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Integrating Assessment with Teaching-learning of Science: an Experiment

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Abstract

Integrating assessment with teaching-learning of science provides information about students' existing ideas and to identify their learning gaps. It helps teachers to redesign teaching-learning experiences being responsive to their learning needs. Many teachers carry out a variety of assessment activities in the classroom during teaching-learning of science; however these are rarely used for formal assessment as recording each student's performance remains a problem. Some experiments on the design of assessment activities were tried out by integrating assessment with teaching-learning in a science classroom. Two such experiments are reported in this paper. Very simple and practical ways of recording students' performance are also presented. It was found that when assessment followed the flow of continuous dialogue and interaction with students, they moved beyond rote memorisation.These assessment activities helped students to focus more on what is to be learnt rather than worrying for their performance in paper-pencil test.

1. Introduction

The purpose of assessment is necessarily to improve teaching-learning process and materials (NCERT, 2013). For this, assessment needs to be student-centred and it should be integrated to enhance teaching-learning. When used in process of teaching-learning, it provides information about students' existing ideas and their conceptual development. It helps teachers to identify their learning gaps and redesign teaching-learning experiences being responsive to their learning needs. Day-to-day teaching learning activities when used for ongoing assessment can motivate them to learn and trim down their stress. NCF-2005 views, "the belief that assessment must lead to finding learning difficulties and those difficulties can be remediated, is often

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very impractical and not founded on a sound pedagogic practice. Problems regarding conceptual development cannot and do not wait for formal tests in order to be detected. A teacher in the course of teaching-learning itself come to know of such problems by asking questions that make children think or by giving them small assignments. She can then attend to them in the process of teaching-learning by ensuring that her planning is flexible and responsive to learners and their learning." It is important for teachers to realise the significance of dynamic engagement of students with the world through observing, inquiring, experimenting, discussing, listening, thinking and reflecting — both indivually and with others in the process of their knowledge construction. Activities can be designed to assess students when they are engaged in the process of knowledge construction. Proficiency in observation, inquiry, prediction, experimentation, recording, explanation with reasoning and evidence, looking for cause-effect relationship, conclusion, interpretation, communication, application of understanding of scientific concepts in novel situations are important process skills of science. These proficiencies need to be assessed in the process of teaching-learning of science itself.

There is a lot of psychological data to suggest that different learners learn differently, and, hence, to test all learners through a written test of the same type in subjects after subject is unfair to those whose verbal proficiency is superior to their writing skills, those who work more slowly but with deeper insight, or those who work better in groups than individually (NCERT 2009). Besides, only quantitative assessment does not help the teacher much in reflecting on teaching-learning strategies. Hollins and Whitby (1998) hold the view 'there are a variety of strategies and opportunities for teachers to choose from in measuring the progress of different aspects of the science learning of individual pupils, some of which are more appropriate than others, depending on the area of science that is being covered and the age range of the pupils'. Plenty of such opportunities can be explored in a constructivist classroom. Prabha (2010) observes that teacher in a constructivist classroom designs and manages her activities in such a way that students are eager and ready to exchange their ideas. They are not afraid of being ridiculed. Teacher encourages her students to ask and share the thought processes going on in their mind. She assures her students that no question is silly one. Getting familiarised with students thought patterns helps her to help students in constructing their knowledge.

Several studies show firm evidence that innovations designed to strengthen the frequent feedback that students receive about their learning yield substantial learning gains (Black and William, 2006). Immediate feedback encourages learners to engage themselves in teaching-learning process.

Many teachers carry out a variety of assessment activities in the classroom during teaching-learning of science; however these are rarely used for formal assessment to adjust the learning needs of students as recording each student's performance remains a problem. There is a need to evolve and maintain credibility in assessment in order to use students' performance in a meaningful way. Some experiments on the design of assessment activities were tried out by integrating assessment with teaching-learning in a science classroom. Two of such experiments are reported in this paper. Both of these experiments were tried out on the same sample and during teaching-learning of the same concepts. Very simple and practical ways of recording students' performance are also presented.

