R. R. Koireng
karenkrr@gmail.com

Conceptualising Learning Outcomes in Science at the Upper Primary Stage and its Integration in Classroom Processes

Abstract

The paper discusses the conceptual ideas of learning outcomes in Science at the upper primary stage and how the learning outcomes are derived from the curriculum expectations. The paper also explains the broad nature of the learning outcome and how they are interdisciplinary in nature and involve crosscutting concepts. Further, the paper also illustrates some strategies to be adopted by teachers for integration of learning outcomes while transacting concepts in Science at the upper primary stage.

Introduction

The National Curriculum Framework (NCF) – 2005 clearly envisages quality education as a prime goal. It is expected that all children learn and have opportunities to become autonomous learners and acquire the knowledge and skills needed to become global citizens. This demands setting goals that are clear and measureable. Often teachers are not clear about what kind of learning is desired and the criteria against which it could be assessed. They use textbooks as the complete curriculum and assess children using questions and exercises given at the end of the unit.

The document "learning outcomes" at the Elementary Stage prepared by NCERT provides outcomes for each class subject wise. These learning outcomes are expected to help the teachers to direct their teaching learning in the desired manner and also make other stakeholders, especially the parents/ guardians, school management committee (SMC) members, community and the state functionaries responsible and alert towards their role for ensuring quality education.

Science Curriculum Expectations and Learning Outcomes at the Upper Primary Stage

Learning outcomes and curriculum expectations are closely related. Usually learning outcomes are derived from the curriculum expectations. Learning outcomes are statements that describe what the learners must know or have attained at the end of a course of study that is measurable in a qualitative or quantitative manner. The National Curriculum Framework (NCF-2005) recommends that at the upper primary stage, the child should be engaged in learning the principles of Science through familiar experiences, working with hands to design simple technological units and modules and continuing to learn more about the environment and health, including reproductive and sexual health. At the upper primary stage Science is introduced as a discipline for the first time. Science education at this stage should provide a gradual transition from Environmental Studies of the primary stage to elements of Science and Technology. Scientific concepts are mainly to

be arrived at from activities and experiments. Group activities, discussions with peers and teachers, surveys, organisation of data should be important components of pedagogy. Thus, if we want our children to learn principles of Science through familiar experience and working with hands to design simple technological modules, the learning outcome should necessarily reflect the expectation we have from children. Hence, it is important that the learning outcomes are in consonance with curriculum expectations (curriculum objectives).

The details of learning outcomes in Science to be achieved at the upper primary stage are listed in the Learning Outcome documents prepared by NCERT. A part of the learning outcomes in Science for Class VII is shown in Table 1 as an illustration. The right column lists the learning outcomes to be achieved and the left column outlines the suggested pedagogical processes. The learning outcomes and suggestied pedagogical processes are not in one to one correspondence.

Table 1: Class VII Science Learning Outcomes

Suggested Pedagogical Processes	Learning Outcomes
The learner is to be provided with opportunities in pairs/ groups/ individually in an inclusive setup and encouraged to — • Explore surroundings, natural processes, phenomena using senses viz. seeing, touching, tasting, smelling, hearing • Pose questions and find answers through reflection, discussion, designing and performing appropriate activities, role plays, debates, use of ICT, etc. • Record the observations during the activity, experiments, surveys, field trips, etc. • Analyse recorded data, interpret results and draw inference/ make generalisations and share findings with peers and adults. • Exhibit creativity presenting novel ideas, new designs/patterns, improvisation, etc. • Internalise, acquire and appreciate values such as co-operation, collaboration, honest reporting, judicious use of resources, etc.	The learner — • Identifies materials and organisms, such as, animal fibres; types of teeth; mirrors and lenses, on the basis of observable features, i.e., appearance, texture, functions, etc. • Differentiates materials and organisms such as, digestion in different organisms; unisexual and bisexual flowers; conductors and insulators of heat; acidic, basic and neutral substances; images formed by mirrors and lenses, etc. on the basis of their properties, structure and function. • Classifies materials and organisms based on properties/characteristics, e.g. plant and animal fibres; physical and chemical changes. • Conducts simple investigations to seek answers to queries, e.g. Can extract of coloured flowers be used as acid-base indicator? Do leaves other than green also carry out photosynthesis? Is white light composed of many colours? • Relates processes and phenomena with causes, e.g. wind speed with air pressure; crops grown with types of soil; depletion of water table with human activities, etc.

