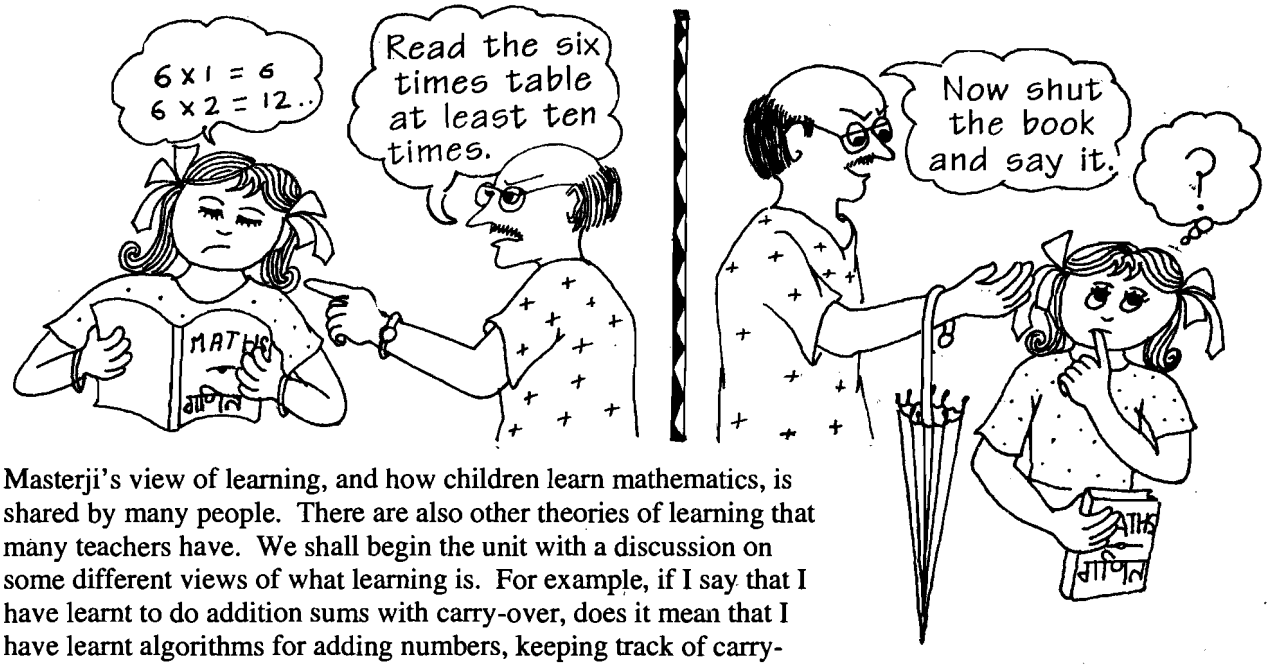
UNIT 1 THINKING ABOUT LEARNING

Structure **Page Nos.**

1.1 INTRODUCTION

Masterji was really annoyed with 7-year-old Seeta. He had asked her to learn the six times table, and here she was, not being able to repeat it beyond 'six threes'. So he angrily told her to read out the whole table ten times. After she did that, he told her to shut the book and say the table. She, poor thing, still couldn't remember much more than what she had earlier known. Masterji, of course, believed that the constant repetition should have made her learn it.



Masterji's view of learning, and how children learn mathematics, is shared by many people. There are also other theories of learning that many teachers have. We shall begin the unit with a discussion on some different views of what learning is. For example, if I say that I have learnt to do addition sums with carry-over, does it mean that I have learnt algorithms for adding numbers, keeping track of carry-over for it? Or, does it also mean that I have understood **when to add** numbers in common classroom and home situations?

Why do we need to think about learning? As teachers, we plan our activities of teaching on the basis of our understanding of how children learn, and what we want them to learn. In other words, each of us has a model of the process of learning in our minds. Such a model tries to explain how knowledge develops in the mind. In the next three sections of the unit, we discuss three models of learning in detail. The aim of these sections is to help you examine the model of learning you follow while teaching any subject, and mathematics in particular. In the process, we will raise questions for you to think about regarding the place of memory in learning, whether algorithms are learnt by solving many problems of the same kind, how important it is to let the child build her own understanding at her own pace, and many other basic issues like these.

Of course, as in AMT-01, the way the unit unfolds is through examples, and exercises. While studying it, please consider every point through your own experiences.

Objectives

After reading this unit, you should be able to

- explain your understanding of what 'learning' is;
- describe the characteristics of the banking, programming and constructivist models of learning;
- explain the understanding of learning that each of these models of learning reflects.

Let us now see what different understandings people have of the term 'learning'.

1.2 MAKING A MODEL OF LEARNING

Seema, a primary school teacher in a public school, makes her class repeat every addition fact again and again, loudly, in unison. When asked why she does this, she says that this ensures that the children learn addition.

Ayesha is teaching Class 3 children the concept of place value in a village in Madhya Pradesh. For this purpose, she gives them a lot of time to play with beads, making them into necklaces, counting the leftover beads, and so on. She also involves them in several other activities like counting little sticks and grouping them. At each stage she talks to them, asking them to explain what they are doing, and responding to their explanations.
Ayesha believes that this is the best way for children to learn place value.

