Enhancement of Learning Science at Primary Level Through Collaborative Activities

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ABSTRACT

Science has become an integral part of day-to-day life. Hence, a proper foundation for learning science needs to be laid at primary level. In Sri Lanka, science is taught under the subject ‘Environment Related Activities’ (ERA) at primary level to develop five basic competencies, namely, competencies related to communication, environment, ethics and religion, play and leisure and, learning to learn. However, development of competencies was not happening in the classrooms as expected by the reformers. This study focuses on the development of competencies through collaboration of children in doing science related activities. Two schools in the Kandy district were selected for the study from an urban and a rural area considering the convenience to be in the classrooms for a period of six months. In each school five classrooms were selected from each grade one to five. After observing how ERA lessons were taught in the ten classrooms for two weeks, new ERA lessons were planned with small group activities for the five grades. To complete a given activity, all students in a group had to play a role. Teachers implemented the lesson plans developed by the researcher. Detailed field notes of classroom observations and transcripts of interviews were made. It was observed that the students were very cooperative by sharing experiences, presenting ideas to solve the problem in a given activity, giving conjectures and helping each other in holding objects, pasting pictures, writing the report and presenting it to the whole group. Interviews with teachers, children and their parents revealed how children were motivated to learn science. By triangulating data gathered from various sources and, analysing data using the grounded theory, it was found that children enjoyed learning science in their group activities and appreciated the collaboration of the group members. Teachers were also of the view that children learn better when they work in groups, but it is difficult to set up the activities to involve all children. It is recommended that teachers need further guidance in designing and presenting challenging activities to promote scientific thinking.

INTRODUCTION

The policy, “Science for all” was introduced by UNESCO with a vision to improve science education around the globe. The advancements of science had led the modern man to lead a comfortable life by developing many competencies to comprehend the world around us. A proper background to learn science is essential to be laid from early years in school. In Sri Lanka, major changes were introduced to the Education System from early childhood to tertiary level through education reforms introduced in 1997. The basic aim of the reforms was to lay a proper foundation for the
development of the personality of the child to enable her/him to face the challenges of life in the modern world successfully (Presidential Task Force, 1997). Hence, curriculum was developed competency-based to develop five basic competencies at primary level. They are:

- Competencies related to communication
- Competencies related to environment
- Competencies related to ethics and religion
- Competencies related to play and leisure
- Competencies related to learning to learn

The primary cycle of education has been divided into three key stages. At the end of each key stage it was expected to achieve a set of essential competencies. The key stage one consists of grades one and two. The key stage two consists of grades three and four. The key stage three consists of grade five which is the final grade of the primary level. The primary curriculum consists of four main subject areas: First language, Mathematics, Environment Related Activities (ERA) and Religion. The ERA is an integrated subject of science, health and nutrition, aesthetic education, creative work and physical education, in which competencies could be developed easily.

Research reveals the importance of collaborative work in teaching and in learning (Fullan and Hargreaves, 1991; Loucks-Horsely et al., 2003) to develop a shared content understanding. Karunaratne (2003a) proposes that collaborative work with problem solving enhances learning science at all levels. Anderson and Smith (1986) and Vellom et al. (1994) propose that collaborative work among the group members help develop many process skills and follow norms of participation to respect one’s ideas, to defend own ideas with evidence and to arrive at a consensus in explaining observations and making interpretations. Millar (1989) states that, scientific concepts and principles are obtained only through the operation of science processes, such as observing, classifying, describing, communicating, drawing conclusions, making operational definitions, formulating hypotheses, controlling variables, interpreting data and experimenting. To shape the lives of the younger generation to lead a successful life in future it is necessary to develop science process skills from the early years of schooling.

Harlen (1992) emphasizes the responsibility of the teacher in developing process skills of students. It is necessary that a teacher should be able to provide opportunity to use process skills in the exploration of materials and phenomena at first hand. Symington and Kirkwood (1995) emphasize that if children are involved in hands-on activities they will be developing process skills. Then students will be able to use their own senses and to gather evidence from which to raise questions, formulate hypotheses based on ideas enabling them in developing many competencies. Providing opportunity for discussion helps students to share their ideas, listen to others, explain and defend their ideas and to involve them in thinking through what they have done. This kind of sharing and argumentation helped them in proposing explanations (Berland and Reiser, 2009) and to behave as a community of learners (Calderwood, 2000.) Peer-led teams (Cracolice and Deming, 2001; Gosser and Roth, 1998) make students empowered and to bring up many ideas from their previous experiences. The interactions among children in group activities help them to share their experiences and ideas to construct their own meanings (Driver et al., 1994; Vellom et al., 1994; Solomon, 1989.) These social constructions in turn help in cognitive development. Crafting challengeable group activities requires collegiality among teachers and pedagogical skills (Ball and Cohen, 1999) and a thorough understanding of the subject to design collaborative activities to enhance learning. It is very difficult to make a shift
from the traditional didactic teacher-centred approach to student-centred approach (Karunaratne and Dias, 2003 & 2004). Earlier studies (Abeykoon and Karunaratne, 2004; Mahagamage and Karunaratne, 2004) in primary classrooms also found that teachers need guidance in developing activities to present science in ERA. Hence, in this study, researchers intervened to help teachers in designing small group activities with collaborative work to develop many competencies.