As mentioned in the earlier para, learning outcomes are those that are attained or acquired and that can be identified through certain assessment. This means that learning outcomes are products that are based on specific processes that produce the product. However; learning as a process of construction of knowledge also implies that during the process of acquiring a concept, structuring and restructuring of ideas take place and a number of interrelated concepts and learning outcomes emerged and they are to be tackled and integrated in the teaching learning process. These outcomes which emerge during the course of teaching learning process are also 'learning outcomes'. The classroom transaction is crucial in this context. For example, to help the children

learn the concept of certain materials dissolved in water, the teacher along with the children perform an activity/experiment. The teacher asks a child to drop a spoonful of sugar in a glass of water and stir. It is found that the solid sugar disappears (dissolves) in water. Subsequently, a child drops a few pebbles in another glass of water and stirs. The child finds that the pebbles remain in the water and do not disappear (insoluble). From the activity, it can be inferred that certain materials dissolve and some do not. The product (knowledge) that some materials dissolve and some do not is the 'outcome'. Of course the process of finding it is also an 'outcome'. It means the child has to demonstrate or illustrate the method of finding out that some materials dissolve and others do not.

The pedagogical processes are intended to give directions to teachers to design learning situations for students. In transacting a concept, the learners are actively engaged in the process of constructing knowledge. Learners construct their knowledge by connecting new ideas to the existing ideas on the basis of materials/activities presented to them. The process may include engaging learners with activities such as exploring surroundings, designing and performing appropriate experiments, recording observations during the experiment, etc. Therefore, teachers' understanding of learners' experiences and existing ideas are very important for designing teaching–learning situations. The teachers are also expected to design appropriate learning situations as per the availability of resources and local context. It is expected that the teacher will provide opportunities to the children to engage in the practice of Science and construction of scientific knowledge. Thus, it is also important to view the learning outcome as a part of the process of development and changes in the students' personality rather than being only the final product of specific inputs and processes. In actual classroom transaction, a number of learning outcomes may get touched upon in the course of transaction (it is discussed in illustration II). Further, many learning outcomes are also recursive. For example 'conducts simple investigations' as an outcome gets revisited while conducting activity/experiment during teaching learning of different concepts in Science. The teacher may take note of these learning outcomes and organise them in a logical sequence during the transaction process.

Illustration I: Leaning outcomes are broad and interdisciplinary in nature.

Let us take one learning outcome from class VII i.e *'differentiates materials such as conductors and insulators of heat; acidic, basic and neutral substances; images formed by mirrors and lenses, etc., on the basis of their properties, structure and function'*. When we talk of the learning outcome *'differentiates materials'* without giving any specific items for differentiation, we can assume that it is a general learning outcome because differentiating materials may involve a wide range of materials to be differentiated on the basis of their properties, structure, function, etc. and it gives no specific way to differentiate materials. However, when we say "differentiates materials on the basis of conductors and insulators of heat," it gives us a specific way to differentiate materials and it can be said that it is a specific learning outcome. Identifying the basis on which materials are to be differentiated is important so that appropriate activity can be designed for the learners. It is also to be remembered that examples given in learning outcome *'differentiates materials'* are only directional and are not exhaustive. It is expected that whenever the teacher teaches any concepts, the idea of differentiating materials may be applicable to those concepts also. The learning outcomes listed in the Learning Outcome document of the NCERT are broad and the examples listed for differentiating materials are only directional to achieve learning outcomes in the context of some specific items/situations.

Learning outcomes are also interdisciplinary in nature and involve crosscutting concepts that are intended to lead to a Science learning in a coherent way. For example, the learning outcome from Class VII Science "relates processes and phenomenon with causes" could be discussed in the context of core concepts of Science such as motion of an object or adaptation of animals and plants with their habitats or expansion of air on heating. The idea is also to make them appreciate the interconnections among concepts and integration of these crosscutting concepts with practices and day-to-day life. What is important here is the need to provide sustained opportunities to children to engage in practical applications of Science.

Illustration II. Incorporating learning outcomes in the teaching learning process:

Transfer of Heat

An example to integrate learning outcomes while transacting transfer of heat concept from NCERT Class VII Science textbook is discussed. This may be treated as one of the strategies while a teacher may have other ways of transacting the same concept. The key idea is that the adopted strategy should enable the learner to construct knowledge and incorporate learning outcomes in classroom processes. In the transaction of the concept of transfer of heat, learning outcomes such as **"***Conducts simple investigation; relates process and phenomena with causes; differentiates and classifies materials on the basis of their properties; applies learning of scientific concepts in day-to-day life; exhibits creativity in making use of available resources"* get interwoven during the course of the transaction of this concept.

