will help you when you come to the next stage.

In Fig. 1 we have given a sample of some diary entries.

Please **don't destroy your diary** after writing your report. This is because, if your study is unusual and innovative, we would like to know the details involved. These details will be given in your diary, which would then be a useful addition to our project library.

Date &
time taken
13/1/95

Discussion
took 2 hours

13/1/95

1½ hours

18/1/95

Details of activity done.

Discussed paper that I had written on the problems children face in using the multiplication algorithm. Since the material I'd studied was about urban-based private school-going children, she suggested that my conclusions should be modified – not to be generalised to all. In fact, I'll see if the same conclusions work with the district primary school children nearby.

At night worked on the kind of questionnaire I'll use. Also considering strategy suggested by Kabra to see if it works.

Questionnaire will have

- ① direct questions: single-digit by single-digit, multi-digit by single-digit.
- ② verbal problems – simple & from textbook, simple ~~not~~ from textbook, slightly more complex ones also.

Met the headmaster + teacher of Class 3 of the School. Very friendly & helpful.

Fig. 1: Some diary entries

STEP V

E) Preparing the final report:

Now that you have completed your project, you need to write up a report about it. This should consist of about 2000 words. It should be written in simple language, clearly and precisely. You should present your report in a manner that brings out the quality and quantity of mental and physical labour that you have put into the project work. It should include:

- a short paragraph on the aim of your project, why you chose this particular project and how it is related to the objectives of the course.
If you modified your aim at any stage, give the original and modified form. Also give a reference to the place in your report where you have explained the reason for your change in aim.
- details of the children and/or adults you worked with (their social and educational background, etc.)
- a brief outline of the method you used.
- an outline of your weekly progress, a kind of shortened version of your diary.
- any data that are relevant to your results (for instance, games used, test papers and marks, etc.)
- the analysis of your observations/results.
- the conclusions you have come to, and why.
- what insights related to teaching or learning mathematics you have gained by doing the project.

To your report, you should also attach copies of games/kits/questionnaires etc., used by you during your project.

F) Submitting your report:

You should submit this report to

The Registrar
Student Evaluation Division
IGNOU, Maidan Garhi
New Delhi - 110 068.

along with Form B and Form C (see Appendix).

You must clearly write "AMT-01 Project Report" on the postal envelope.

PLEASE KEEP ONE COPY OF WHATEVER YOU SUBMIT.

3 HOW YOUR COUNSELLOR CAN HELP

In this section we shall gather the various points that we have mentioned earlier related to your interaction with your counsellor.

- Your counsellor can advise you about the type of project you can choose, and how you should proceed.
- She/he can suggest books/articles that you may find useful for your project.
- She/he should approve your project proposal, before you begin to actually do it.
- She/he will be available for discussion and help throughout the different stages of your project. You should fix up mutually convenient times for this purpose.

4 EVALUATION

The weightage of this component of the course is 25%. To complete your course successfully, you will need to pass in both the components of the course separately — the theory portion as well as your project work.

While evaluating your project, we would consider the topic you choose, how you conduct your project, how you analyse your data and draw inferences from them, and, in general, the way you have presented your results.

In the next section we have given examples of projects that can be taken up. These are not the only possibilities. They are merely suggestive. You can think of any other kind of project that is related to the objectives of this course. In fact, you will get some weightage for doing projects other than the kind suggested below.

5 PROJECT SUGGESTIONS

In this section we aim to give you some idea of the variety of projects that you could take up. These suggestions do not cover all the possibilities. There are many others that you can think of.

We have broadly listed 4 types of projects. In each of them we have listed the steps. Alongside we have mentioned the average time that doing the step would usually take. The amount of time listed is flexible. You may need to take more, or less, time in a particular step — that is entirely up to you.

TYPE I: Finding Out How Well A Concept Has Been Understood

The project could be studying the acquisition of a concept or a series of concepts by children. They could be students of a certain class in a school, or those in your neighbourhood or elsewhere. In order to assess the child's basic understanding of the concept, you could make a set of questions that test it. Or you could give them a series of activities for this purpose. Let us consider examples of both these possibilities, one by one.

- Here we shall look at a project which involves giving children a test paper to do to see how well they have understood a concept. While making the test paper, you would need to be careful about selecting questions that are relevant for this purpose. This test would be given to a carefully chosen sample, which could consist of students of a particular class from one or more schools. You could give the children prior notice of the test, or you could give them a surprise test. In either case the same conditions would have to be provided to all the children who are being taken as a sample. You would also need to talk to the teachers of the class concerned and the headmaster/principal of the school for permission to administer the test to the children.