METHODOLOGY

Two schools were selected for the study from an urban and a rural area considering the accessibility and convenience of the researcher to be in the classrooms for a period of six months (Bogdan and Biklen, 1998) to gather data through observations, interviews and documents. In each school, five classrooms were selected from each grade one to five. At the first phase, preliminary observations were done to understand how teachers presented ERA lessons and their capability in organising activities to promote student learning for a period of two weeks. Special attention was paid to observe opportunities given for students to work together and to make them interested and to be active in the learning process. Based on observations, new activities were developed to arouse curiosity and to let students behave as investigators. Interaction among the group members was a key feature in the activities. For each grade five activities were developed. A pilot run was done to revise the developed activities.

Teaching ERA in the ten classrooms was done by the teachers using the activities developed by the researcher. A qualitative approach (Denzin and Lincoln, 2000) was used to gain insights into how students work collaboratively to learn science. The teaching and learning occurred in ERA lessons were observed carefully and detailed field notes were made to identify changes of behaviours of students in learning science. A tape recorder was used to record all verbal interactions in the classroom to use those from the participants’ own words and not to lose important data (Best and Kahn, 1993). Based on observations, interviews were conducted with teachers and students to get more information about what was happened in the classrooms. In addition views of parents about instruction and school were also collected. Transcripts of interviews were made. To ensure confidentiality, instead of actual names of teachers and students, pseudonyms were used in the transcripts. With the permission of the teacher, students and parents, photographs of classroom situations were taken and some classes were video taped. Reports and crafts made by children were also collected. Data gathered from various sources were analysed qualitatively using triangulation (Mathison, 1988) and grounded theory (Creswell and Miller, 2000).

RESULTS

First Phase

Most of the lessons observed during the first phase had some common features which were not helpful in developing competencies in students and, are presented under following sub-sections:

Introducing Lessons

The teachers started the lesson by asking previous work. For example, Mrs. Silva started the lesson on the theme, ‘New Year’ in grade two asking the question, “Can you remember that we did changes in the environment in the New Year season”? She continued the lesson by asking some questions and giving self-answers without waiting for the responses of students. There were some occasional nods, but no answers. The teacher failed to get the attention of students because of the monotonous way of presenting facts and, students passively listened to the teacher. This was a common phenomenon in the other classrooms too. Mrs. Fernando and some other teachers started the lesson by asking students to “Stand
up; Hands up; Hands down; Hands up”. Although, the teachers assumed that students would be refreshed after doing this, the way they behaved in raising hands did not impress the researcher that they were motivated because it had become a routine thing.

**Questioning and Wait-time**

All the teachers asked questions in their teaching, but these questions were not inquiry-based. They were of yes/no type. Wait-time was not at all sufficient for students to think. The lessons were not properly planned to achieve the objectives. The predominant mode of teaching was the didactic instruction, although in the reforms it was stated that at the primary stage more emphasis to be given to play and activity.

**Demonstrations**

The activities given in the teacher guides were mostly done by the teacher as demonstrations. In the classrooms students were seated in groups, but no activity was given for them to be done in groups. They found it difficult to observe the demonstration due to the seating arrangement and failed to learn anything new. The teachers had the difficulty in setting an experiment to demonstrate it to the whole class.

**Group Activities**

There were instances where students were asked to bring materials for activities. As the instructions given were not in an organized way to help student thinking to do science, materials were not used properly in groups to obtain the anticipated learning outcome of the activity. Teachers did not pay attention to what students do in the groups. Attention was given to finish the activity and not to understand how students learn. It was revealed from teachers that implementing ERA as suggested in the teacher guides was difficult. Mrs. Perera said, “It is difficult to do group work with grade one children, because they do not listen carefully.” Involving children in group work was emphasized in the teacher guides of grade one and two.

**Second Phase**

In the phase two, with the assistance of the researcher, teachers used activities developed by the researcher. These activities were developed as group activities of varied types to arouse curiosity of students (Karunaratne, 2003b). One such example was a lesson on the theme, ‘Play with light’ done by Mrs. Cooray.