Classroom Transaction

Think of a situation in which an object becomes hot. You might have witnessed various objects becoming hot, such as a frying pan becomes hot when kept on a flame.

In this process teacher may ask students to:

a) Share their experiences about objects becoming hot in their surroundings.

b) Make a list of situations in their surroundings in which transfer of heat is involved.

Let us try to explore how heat is transferred from one place to another. One way to explain it is by performing an activity or experiment. Let us perform the following activity.

Activity 1: To show transfer of heat in a metallic strip (The activity is to be performed by involving student)

Learning Outcomes: *Conduct simple experiments; relates process and phenomena with causes.*

The teacher may involve students in arranging materials for performing the activity and ask them to bring some of the material required for conducting the activity. The activity described below is one among the many activities that a teacher can perform.

Materials required: A metal rod, wax, and candle.

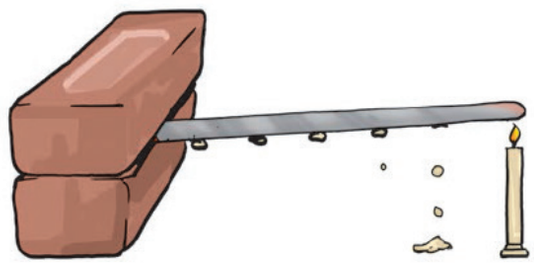

Figure 1: Flow of heat through a metallic strip.

- ✓ Take a rod or flat strip of a metal say of aluminium or iron.
- ✓ Fix a few small wax pieces on the rod. These pieces may be placed at nearly equal distances as shown in the figure 1.
- ✓ Clamp the rod to a stand. If you do not find a stand, you can put one end of the rod in between bricks.

- ✓ Now heat the other end of the rod for a while and observe.
- ✓ What happens to the wax pieces?

The teacher may initiate discussion and ask students: Do the wax pieces begin to fall? Which pieces fall first? Do you think that heat is transferred from the end nearest to the flame to the other end? Teacher may help students conclude that heat is transferred from a hotter place to a colder place and this process is known as conduction.

Thus, it may be concluded that the process in which heat is transferred from a hotter place to a colder place is called conduction.

Activity 2: The teacher facilitates a group activity by performing the following activity. The activity is also to be performed by students in small groups or individually.

Learning Outcomes: *Differentiates and classifies materials on the basis of their properties*

The teacher may ask students to perform the following activity in groups/individually. Students may be asked to bring some article such as a steel spoon, plastic scale, pencils, iron nails, etc.

- ✓ Some water is heated in a small pan or a beaker.
- ✓ One end of the articles such as a steel spoon, plastic scale, pencils, iron nails, etc. are dipped in hot water as shown in figure 2.
- ✓ After a few minutes touch the other end.
- ✓ What do you observe? Does the other end become hot?

Figure 2: Conduction of heat by different materials

Table 2

S. No	Article	Material which the article is made of	Does the other end become hot Yes/No
1	Iron nail	Metal	Yes
2	--------		
3			
4			

From table 2 teachers may help the student in arriving at the conclusion that materials which allow heat to pass through them easily are called conductors of heat. For example, steel spoon and iron nail. The materials which do not allow heat to pass through them easily are poor conductors of heat and they are known as insulators. For examples, plastic scales, wood, etc.

Assessment

Teacher may

a. Ask students to discuss among themselves and identify some of the applications of conductors and insulators of heat in their daily life.

b. Give opportunities to students to create utility items such as handle of a steel kettle, handle of a frying pan using available resources in the surroundings.

(Learning outcomes: exhibits creativity in making use of available resources, applies learning of scientific concepts in daily life)

Conclusion

The learning outcomes are derived from the curriculum expectations. It is important that learning outcomes are in consonance with curriculum expectations. The outcome based education demands teachers to direct their teaching learning in the desired manner and also make other stakeholders responsible and alert towards their role for ensuring quality education. During the process of acquiring a concept, structuring and restructuring of ideas takes place and a number of interrelated concepts and learning outcomes emerge

and they are to be identified, tackled and integrated in the teaching learning process. These outcomes which emerge during the course of teaching learning process are also 'learning outcomes'. Hence, it is necessary to incorporate learning outcomes during classroom transaction processes to achieve the desired learning in children.

References

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