Seema, Ayesha, and thousands of other people (including you) are in the process of teaching mathematics to young children. How you go about it depends on many factors. One of them is your understanding of the process of learning. Of course, this would include understanding how a child learns, the nature of the subject matter that you want to teach (or what you want children to learn) and an understanding of what learning is. These three aspects form what we call a **model of learning**.

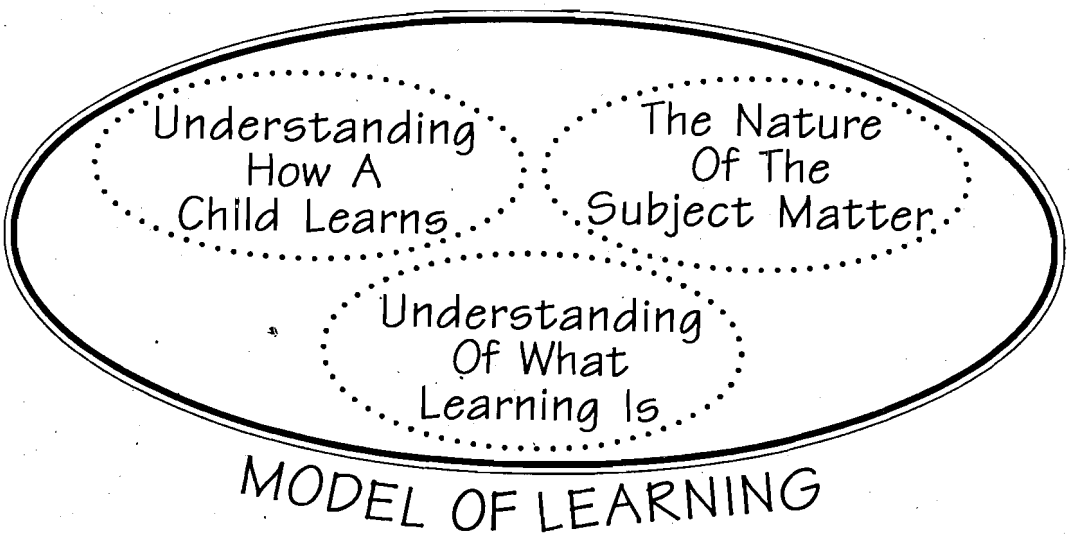


Fig.2

As you can see, one of the most important factors that determines the model of learning any of us follows is what we understand by the word 'learning'. For instance, would you say learning has taken place in the following example?

Example 1: Nair had spent two weeks teaching his Class 4 students how to add fractions. He had done many examples from the textbook and from other books for them on the blackboard. He also gave the children questions from the textbook as homework. On checking their homework, he found that most children could do all the problems correctly. Based on this and the classroom performance, he was certain that they had **learnt** addition of fractions. A week later, when he asked them some similar but new questions related to operations on fractions, most students couldn't do them. He was extremely disappointed.

———————×———————

Do you think Nair's class had learnt to add fractions? How would you judge this? Wouldn't you judge it according to your definition of learning? Let us consider a sample of ways in which some teachers we spoke to understood learning.

- Learning is production of an expected response to a given stimulus.
- Learning is a change in behaviour due to practice.
- Learning is a change in behaviour due to practice and experience.
- Learning is a permanent change in behaviour because of reinforced practice.

Think about these views while doing the following exercise.

E1) Which of the definitions given above do you accept, and why? If you have yet another definition, write it down. Explain why you accept it, and explain how it is different from the ones given above.

All the definitions above talk of learning having taken place only if it is visible to **other people**, that is, other people should be able to see the change in behaviour of the learner. For instance, according to these definitions, if a child gives you a correct answer to a subtraction problem, then the child has learnt subtraction; but if the child does not give the correct answer, she will not have learnt it. The teacher is not interested in what understanding the wrong answer shows, or how far this child has understood the concept. However, this child may have developed some understanding of subtraction, and may have realised that when you subtract you get a smaller number. So, even though she does not give the expected answer, she may have some feel for subtraction. This understanding may not immediately show up in an ability to solve subtraction problems. But, as she applies it in more and more situations that she is faced with, she would develop it further.

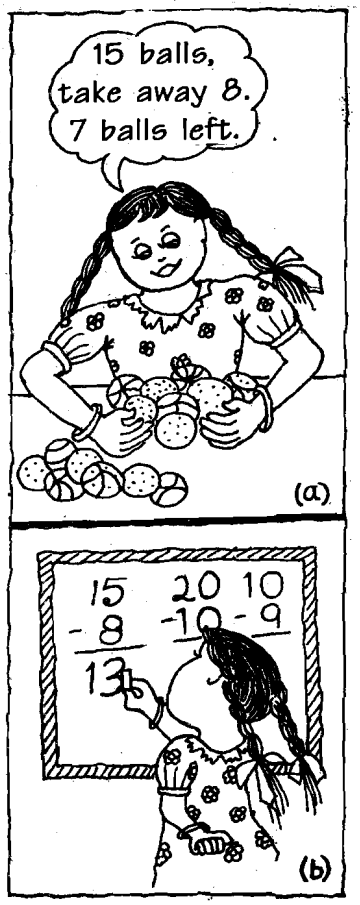


Fig.3: Anisha subtracting (a) with objects; (b) formally. Does Anisha really not have any understanding of subtraction?