**Enhancing Curiosity and Play**

Each student was provided with a material (glass, cloth, cardboard, black drawing papers, cellophane) to see a lighted candle through it. The teacher fixed the lighted candle in the middle of each group. When the teacher was with one group, others were waiting impatiently and called the teacher to get their lighted candle. With many “aha” statements students shared what they had seen through the material given to them and exchanged the material with others to see what could be seen. Each group was given three cellophane frames to look at the candle. They were very enthusiastic to see the colours through the frames. Some were amazed to see a different colour through the frame and shouted “Teacher, we can see blue”. Some wanted to see what could be seen when they looked through two frames together. They were delighted to see purple with the use of red and blue frames and shouted, “Teacher, now it is violet.” In this classroom, not a single student was observed as bored because everyone was doing something and communicating with others.

**Division of Labour and Communication**

In another lesson, the teacher let the students to make “Vesak” lanterns using coloured papers. Some cut the papers; some made designs to be pasted on the lanterns. Even for cutting and pasting one helped in folding the paper and the other in applying glue as seen in figure 1. The group members helped each other in making the lantern.
While helping each other they shared the experiences they had in making lanterns during the vesak season. Hasitha told the group, “We should use red and white tissue papers only. Once we used orange, we could not see at night”. These shared experiences about what went wrong and the selection of colours for lantern panels helped them to make a good lantern. Figure 2 shows a girl holding the unfinished lantern so that the others could finish it while holding.

Observations and Predictions

In one lesson under the theme, “The sky we can see” Mrs. Yapa took her students to the school garden and assigned them to work in groups. For each group, a clear glass bottle (soda bottle), a transparent drinking straw, clay, water and food colouring were given as materials for the activity. She asked the groups to fill the bottle with water to a depth of 3 centimetres (showing the height) and then to add a few drops of food colouring (red) to the bottle. The groups were advised to mould clay around one end of the straw and to insert the other end of the straw to the bottle as shown in the figure 3.

Mrs. Yapa asked the students to put the bottles in a sunny place and to observe what would happen. In spite of the humid hot weather, children did careful observations to see a change (Fig. 4). When they observed a change they were very happy and shouted, “Madam, water has risen through our straw.” Another group also screamed, “Madam, ours also has risen a very little.” While children were observing the changes, Mrs. Yapa asked the students, “What would you expect to happen if the apparatus was kept in the classroom?” They were silent for a moment and one said, “It might not rise.” The children were curious to know what would happen and continued observations upon returning to the classroom. One child was very impatient and told the teacher, “Madam, the water that rose up had come down when we came here.” Mrs. Yapa praised the child for careful observation by saying, “Very good, how about the others?” The other groups were also started saying what they had observed. Then Mrs. Yapa discussed with students why the changes occurred in the classroom and outside. This activity helped the students in developing competencies related to environment, communication, play and leisure.

Recording and Presentations

In another activity under the theme, “The animals around us” Mrs. Silva conducted a short discussion with students reminding the homework given on the previous day to
observe animals around them. She distributed an activity card prepared from Bristol board (Fig. 5) and coloured circles made from varnish paper to each group. Then she gave clear instructions to the children using an example on the board and asked students to write the names of some animals they observed and paste circles according to the number of group members who observed the particular animal.

Figure 3: Coloured water bottle used in the activity.

Figure 4: Students observing rising water level in the straw.

Classroom discourse

When students finished the activity Mrs. Silva asked one student from each group to present their findings while others are listening. She also helped the presenters to display activity cards on the black board. The students presented very clearly what they recorded in their worksheets. During presentations pointing to the completed activity card (Fig. 5), one student said, “Madam, in our group we saw six dogs, three parrots, four butterflies, two squirrels and eight crows.”

Figure 5: (a) Empty and (b) completed activity cards.

Figure 6: Enjoying science learning

It was observed that when a group was presenting the others were looking at their worksheets. After each presentation the teacher asked questions based on the activity card as follows:

Teacher: Now tell me, which animals have they observed most?

Students: Crows (chorus answers as they were very enthusiastic to respond)

Teacher: Why did you say that?

Ruwani: It is higher than others.

Nimmi: Madam, the number of crows they observed is high.
Teacher: Why did you say high?
Ruwani: When I count all, it has the highest number.
Teacher: Very good, give Ruwani a clap.
Which animals they observed least?
Students: Squirrels
Teacher: How many dogs they observed?
Pradeep: Six
Teacher: Now what can you say by looking at the figure?
Nedra: Some animals are high in number and some are low.