2. Research Design

The present qualitative study was carried out at upper primary stage during my field visit of three months duration in a residential school located in an urban village. As flexibility in design is one of the important features of qualitative research, experiments with the design of assessment activities were not rigidly planned, though I had some initial idea about it. It was planned that teaching-learning and assessment strategies would be modified depending upon the response of students. It was redesigned and steered in the light of emerging thinking patterns of students. The experiment was carried out in entirely natural setting. Effort was taken to maintain classroom environment friendly by providing students descriptive feedback and being non-judgemental to their responses so that they could express themselves without any fear. As a broad framework, Fraenkel and Wallen (1996) description of five general characteristics of qualitative research studies were kept in mind for the present study.

Their description includes:

1. researchers collect their data in naturalistic settings (e.g., classrooms), by observing and participating in regular activities.
2. data are collected via words or pictures (not via numerical or quantifiable indicators).
3. processes (i.e., how individuals communicate with each other about a lesson) are as important as products (i.e., whether or not students obtain the correct answers to a problem).
4. most qualitative researchers do not start out with specific hypotheses; rather, they use inductive methods to generate conclusions regarding their observations.
5. qualitative researchers care about participants' perceptions; investigators are likely to question participants in depth about their beliefs, attitudes, and thought processes.

2.1 Research Questions

1. Can some assessment activities be designed by integrating with teaching-learning process to facilitate revelation of thinking process of students?
2. How can these assessment activities be recorded to get credible evidences of students' learning?

2.2 Sample

The sampling technique used in this experiment was purposeful sampling (Best and Kahn, 2010). Specifically, the experiments were carried out in Class VIII comprising thirty-three students during teaching-learning of the concept Chemical Effect of Electric Current. The school was situated in an urban village. It was CBSE affiliated and fully residential. The assumptions were that the representative sample could be useful in answering the research questions.

2.3 Method

2.3 (A) Evidence Based Oral Assessment

I had just joined the school and was not familiar with the name of each student of the class. I made a seating plan chart of the class on a paper and noted down name of each student taking help of the class monitor (i.e., row and column-wise who is seating where). This helped me to remember name of all students within a few days. Few multiple choice questions and short answer type questions to be asked during teaching-learning process of the concept were kept prepared. In the beginning of this experiment, a tick or cross mark was put against the name of the student.However, there was a problem. I found that by carefully observing movement of my pen, some students were changing their responses.Putting tick marks required moving the pen only in upward direction while putting cross mark needed moving the pen twice for the two lines. So, I changed my strategy and started assessing their responses by recording in coded words as abc,bac and cab (one mark, half mark and zero mark depending how their responses were consistent with scientific explanations). Still there was a problem in experimenting with this design of assessment activity. There was a tendency among students to follow the response of the students who was academically stronger in the class. In order to handle this problem, such students were given opportunity to response later in the question answer process and a variety of open ended questions were asked. Their responses familiarised me with their thought patterns that helped me to identify the learning gaps of the students and then bridge those gaps with scientifically accepted explanation. However, it was ensured that all students were assessed a numer of times during teaching-learning of the chapter that was spread over a week.

Findings

This activity kept the class alert and interested in learning. Observing assessment a routine activity, students were not stressed and were motivated to participate in teaching-learning process. While asking questions, care was taken to listen to them attentively with encouragement and appreciation. By the time the chapter was complete, students were assessed several times without feeling any tension and I had a record of their marks without carrying piles of files.

So, even experimenting on the design of this simple looking assessment activity, I had to find ways and means to overcome the problem in recording their responses taking care of its reliability.

2.3 (B) Assessment of process skills of science by making students' thinking visible

Students were facilitated to perform following activity.

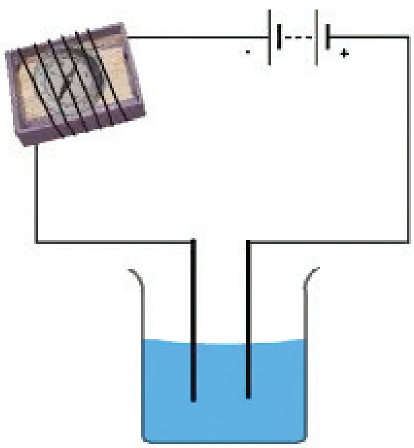

Figure 1

A teaspoonful of common salt and few drops of lemon juice were added to water taken in a beaker. Electric circuit was completed using a battery of nine volt, a zinc plate, a copper plate, a coil of wire wrapped several times (5-10 times around a tray taken from inside of a discarded matchbox) as shown in Figure 1.