Some psychologists have taken this view of a child developing an understanding into consideration. They believe that there are other ways of understanding how learning takes place. They don't expect children to immediately display the 'taught' way of solving problems. They respect the need for the child to think and analyse in her own way, explore and develop **her own way of solving problems**. For this, they suggest providing different kinds of tasks to the children which provide them with an opportunity to learn.

For example, suppose a child is presented with several real-life and classroom situations in which she adds and subtracts objects. These could include buying or selling materials in the market. It is very likely that these experiences would help her develop an understanding of numbers, and what addition and subtraction mean. But, this understanding may not immediately show up in an ability to do different kinds of sums. It may show up as a developed capability in certain situations where she needs to use it.

The kind of tasks that are given to children to help them with learning can be varied. For some teachers, learning is an outcome of repeated practice. To them this means repeating the same task over and over again. They reward those who have done the task correctly and punish those who make mistakes. For example, they give the child an algorithm and several problems to solve using the

In Unit 7 we have a detailed discussion on learning tasks.

algorithm. Following this, they check the child's work, only marking it as correct or incorrect. How much learning takes place with such a view of 'repeated practice' and assessment? Are there other ways of getting a child to visit and revisit a concept?

Throughout the course **AMT-01** you have seen examples of ways of giving a child several opportunities to deal with a given mathematical concept. Much of this practice with a concept or process needs to be in the form of interactions with concrete materials and with tasks that involve the child. The practice would also include the learner setting problems and tasks for herself and for her classmates. **These learning tasks are very different from repetition**, or from doing several problems of the same kind. In fact, each task should be designed in a way that would challenge the child.

Think about what we have just discussed while trying the following exercise.

E2) Make a list of the kinds of experiences which you think lead to learning. (e.g., activities like observation, experimenting, imitating.)

We shall now discuss three relatively distinct models and their implications for teaching. While studying them, please keep the different views of learning in mind.

1.3 LEARNING AS MEMORISATION: THE BANKING MODEL

The other day I met the headmaster of a public primary school. According to him the best way to teach multiplication is to ask the children to sit in a circle under a tree. Then one child should stand at the centre and speak out, for example, '2 ones are two' loudly. All the other children are expected to repeat this loudly after her. In this way the child at the centre says the complete table, and the other children yell out all the multiplication facts after her, again and again. When asked why he thought this was the best method, his reply was, "I learnt multiplication like this, and I will never forget my tables."

According to the model of learning followed by the headmaster, learning is basically the ability to memorise facts and reproduce them quickly when asked for. In other words, memorisation and learning are considered to be the same in this model. Let us look at another example of this model of learning in action.

Example 2: Vikki is in Class 5 of a government boy's primary school. Both of us were chatting about how he does his mathematics problems, and whether he uses the guide-book. The conversation was in Hindi. (Since the flavour may get diluted in translation, we have sometimes given his actual words in brackets.)

Vikki: I do the questions from the books. I don't look for their solutions in the guide.
I : So how do you do them?
V : From my head (dimag se)
I : How do you do it from your head?
V : By thinking (soch kar).
I : What is 'thinking'?
V : Memorising (yaad karna).

———— × ————

As you can see, in Vikki's mind there is no distinction between thinking and recall, between learning and memorisation.

The **expectation from the learner in this model** is to use the ability to reproduce the answer to a question that has been taught to her. In this model, not only are tables memorised, so are proofs of theorems in Euclidean geometry. The learner would be given the theorems and the proofs, with the steps involved. She would be asked to repeat the same proofs (with the same words) again and again. So, the change expected here is the ability to repeat the proofs of theorems in exactly the same way as they have been explained to the learner.

Equating memorising with learning treats learning as if it is just a chunk of information to be shifted from the book into the brain, and again from the brain to an examination answer paper. This approach to learning can be called the **banking model** because in this model facts are constantly added to and retrieved from memory, somewhat like a bank where things are stored. The teachers deposit knowledge into the brain-bank of the students, who then draw the facts out as and when needed.

Paulo Freire, a South American educationist, gave the name 'banking' to this way of educating.