To understand what is involved in this kind of project, consider the project of this kind that a colleague of ours did. He wanted to examine how well children have understood the concept of a fraction. He decided to test the understanding of children of Class 5, Class 8 and Class 10, all of whom are supposed to have studied fractions in detail. He decided to examine their understanding of what a fraction is and how it becomes bigger or smaller. So, he identified two areas of testing as:

- the ability to compare fractions and to seriate them,
- the ability to pictorially represent a fraction.

In each question he asked the children of Classes 8 and 10 to also explain the reason for their answers.

His test paper, therefore, had questions like:

You will be informed about the result of the evaluation of your report within 3 months of your submitting the report.

Though your project may be a general one, you need to narrow it down to assessing children on a few specific aspects of it.

- Which is the bigger of the two fractions?
[Here he gave two fractions with identical numerators and different denominators. He further asked the older children (those from Classes 8 and 10), the reason for their choice.]
- Three sets of fractions are given to you. Please order them in descending order, starting with the largest and ending with the smallest fraction.
(Here he gave 5 distinct fractions with identical denominators, another 5 with identical numerators and another 5 with varying denominators and numerators.)
- How would you represent $\frac{3}{4}$ pictorially?
(Here he asked the children of Classes 8 and 10 to represent a mixed fraction also.)

And so on.

Because of the limited time at his disposal he chose not to enlarge the scope of the test. Otherwise he could have added questions for evaluating their understanding of addition or subtraction of fractions, their multiplication / division, or some other aspect.

After administering the test to his sample, he studied the response. Not only did this involve marking them right or wrong, but also looking at the kind of process followed and the kind of mistakes made.

He made a table based on the way the children answered the questions — how many answered which ones correctly, what the reasoning was when the answers were wrong, etc. For example, he found that

- 15 out of 40 children had correctly answered the first question.
- 10 children had not given the correct answer, but had said that the smaller fraction is bigger as it has a larger number below.
- 80% of the Class 5 children had represented eq. $\frac{3}{4}$ pictorially by making a circle and dividing it into 4 parts, while 80% of the Class 10 students had done the same with a square.
- 60% of those Class 5 students who divided the circle into 4 parts did not shade any portion.

There were other errors too, which he recorded along with the number of students who had made them.

Apart from such a record, he considered how each child had answered the different questions. To try and understand the children's logic and gauge their level of understanding he selected 4 or 5 children to talk to personally. The choice of which students would be interviewed was made by looking at their responses to the various questions. For example, one of the children of Class 8 who had shown $\frac{3}{4}$ by making 7 parts and shading 3 parts was chosen to be interviewed.

The children were not aware that they were to be interviewed. Neither did they know that he had seen their notebook and broadly decided on what to ask each child. He took one child at a time and initially talked with her about general issues. After the child became somewhat comfortable, my friend began the exercise of trying to test her learning. He had decided on certain activities that he would do with the child, and he took the necessary materials with him. While she was doing the activity, he realised that the situation itself required him to create new questions and new tasks as he went along. All these questions were, however, within the broad pattern he had identified earlier, and were aimed at seeking the same understanding. Of course, he recorded these interactions in his project diary for future reference.

The next step was to analyse his data for making an assessment of the children's understanding of fractions. He drew his own conclusions about how far they had been

successful in learning some specific concepts in fractions, where and why they stumbled, and the kind of difficulties they faced in understanding the concepts. He also drew his conclusions about the nature of teaching, textbooks and curriculum.

Let us look at a rough division of the time taken to do this kind of a project.

Time Allocation

- Identifying the series of concepts and sub-concepts, and making the test paper. (6 hours)
- Identifying the school, the class, getting permission to administer the test, and administering the test. (6 hours)
- Looking at the responses, collating and tabulating performance. (10 hours)
- Analysing the response, identifying children to interview, identifying the areas and questions that you want to ask them. (6 hours)
- Interviewing 3 or 4 children and recording the interviews. (12 hours)
- Drawing inferences, and writing up the report. (10 hours)

(Note that you would have already spent about 10 hours upto the time that you submit your project proposal.)

If you do not have access to a classroom, you could do this project with children in your neighbourhood. For a worthwhile study, however, you must ensure that you get at least 25 responses to work with.

- B) Now let us consider a project which involves doing activities with children to examine their understanding of a concept. For example, you could study how well children understand spatial relationships like rotation and symmetry in rotation. You could devise activities for various age groups and get children to do them individually. Examples of some activities are putting together pieces in a jigsaw puzzle, going through a maze, identifying identical shapes in a set of objects or cards, or picking out reflected images and rotated equivalents of certain two or three-dimensional objects.

By assessing the problems the children face, you could draw conclusions regarding the nature of the activities given and the ability of children to understand the abstract spatial ideas.

Apart from the 10 hours that you would spend on Steps I, II and III given in Section 2, let us see how much time the other steps of such a project would take.