Children were very enthusiastic in doing things cooperatively to see what happened and proposing conjectures to explain observations. It is the teacher’s role to orient them to learn through the fun of the activity. At the beginning it was observed that the teachers switched some times to their familiar traditional mode of didactic teaching, but they were also enthused on how students were engaged in doing group work. Mrs. Pieris said, “It is nice to see them working without making noise, but it is difficult for us to organize good activities.”

In many activities, the students were able to use their senses in predicting and classifying things. In the activity on, “Facial expressions” teacher gave green leaf extracts in four cups for each group. Group members had to taste it. When one tastes the extract, the others had to observe the facial expressions. The team leader in each group served a small spoon of the extract to the members to taste as shown in figure 6. Before tasting they had to make predictions on changes in the faces. They had much fun to observe the behaviours when a student tried the bitter taste. They developed high self-esteem when the predictions come to be true and developed confidence to propose their conjectures in classroom discourse.

DISCUSSION

Learning science involves developing knowledge and many skills and attitudes (Driver et al., 1994; Baird et al., 1991.) Teachers with less experience and no background in concept integration fail to present science interestingly to students (Nadeera and Karunaratne, 2004; Vitharana and Karunaratne, 2004.) In the first phase, although the teachers asked questions from students those questions were not to bring about effective teaching and help students to learn (Wilin, 1987) and not given enough time to respond. Rowe (1987) discusses how important it is to give at least undisturbed “wait-time” of three seconds to get correct responses of students. Atwood and William (1991) also propose that as “wait-time” gives “think-time” it helps in generating ideas. In the second phase, most of the time questions came from students and not from the teacher. They had sufficient time to respond to the questions and also opportunities to question presenters of other groups for clarity.

In the activity on, “The animals around us” by putting circles of animals in a given column, what they built up was a bar graph, but at this level (2nd grade) students were not given the term ‘graph’. The skills developed in this activity will help them in future in constructing bar graphs and interpreting data. By nature, children are curious and they are happy to engage in doing something. When the activities were given to them, sometimes they wanted to start immediately without even listening to the instructions. They enjoyed in doing activities. The teachers appreciated how all students were involved and motivated but expressed their difficulty in developing such activities without guidance.

Debriefing session after an activity was very helpful to get the learning outcomes and to improve teacher’s teaching. Although it is not expected to build up science concepts at the primary level, it is the teacher’s responsibility to lay a proper foundation to build up science concepts in future. As Slavin (1990) proposed, the students in the study were able to develop many skills, knowledge and attitudes through their cooperation in doing the hands-on activities. As presented in the results section, students’ collaborative
work helped them to learn science with much sharing of experiences and to produce creative work and to do presentations. This engagement helped them in developing competencies related to communication, environment, ethics, play and leisure and, learning to learn.

CONCLUSIONS

Primary children learn science interestingly when they do things collaboratively in the learning process. The support from each other helped them in developing concepts. Working together also helped them to make close relationships with each other, to do team work and, to maintain discipline and peace in the classroom. They behaved as a learning community. Many teachers do not possess adequate content knowledge, pedagogical knowledge and skills to design challengeable activities to present science using multiple approaches.

In order to help students in understanding science, capacity building of teachers is required. It is necessary to conduct staff development programmes for primary teachers to build up the concept of integration. Then only they will be able to present an integrated subject to help develop many competencies of students. This is also important due to the fact that many primary teachers had not studied science as a subject up to GCE ordinary level which might result in developing misconceptions in students.

Classroom settings with children seated in groups need to be used in instruction. There are several advantages in providing opportunities for students to work in groups. Students are free to talk in small group discussions and it helps to develop students’ vocabulary. However, if teachers continue teaching standing in front of the classroom, students who are seated in groups find it difficult to look at the board and have to turn their heads all the time. Teachers need to know how to set the classroom for different teaching contexts with proper management.

The teachers should realize the importance of group work and developing skills such as observation and communication. They should be able to match the objectives and basic competencies to be developed in crafting problems in the worksheets. Students should be given opportunity to develop many skills by crafting challengeable group activities. Children love to see things in colours. With the funds available from Quality Inputs project in Sri Lanka, teachers should be able to buy materials required in their teaching. Preparation of worksheets, activity cards and other teaching aids could be made utilizing these funds.

Teachers should be able to assess students as an on-going activity and record them in charts so that children can see their progress of learning. Teachers should also make use of these records to identify weaknesses of students and to provide remedial measures to achieve essential competencies. They need to have a clear understanding of school-based assessment (SBA) to assess children.

Primary teachers need continual guidance to help them in teaching, managing classrooms and to maintain records of students. Then only they will be able to have constructive classrooms with active learners.

REFERENCES