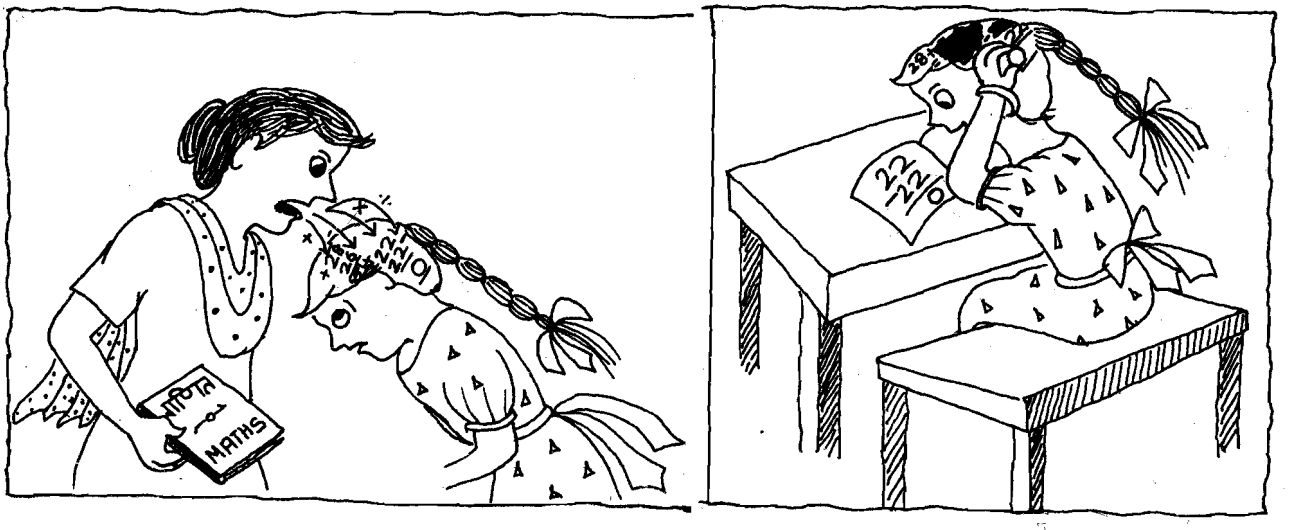


Fig.4: The banking model

Think of other examples of this while doing the following exercise.

E3) Give three expectations from the learner in the banking model of learning, in the context of teaching mathematics.

And now, let us see how we as teachers would go about creating learning opportunities for children if we follow the banking model. In this model, the child would be asked to repeat the same task again and again. She could be asked to speak it out repeatedly (like counting). Or, she could be given solutions to certain questions, and asked to repeatedly solve these very questions or ones like them. Initially, she may be asked to copy the answers to the questions from the board, from one notebook to another many times. By repeatedly practising the solutions of the same questions, the child would gradually be able to write the solutions to these questions from memory.

Isn't this the way in which many classrooms function? When a teacher finishes her lesson, she instructs the children to memorise whatever has been done. When she asks children a question in class, she asks them to recall and tell her. The practitioners of this model of learning believe that a child has learnt something **only if** she can repeat whatever related matter has been said by the teacher, not otherwise.

Fig.5

Children, thus, ask their teachers or their parents/friends to help them check to see if they have memorised the matter. They also ask the adults to lead them through

repetition to help in memorisation. When some children were asked the reasons for memorisation, they said – "so we can do by ourselves, we don't have to look at the book", and "to increase knowledge", and "By memorising, one becomes independent of the book and the teacher because the knowledge is in the brain."

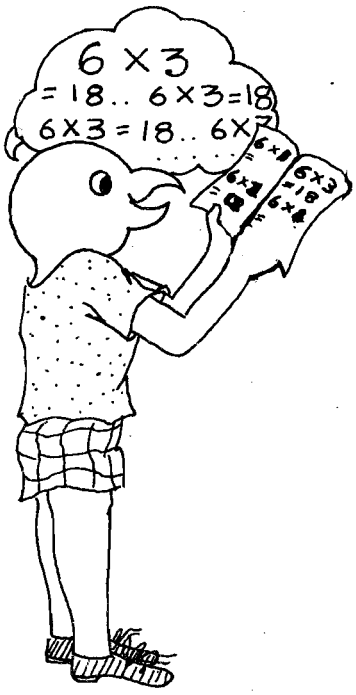


Fig.6: Is the banking model adequate?

Not surprisingly, in this system, the good students are those who have a good memory. These students do work very hard, since memorising is difficult work; you have to repeat things many times to make sure you don't forget. The belief, according to this model, is that students who do not do well in examinations are basically lazy. How many of your teachers believed in this? Think about it and do the following exercise.

E4) How many of the teachers who taught you in Classes 9 and 10 had a 'banking concept' of education? What are the techniques and tricks you used for remembering things you had to memorise?

Now that you are familiar with the banking model, think about whether it is sufficient to describe the learning process. Some of my friends would agree that memory plays an important role in learning and dealing with the world. But, is the human mind merely a storehouse of information and experience of the past on which all future actions, thoughts and new learning is based? If so, how would you explain the fact that each child knows her mother tongue and can use languages spoken around her naturally?

When a child listens to a sentence, she tries to extract the meaning of the words used. For example, when a child hears the sentence 'The dog is big', she would interpret it in the context of a comparison with something that is smaller. As soon as she compares the dog with a bigger animal which she may or may not have seen before, she says 'The dog is small'. Similarly, in her routine interactions, the child expresses many ideas and feelings. In her own way she describes situations that she is placed in. She is able to express herself even if it is a situation that is new to her. She is able to communicate and formulate many new sentences that she may not have heard before. The child is also able to read a book that is presented to her even though she has not seen the book before. She is able to make sense of the story and learn meanings of new words that occur in the story. For example, a child reading a story about a giraffe, may realise that a giraffe has a long neck and eats leaves. It is also true that the child has an ability to accommodate multiple meanings of words in her mind and choose the appropriate meaning in a specific context.

After going through what we have just said, do you think the banking model explains all these abilities? Doing the following exercises may help you to clarify your ideas about this.

E5) Does the banking model of learning adequately explain how children learn mathematics? Does this model explain the ability of the mind to organise and re-organise information? Give reasons for your answers.

E6) Give two examples of classrooms where it appears that the teaching has focussed on banking of information. How would you change the teaching process in them to make it meaningful?

E7) Think about an activity for children in your class. How much is it centred around memorising? Ask any of your friends to do the same exercise. Is the objective of her/his activity also memorising facts?

Let us now consider another popularly used model of learning.