A small compass needle was kept inside the tray. The circuit was closed by making all connections. I found that students observed bubbles near the electrode which was very exciting to them.

Students were then asked, 'What did you observe in the activity?' A few of them replied that they observed bubbles near the electrodes. I asked the same question to different students. I got similar responses. In my attempt of eliciting ideas of all students and making their thinking visible to me, I modified my question and made it open ended – 'Observe the activity carefully; change the distance between electrodes; change the length of the electrodes immersed in water; think for two minute and just say whatever comes to your mind. What are the observations you are curious about? What can you tell me about the activity you observed? Each of you have to ask some question or say something related to this activity'. Offering such a wide choice encouraged students to open up. It was *an Aha moment* for me. Students started giving interesting and varied responses! Now the problem was how to record their responses so that I could relate thinking of each student with his/her conceptual understanding. Three students volunteered to jot down the responses of students. While first volunteer was jotting down the response of one student, second and third volunteers were recording responses of second and third student, respectively. Again response of the fourth student was recorded by first volunteer. This way, there was sufficient time to record responses of all. Name of the student was also noted down against each response. Their responses comprised two to four lines. This exercise took me about twenty minutes.

I had finally a mirror in my hands reflecting thinking patterns about the activity of each student. Recording responses helped me to review what each student has already learnt and what s/he still needs to work on and improve.

While listening to their ideas, I was thinking how to redesign teaching-learning process to cater the learning needs of all.

Some of the questions asked by students were: 'Why did you add salt to water?' 'What will happen if more salt is added to water?' 'Why are bubbles coming out from water?' 'What will happen if zinc and copper plates are bigger?' What if only wires are emerged in the water and there is no zinc or copper plate in the experiment?' 'Why have you wrapped the wire several times over the magnetic compass box?' 'If we add vinegar instead of lemon juice to water, still deflection will be observed?'

Some of the questions that I asked were: 'If distance between the electrodes are increased will there be more deflection or less deflection in the compass needle?' 'If number of turns of the wire over the magnetic compass increased, will there be more deflection or less deflection in the compass needle?' Students made different predictions. Two groups having contradicting ideas over these issues came forward. I facilitated them to perform the activity again by changing these parameters and observe and conclude on their own.

Their responses included description of the activity and expression that they learnt 'electrical current can produce chemical effect'; 'bubbles are coming out due to chemical effect of electric current'; 'air is dissolved in water'; 'this is a chemical change'; 'some chemical reaction is taking place in water'; 'water is good conductor of electricity when a little salt is added to it'.

As questions asked were beyond what was given in the textbook, students had to think and express themselves in their own words to give answers.

This interaction helped students to use technical words related with the concept in proper perspective, like electrode, good and bad conductor of electricity, chemical effect of electric current,coil. One student could not name compass needle and called it electromagnet. I enquired, 'Do you think electromagnet and magnetic compass are same thing?' 'Have you made an electromagnet in your previous class?' In the next period I facilitated him to make an electromagnet and observe its magnetic properties. He could then differentiate between an electromagnet and compass needle.

Thus, one to one interaction in a class of thirty-three students helped me to identify their existing ideas.