Time allocation

- Identifying the abilities and concepts to be tested. (3 hours)
- Identifying and ordering the activities/tasks. Finding necessary materials for doing them. (10 hours)
- Choosing a group of 15 or more children to work with, and getting the necessary permission for doing so. (3 hours)
- Doing the activities, and recording how each child does the tasks, what kind of slips she makes, the path she takes, etc. (15 hours)
- Collating the data, quantitatively and qualitatively. (8 hours)
- Analysing the data, drawing broad conclusions. (6 hours)
- Writing up the report. (5 hours)

This type of project can be about the understanding of concepts/processes/rules in other areas too. You could take examples related to numbers and number operations, elementary algebra, and even elementary probability.

Let us now look at another type of project.

TYPE II : Developing And Trying Out A New Teaching Strategy

In this type of project, you would identify a concept / process / algorithm that children usually find difficult to grasp. Then you could devise a teaching strategy that, according to you, would give children the best possible opportunity to learn the concept. The series of activities that you devise could also consider using locally available materials instead of a complex apparatus. These activities could include handling objects, using models, charts, playing games, singing, role-playing, story-telling, interesting exercises for the children to do outside the classroom, etc. The series of activities could be tried out on **at least 15 children** in a classroom situation or in an informal outside-the-classroom situation.

You would also need to assess the effectiveness of your strategy. While doing so you would need to observe the interest the activities / exercises generate in the child, the kind of mental exercise that they force the child to do and the kind of questions and mathematical understanding that they develop in the child.

For an example of this kind of project, you could look at some ways of communicating the concept of hundreds, tens and ones. Think of a series of activities in this context, which use simple materials. Now take two sets of **about 15 children each** with more-or-less the same background. Do the series of activities you have devised with one set of children. And, give the other set the "usual" kind of exercises for practising HTO. Midway through this process, give each group a test, and interview one child from each group.

About 10 or 15 days after this teaching process is over, administer another test to both sets of children. Also interview a couple of children again. The tests can include problems involving carry-over and borrowing. In the interviews try and get the children to articulate the algorithm used and the reason for choosing the algorithm.

You can compare the performances in the two tests by the two sets of children to assess the impact of the activities.

For each activity, observe and keep a record of the extent to which children participate in it. Make a 5-point scale and try to mark each child's participation. Looking at the assessment made earlier, examine it to see if there is a relationship between participation and the extent to which the concept is learnt. If a child is not participating, try and find the reasons for this. Modify the activity so that it increases participation. Assess the impact of the change.

You should record all these aspects and stages of your work in your project diary. Your project report should be based on this.

Let us consider the different stages of such a project, and the time taken by each.

Time Allocation

1. Identifying the concept/process/algorithm as well as the kind of activities and/or methodology being used for teaching the concept. (3 hours)
2. Devising activities which can be considered as learning opportunities for the learner. Sorting the activities according to their level of difficulty and according to the concept they get the child to practise. Ordering the activities according to which should be done earlier and which later. (9 hours)
3. Collecting the material required for doing the activities. Choosing the sample of children that you will study. Doing the activities with the children. (15 hours)
4. Assessing the impact of the activities by giving children a test and interviewing some of them, during and after the teaching process. (8 hours)
5. Assessing the quality of the activities on the basis of children's participation and what they have learnt. Noting the difference in effectiveness of the usual way of teaching and of your strategy. Making changes and improving the activities. Writing up a report. (15 hours)

And now let us consider the third type of project that you could undertake.

TYPE III : Assessing Children's Problem Solving Abilities

In this type of project you could assess children's ability to reason mathematically and solve problems. Regarding their ability to solve problems, it is generally believed that children perform much better in tests that are restricted to those word problems, from their textbooks which they have done before. They are said to have a lot of difficulty in solving problems that they have not done before, even though these questions may be simpler than those they have done in their classes. This hypothesis could be tested in various contexts. You could take several questions built around a concept or a series of concepts. Some questions should be those that the children have done earlier, and some should be new to them. Do a comparison of their performance in solving the familiar questions vis-a-vis their performance in solving the unfamiliar ones.

To see what goes into such a project, consider an example of one that a friend of ours did. It was related to the division of numbers. She took 20 Class 3 children of an English-medium school and asked them to solve a test which had various questions that they had solved like, 'If 4 sweets can be packed in 1 packet, how many packets are needed to pack 48 sweets?'. In the test she also included questions like 'Charu had 55 toffees, which had to be packed. Each packet could contain 5 sweets. How many packets would she be able to make?', which the children had not come across before.

Most of the children fared very badly while solving the unseen questions as compared to the known ones. Many of them tended to multiply 55 with 5 to answer the question about Charu and her toffees.