1.4 LEARNING AS PROGRAMMING

Rajni was explaining the algorithm for adding with carry-over to the children of Class 2. She was saying, "Wherever you get two or more numbers to add, make three columns. On top of each of these columns you write 'hundreds', 'tens' and 'ones'. Write 'hundreds' in the leftmost corner and 'ones' in the rightmost. Write the numbers one below the other, keeping in mind that the tens are written in the 'tens' column and the units are written in the 'ones' column. Add the numbers in the 'ones' column first and then carry-over if you need to. Then add the second column. In the same way, add each column and find the carry-over each time."

What is going on in Rajni's classroom? Is it memorising? Or is there another model of learning in action? Rajni is trying to give the children a clear procedure that they can use without worrying about making a mistake. The important thing is that the children must be able to remember the particular procedure and to follow it. If she is given plenty of practice in following a series of steps, she will be able to repeat these steps without thinking, as soon as she recognises a problem that requires this.

If you believe in this approach to learning, you would be taking children from the known to the unknown, based on the following beliefs:

- I know the best method of solving problems of this kind, and I must share that with children;
- Do not put too much load on children, but give them knowledge in small chunks, bit by bit;
- If I teach them the procedure step-by-step and ensure that they know how to follow the steps, they would have no difficulty in solving any problem;
- The children should first be able to do the simpler problems, and then I can teach them how to do the less simple ones;
- If a child solves many questions of the same type, she will have learnt the algorithm concerned.

According to this model, learning is a sequence of programmes to be remembered and followed. It considers learning to occur in small pieces, bit by bit. It assumes that all children learn in the same way, maybe at different paces. So, all it needs for those who have not learnt is to spend some more time on the same programme, doing some more examples. Then they would automatically acquire the same learning. You may agree that the name **'programming model'** is appropriate for this approach to learning. As you can see, this model has many similarities with the banking model.

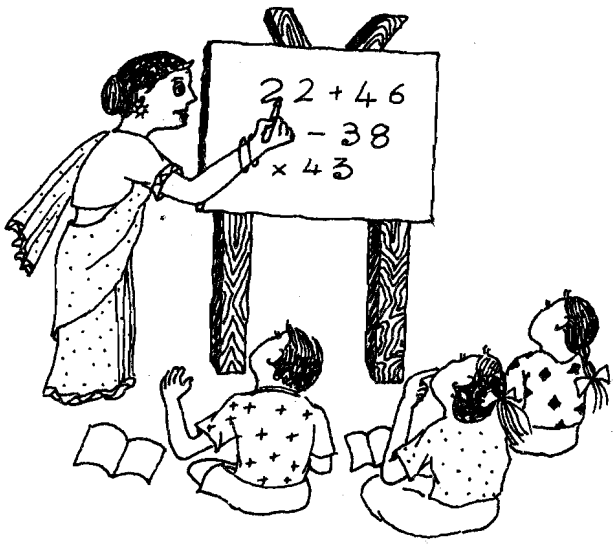


Fig.7: Practice makes the children perfect listeners!

So, if you follow the programming model, you would teach the child in a linear manner and move from 'simple' to 'complex' ideas through a series of carefully taken small steps. As Rajni says, "Once most of the children in my class have learnt how to add two-digit numbers without carry-over, I introduce addition of two-digit numbers with carry-over and explain the steps in it. Once I give children sufficient practice with exercises with carry-over, then I begin subtraction."

Apart from linearity, you would give the child one type of problem at a time if you believe in learning taking place by programming the child. The questions you give would follow the single algorithm to be used. To avoid confusing the child, you would not give her a mixture of problems. Only those problems that use the given algorithm would be considered. The problems that do not use the algorithm, or problems that use a variation of the algorithm, would be avoided.

For instance, Rajni would teach two-digit additions with carry-over, and then give a lot of similar sums. Then she would give word problems which the children knew would need the same algorithm for solving them. Even when she goes on to subtraction, she will not include word problems with addition in the test or homework, till much much later.

Think about Rajni's approach to teaching, while doing the following exercise.

E8) A teacher who follows the programming model argues, "How can children learn anything about area before they know multiplication? After all, area calculation does require multiplying length and breadth. And, without learning that how can the children begin to learn about area?" Why do you agree or disagree with this teacher?

The process of learning in the programming model is to take the child from the abilities that she shows at the beginning of the process to the final desired behaviour. This process is broken into small 'chunks' or sub-stages. For each sub-stage, a learning task is designed as a stimulus. Appropriate responses to this stimulus are selected and reinforced by practice. Responses that are not wanted are eliminated. Each 'chunk' of behaviour is to be learnt and mastered. Final learning is achieved through the series of responses being shaped to yield the final desired behaviour. Let us consider an example of this.

Suppose the child is to learn addition of natural numbers. The first step would be to see if the child remembers the counting sequence from 1 to 50 or 1 to 100. (While even this could be broken into smaller pieces and sub-stages, we will not go into that.) The next stage would be to write numerals. This would begin from 0 to 9, and then go on. The third stage would be to add numbers with a sum upto 9. After all this has been 'mastered', the next stage would be introduced. This stage would involve leading the child up to writing numerals above 10 and adding single-digit numbers. In this way, gradually, piece by piece, a series of behaviours would become part of the child. In this process, the child would constantly be told what is right and which of her responses are wrong.