Findings

As the situation in the class unfolded, the lesson was redesigned to adjust the emerging information about thinking patterns and learning needs of the students. Teaching-learning was shifted from pre-determined set of learning outcomes to one that provided students opportunity to apply their reasoning and understanding. Students were involved in their own learning by giving immediate feedback. It made them comfortable in sharing their ideas. Students were given opportunity to form hypothesis, perform the activity again to check their hypothesis. Repeating the activity facilitated them to monitor and assess their own learning. They were allowed to inquire, predict and analyse their predictions in the light of their observations. They were facilitated to construct their own explanation of their observation. It provided me with insight into students learning progress and helped me to make informed choices about further course of teaching-learning. All students got equal opportunity to participate in teaching-learning process. They organised their thoughts to express themselves. I got hint what they have learnt and what they still need to learn. It revealed me students' status of conceptual development. Assessment followed the flow of continuous dialogue and interaction with students. Students moved beyond rote memorisation. From this activity, it was found that asking only one question to the whole class could not elicit ideas of all students. When the question was made open ended and I listened to them without being judgemental, keeping atmosphere in the classroom relaxed, students had confidence that they will not be ridiculed and therefore expressed themselves freely.

3. Discussion

Current practice of frequent paper-pencil test in the name of formative assessment should be minimised by exploring some innovative ways of assessment. Many times it detracts from day-to-day process of learning. Teachers assess continuously during teaching-learning process. However, due to lack of evidence, these assessments are not recognised. Many creative, novel and practical ways of assessment of various parameters of learning science can be designed by the teacher despite the pressure of completing the syllabus, if they start feeling that they are empowered to do so. A wide range of assessment activities can be interwoven in the process of teaching-learning itself and modality of its recording can be tried out. Moreover, having positive attitude and belief towards teachers' innovative practices in the classroom and giving the necessary support by the administration is very important.

Keeping formal record of all assessment is unnecessary, however recording assessment that can provide direction to further teaching-learning process can be helpful. Recording of the data done during assessment activities can reduce number of paper-pencil tests in the school as well as stress of students. It can also reduce demand on teacher's time and efforts to prepare meticulous records. The precious time saved in this way can be utilised for enriching teaching-learning process.

Participation in innovative assessment activities can keep students engaged in learning. Such assessment activities can help them to focus more on what is to be learnt, rather than worrying for their performance in the paper-pencil test. Students can enjoy learning with new flavour in classroom processes.

Teachers need to realise that students have a range of background knowledge and varying motivation to learn. Therefore, assessment needs to be flexible and the manner and modalities must vary from situation to situation and sometimes from one group of students to another (NCERT, 2012). A number of capacity building programmes need to be organised to help teachers use multiple modalities of process-based assessment in science.

Qualitative research does not bring out 'everlasting truth' because the context is continuously changing. This study can be replicated on larger samples and by integrating with teaching-learning of other concepts. Exactly similar responses cannot be expected in other situations or even with the same classroom at some other time by the same investigator. However, many such experiments can be explored. It is suggested that instead of a rigid lesson plan, a framework of few key ideas should be designed to provide student-centred environment for collaborative discourse and reflections and integrated assessment. Carrying out a range of assessment activities in the class can cater to the diverse learning needs of all students.

References

Best, J.W. and J.V. Kahn. 2010. *Research in Science Education*. PHI Learning Pvt. Ltd., New Delhi.

Black and William. 2006. Assessment and Classroom Learning, *Assessment in Education: Principles, Policy and Practice.* 5(1). 1998.

Fraenkel, J.R., and N.E. Wallen. 2009. *How to design and evaluate research in education (Seventh Ed.)*. McGraw-Hill, New York.

Hollins, W. and V. Whitby. 1998. *Progression in Primary Science*. David Fulton Publishers, Great Britain.

NCERT. 2005. *National Curriculum Framework*. National Council of Educational Research and Training. pp.73

_____2008. *Science Textbook for Class VIII*. National Council of Educational Research and Training, New Delhi. 172-183.

_____2009. *Position Papers of National Focus Groups on Systemic Reform Volume II*. National Council of Educational Research and Training, New Delhi. pp.150.

_____2012. *Sourcebook on Assessment for Classes VI-VIII*. National Council of Educational Research and Training, New Delhi. pp. 8.

_____2013. *Pedagogy of Science Physical Science Textbook of B.Ed.Part II*. National Council of Educational Research and Training, New Delhi. pp. 351.

Prabha, S. 2010. Characteristics of Constructivist Classroom, *Journal of Indian Education*. 36(1). 20-28.