She decided to interview a few children of both groups — those that had done most of the sums correctly, as well as those that had not. Of the ones who divided 55 by 5 in response to the question written above, when asked why they did so, most couldn't give any reasons. Some of them also said, "Maybe I should do 55×5 ."

Our friend tabulated the results of the test, and analysed all the written responses. She also analysed what she could gauge from the interviews. On this basis she drew broad conclusions of where the teaching strategy could be altered. Of course, the new method would further need to be tried out, as in the Type II project.

Under this kind of project you could also test the children's ability to recognise patterns and relationships, to make deductions, to classify, to recognise pictorial representations, etc.

Let us look at the different stages of the project work, and the average time required for each stage.

Time Allocation

1. Identifying an area, the concept and the algorithm that the children are supposed to know. Making a test paper that includes questions from their textbook that they have done before as well as questions about the same concept, worded and presented differently. (8 hours)
2. Identifying the set of about 20 children you want to test, getting the necessary permission and giving them the test. (6 hours)
3. Looking at the responses, collating and tabulating performance. (8 hours)
4. Analysing the responses, drawing broad conclusions, identifying points to clarify and children to interview. (10 hours)
5. Interviewing 3 or 4 children and recording the main conclusions obtained. (12 hours)
6. Writing a report on your study. (5 hours)

Now let us consider another broad category of projects that you can take up.

TYPE IV : Diagnosing And Remedying Children's Learning Difficulties

Children have a lot of difficulties in understanding certain concepts. There are certain common points on which they get stuck while dealing with the wider concepts. In the units given to you, patterns in the errors children make are indicated at several places. You could identify these points and explore, with an available set of children, if they follow the same pattern. Interview some children, and try and understand why they make those errors, or why they have a learning difficulty at that point.

For example, you could consider the difficulties children have while dealing with word problems. It is commonly observed that children seem to follow certain algorithms easily and can solve the directly stated questions. But they are not able to do related word problems. Some aspects of this are explored in Unit 11. You could read this unit again carefully, and discuss your ideas with your counsellor. She/he may also be able to suggest books and references that are relevant to your project. You should explore them too. Do this reading and prepare a paper on what you've gathered about the kinds of difficulties that children face when dealing with word problems.

On the basis of what you gather, you could choose a group of about 15 children and devise a test which evaluates their ability to do simple, slightly complex and very difficult word problems. The problems should be built around algorithms that the children are familiar with. Based on the test results and the conclusions they suggest, you could think of ways of helping children to understand and solve the word problems. Finally you could try your method out on a group of 4 or 5 children, and see its effectiveness.

Other patterns that you could tackle in this kind of project are related to

- i) the definition of a triangle — all triangles that do not have their tips pointing upwards are considered to be non-triangles by children.
- ii) the definition of a square — children often believe that a square is not a rectangle.
- iii) the fact that a fraction is a number — for most people numbers are only 0,1,2,....

Let us look at the different stages involved in such a project, along with the usual time each stage would require.

Time Allocation

1. Defining the pattern in the bottle-necks, discussions with counsellor, and gathering material from the course units and other written sources. (8 hours)
2. Conducting interviews, devising a test to verify your hypothesis, giving about 15 children the test, collating the test results. (14 hours)
3. Studying responses, and drawing broad conclusions. (8 hours)
4. Devising a new method and trying it out on a few children. (10 hours)
5. Reaching broad conclusions, and writing the report. (10 hours)

6 APPENDIX

FORM A

(Before filling it, see Step III of Section 2.)

This is to certify that I have examined the proposal of the project entitled _____

submitted by Ms/Mr. _____

(Roll No. _____), and have found it to be satisfactory.

Signature of course counsellor

Date: _____

Study Centre Code: _____

Name of course counsellor

FORM B

(Before filling it, see Step VI of Section 2.)

This is to certify that the project entitled _____
_____ was

Undertaken by Ms/Mr. _____

(Roll No. _____) under my guidance. The enclosed report on
the project is the result of bonafide work done by her/him during the period

_____ to _____

Signature of course counsellor

 Date:

Study Centre Code:

Copy to:

The Registrar, SED
IGNOU, Maidan Garhi,
New Delhi- 110068
(To be sent with Project Report)

FORM C

(Before filling it, see Step VI of Section 2.)

Name of Student:

Enrolment No.:

Name of Course Counsellor:

Address of Study Centre:

Please tick the type of project you've done, according to Section 5 of the Project Guide, in the appropriate box below:

☐

I

☐

II

☐

III

☐

IV

☐

Any other

If 'Any other', then briefly write how it differs from the 4 types listed:

 Date of submission of approval to study centre coordinator.

Signature of course counsellor

Date:

Place:

Copy to:

The Registrar, SED
IGNOU, Maidan Garhi,
New Delhi- 110068
(To be sent with Project Report)