Let's also take the example of how multiplication would be dealt with in this system. Multiplication would be regarded as essentially the ability to respond to questions like 'What is 8 multiplied by 4?' In such situations she would be expected to immediately say '32'. If this answer is selected out of many that the child may give, it is repeatedly reinforced as the right one. Other answers would simply be dismissed as being wrong, without wondering how she has arrived at this answer. In this method, whether a child says '40' (maybe making an estimate based on her knowledge of 10×4), or says 2, or gives any other number, is not important. **The teacher has no interest in making a distinction between the types of errors children make and what these errors may indicate about their**

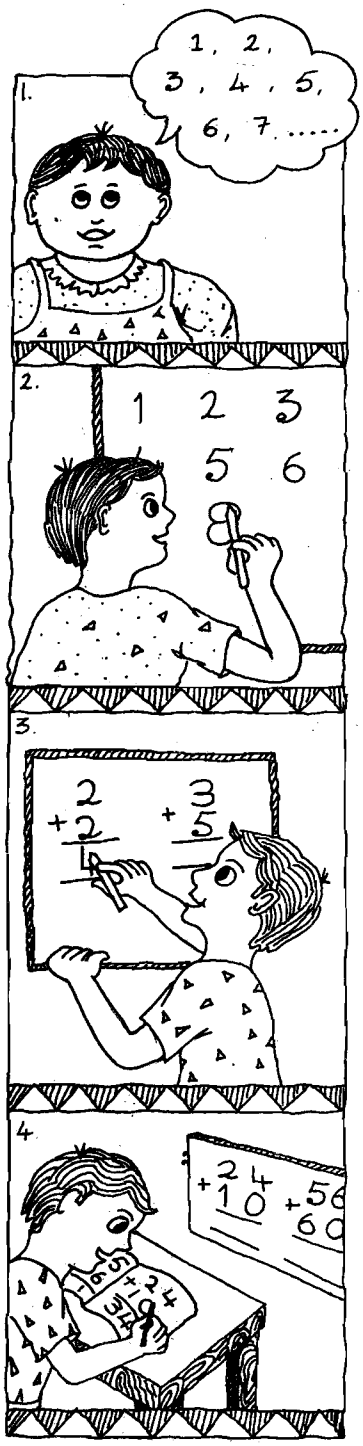


Fig.8: Bit-by-bit hierarchical learning

conceptual development. No one wonders if the answer is merely because of poor recall, or also because of the lack of a sense of estimation.

Moving further, in this method, if we want the child to learn how to multiply bigger numbers, she would need to remember all the multiplication facts, and the rules for the algorithm. Each part of the algorithm, from one-digit numbers, two-digit numbers, borrow and carry, to what must be done with zero, etc., will be systematically built up 'piece by piece'. Because of this training, if a child has just calculated 42×5, she may need to go through the whole process again to answer '$42 \times 6 = ?$'.

Think about these examples while doing the following exercise.

E9) What strategy would a teacher who follows either of the two models discussed above use to teach children any theorem of algebra or geometry?

Let us now discuss how evaluation takes place in the programming model. How does the teacher check if learning has taken place if she follows this model of learning? She considers how much of a difference she can **obviously see** in the child's abilities and behaviours at the end of the teaching versus when the child started the programme. The emphasis is on changes in behaviour that are **visible to others**. According to this approach to learning, a child has learnt to swim only if she is able to show this new ability by actually swimming when she is in water. A child who has learnt to multiply is expected to be able to show this by correctly using the algorithm to multiply. In fact, the teacher evaluates a child's understanding by giving her problems she is familiar with. The child is never given unfamiliar problems, even if they are very similar to what she may have done. If a child gives a wrong answer, there is no recognition of the fact that she may have been able to learn a small bit. The child has learnt only when she can **show others** that she has learnt by giving the solution taught by the teacher to questions asked of her.

In both the models we have discussed so far, the changes we wish to bring about through learning can be understood as **behavioural**, and learning is understood as **reinforced behaviour**. This means that if you want the child to show a certain ability or behaviour, then you should get her to practise it again and again. When she does it the way you want her to, you reinforce it by giving her positive feedback. When she makes a mistake, you frown on it and punish her. For instance, if a child has to learn to subtract, she would be made to practise subtraction by subtracting similar kinds of numbers. She would be evaluated for her ability to solve the same kind of sums. While doing this, she would be given pats on the back for being correct and reprimanded for mistakes or for using another method (which may very well be correct).

Because of this attitude, children look for ways to cover up their lack of understanding and try to **give the appearance of having learnt** the matter. For instance, children who learn through these models respond in the following way to a mixture of word problems dealing with numbers:
"If I see 'more' or 'altogether' in a problem, I know I have to add the numbers.", or
"I look at the numbers in the problem. If they are, say, 86 and 51, then I'd add or multiply. But if they are 86 and 5, I would divide."

Why don't you try this exercise now?

E10) What are the similarities between the banking model and the programming model?

Now that you have considered two models of learning, ask yourself if these models are enough to describe what the child can do. To answer this, you may like to consider the two problems below:

(a) *If you are told that the whale is a mammal even though it looks like a fish, what kinds of things are you likely to know automatically about the whale even without being told? (e.g., that it is warm blooded).*

(b) *Given the number 1986110, write down five facts about this number that you know are true, even though you have never thought about this number before.*

What mental processes did you go through for dealing with these problems? Did you **make new connections** between concepts? Did you **deduce or infer** some properties?

Neither the programming model, nor the banking model, regard the child's mind as having the ability to create ideas and make new relationships between concepts. These two models are not able to explain **the ability to comprehend and organise new information.** Do you think they can explain **the abilities to hypothesise, estimate, guess, deduce, infer?** None of these abilities are given any space in the two models.

In both the models the child is expected to passively reproduce certain facts or follow certain procedures without having to think or modify them. But children's behaviour and reactions say otherwise. To explain this difference, there is yet another model of learning. This believes that the learner is the most active component of the learning process. Let us have a look at it now.

1.5 LEARNING AS CONSTRUCTION

As you have seen, the two approaches to learning that we have discussed so far are not sufficient to explain many aspects of learning. They don't recognise the child's mind as active in making sense of and understanding the world. The learner plays a passive role in the learning process in these models. Any mistakes that she makes in taking in information provided by the teacher are to be got rid of by a system of punishment and reward. These models don't believe that a child's errors tell us anything about how the child thinks. They don't realise that **mistakes are often evidence of an 'active mind'.**

Mathematical errors are an excellent means of gaining insight into the child's mathematical thinking.

Early in the 1920s, while working on developing intelligence tests, the Swiss psychologist Piaget realised that children's mistakes show us how they think. Throughout the course AMT-01 you have read several examples of how to utilise the errors children make for helping them learn. We need to base our practices of teaching and organisation of learning on the basis of models which recognise this active nature of the child's intelligence and cognition.

The approach to learning that regards the learner as the **active agent** of her learning — **actively making sense** of the physical and social environment around — is called the **constructivist model**. According to this model, the child builds (constructs) her own understanding based on her interaction with the world and people around her. If you teach according to this model, you would provoke the child to think harder and about many different aspects. You would get her to explore the concept on her own, with some support from you. You would provide the child opportunities where she has to struggle to find her own methods of solving problems, helping her and providing inputs to her as and when she needs them. You would give the child problems that do not have the same kind of solutions, and would expect her to think how each problem can be dealt with. This method would require you, the teacher, to discuss with the child what she has

done, and give her an opportunity to solve a wide variety of problems related to the concept she is trying to learn.

Let us consider a brief example of this model in action.

Example 3: Fatima was planning to introduce the children of Class 2 to triangles and their properties. She had cut out triangles and other shapes of different kinds from chart paper. Her plan was to let the children play with these objects. She would devise activities, through which they would explore what a triangle is, where they see it in their lives, a triangle's properties, how it is different from circles, etc. In the next few classes she hoped to lead them from the concrete to the abstract notion, via pictures of all kinds of triangles.

At each stage she would try and get the children to discuss their own understanding with each other and with her. She believes that this will help the children build their own understanding of triangles. Of course, she is planning to test their understanding through certain activities also.

———————×———————

Does this example give you some idea of what the learning expectations from the child are in this model? A constructivist believes **that a child learns by acting on objects**. No experience is a waste. Given any task, the child learns **something** while trying to do it. Given any theorem, the child can make an effort to solve its corollaries. She could try to prove new theorems and, along with her peers, discuss the theorem and its proof logically. A believer in this model expects the child to be able to try to discover patterns in sequences of numbers. She also expects the child to look for generalised rules in empirical data given to her and have the **ability to articulate the process followed and the reasons in following that particular process.**

Fig.9: Paro building her understanding of 'round'.

This kind of understanding implies that the child acquires the ability to find answers to questions and apply her mind to create new connections between concepts. This way of looking at learning is clearly different from the way in which only known problems are to be solved (banking model). It focusses on the ability of the child to utilise her abilities, think and attempt to discover answers to new problems and questions.

Why don't you try some exercises now?

E11) Give some other examples from the context of mathematics learning of learning expectations in the constructivist model.

E12) Read Sec. 6.2 of AMT-01. Now, based on this section and what we have said above, write down three features of the constructivist model.

E13) Going by your study of AMT-01, give three differences, with examples, between each of the following:
i) the banking model and the constructivist model;
ii) the programming model and the constructivist model.

E14) If you have done a degree or diploma in teaching, you must have done an exercise in formulating 'behavioural objectives' for your lessons. Examine the objectives of any one of your lessons and see which model of learning it resembles or comes closest to.

So far we have presented different views of learning. Depending on our understanding of learning, we develop different models of learning in our minds. Some of us believe that children are not willing to learn. In this case, the theory

of learning and approach to teaching would need to focus on how to make children willing to learn, or how to make them learn against their will.

On the other hand, some of us believe that children are basically motivated learners, provided they can see the purpose of the learning task. In this case, the theory of learning would be quite different.

Every action and interaction between the teacher and the child is coloured by the model of learning followed by the teacher. These models, **or a mixture of them**, are used by all of us in our classrooms or in the teaching learning process that we engage in, even though we may not be aware of it.

In this section we have only given you a brief look at the constructivist approach to learning. **In Unit 3 you will study it in more detail.** For now, let us summarise what we have discussed so far.

1.6 SUMMARY

In this unit, we have made the following points.

1) A model of learning is a total approach to the learning process — what learning is, what is to be learnt, the learner's characteristics, picking the appropriate teaching strategy.

2) The features of the banking model, in which learning is considered equivalent to the ability to memorise and reproduce facts.

3) The features of the programming model, in which learning means following a series of programmes that a teacher gives for solving a particular type of problem.

4) A brief discussion on the constructivist approach to learning. A detailed discussion on this will be taken up in Unit 3.

In the next unit we shall concentrate on different views people have of children's abilities. But first, please go through the following comments on the exercises throughout Unit 1, which we hope you have already done. Also, please **go back to the objectives** listed at the beginning of the unit, and check whether you think you have achieved them.

1.7 COMMENTS ON EXERCISES

E1) Think about each of these definitions. For example, can we say learning is an expected response to a given stimulus? How would you distinguish 'learning' from 'reflex action'? (Reflex action means an immediate physical response, without thinking, to something that affects you. For example, when a thorn pricks your foot, you move your foot away almost without thought. In fact, the centre for reflex action is not in the brain; it lies in the spinal cord.)

Analyse all the other definitions similarly, and see if you find them acceptable.

E2) Think of possible activities that you can engage children in — asking them to observe something, do an experiment, imitate someone, read on their own, learn some facts, write about something they have seen, etc. Which of these activities do you think lead to learning? You may say that

writing about something independently forces the learner to think, and hence would lead to learning.

E3) For example, memorising tables, and even proofs of theorems. The child is expected to be able to repeat tables or other "important" facts. Think of three expectations **apart from those given** in the unit.

E4) How many of the concepts procedures you memorised do you still retain? Why do you think you remember the ones you do and have forgotten the others?

E5) According to the banking model of learning, information has to be transferred from some place to the mind of the child. Each piece is separately placed in the mind and consolidated by repeated memorisation. Think about whether such a model can explain the way children make new connections between numbers, generate newer shapes and do many other things which are new to them. If learning is to be explained by the banking model, then this ability of the human mind cannot be explained.

Give other examples of what a human mind can do which cannot be explained by the banking model.

E6) The classroom which focusses on the banking model would attempt to make the learner repeat the same things many times. In the classroom you would find the teacher providing information and students receiving it to 'store' in their minds. Think about how such a classroom would be organised. Think about what needs to be changed so that the process does not remain focussed on putting information into the mind of the child, and becomes more meaningful. For example, if memorisation is the focus at present, what strategy would alter this?

E7) If you are a teacher, think of what you are planning to do in the next couple of days. What are the children doing during the class and what are your expectations from them? Do you expect the children to remember facts, or are you giving them many opportunities for repeating some facts in different ways, or are you and they doing something else?

If you are not a teacher, think about what you would like to do in the classroom, and analyse it in the same way.

After you analyse your own activity, find a friend who would be willing to discuss one of her classroom activities with you. Analyse this activity as you have done above.

E8) One of the implications of the statement is that a person who cannot calculate the area does not have any understanding about area. This also implies that those who have not learnt anything about multiplication cannot even distinguish between large surfaces and small surfaces. Do we always multiply length and breadth when we estimate surface areas? Do you share the view of the teacher or do you recognise that children can have a sense of area much before they learn multiplication?

E9) A teacher of Class 8 was teaching some children a theorem on congruence of triangles. She gave them a step by-step "proof " from the book, and made them repeat it. Then she gave them two exercises related to this result, again from the book. Her exam questions were geared towards reproducing these proofs, or something similar.

E10) These two models have the same understanding of how children learn and the kind of processes we must have in the classroom. The only distinction between them is in the definition of sub-stages. One model formulates the sub-stages in terms of facts memorised till that time, while the other one emphasises the procedures or algorithms 'mastered' uptil then. Both these have clearly defined behavioural objectives. Both these break learning up into specific sub-stages which are to be acquired individually by repeated practice.

In the programming model, as also in the banking model, the student's mind is essentially passive. It is shaped primarily by the teacher, who selects and reinforces desired behaviours. According to this model, what is to be learnt and how it is to be organised is given to the learner. Once these inputs have been given and the brain has been 'programmed', it can apply this knowledge to new situations.

As pointed out in the case of learning as memorisation, the abilities of hypothesising, guessing, estimating, deducing, inferring, and especially understanding, have no real role in learning through programming.

E11) As we know, the constructivist model suggests that the child is actively involved in the process of learning. She learns by developing her own framework of understanding. Some of the learning expectations in mathematics, when we consider the constructivist model, would be the ability to attempt new types of tasks, explore questions given to her, be able to see patterns in the numbers as well as shapes, etc. She must also be able to develop her own learning strategies.

Think of more such expectations.

E12) In AMT-01, Section 6.2, we have spoken about the need to allow children to develop and use their own strategies and understanding in the context of learning units, tens and hundreds. This is one feature of the constructivist model of learning. List three other features of the constructivist model.

E13) In AMT-01 we have discussed many examples of classroom situations where children have been involved meaningfully. We have also given situations where children are only required to put information in their minds, and/or practice algorithms one by one repeatedly and master their use. The chief features of the three models have already been identified by you in the exercises above.

A major difference between the banking model and the constructivist model is the teacher putting knowledge in the child's head versus development of the child's own understanding. One example of this difference is in the memorisation of tables versus getting children to construct multiplication tables.

E14) Pick out the objective you wrote, and all the other objectives that you can think of. Which model of learning do each of these objectives come closest to?