TEAM-PAIR-SOLO STRATEGY OF COOPERATIVE LEARNING IN DEVELOPING SCIENCE PROCESS SKILLS AMONG SECONDARY SCHOOL STUDENTS

Dr. Elizabeth Joshua*

ABSTRACT

This study determined the effectiveness of Team-Pair-Solo Strategy of Cooperative Learning in Developing Science Process Skills among Secondary School Students. The study was carried out on a representative sample of sixty students in standard VIII of Kottayam District. For measuring the dependent variable, the investigator developed and standardized Science Process Skills test in Biology of Secondary School Students. Two different methods of strategies, Team-Pair-Solo Strategy of Cooperative Learning and Activity Oriented Method were experimented and compared for their effectiveness. The scores of experimental and control groups were subjected to Analysis of Covariance to determine the effectiveness of Team-Pair-Solo Strategy of Cooperative Learning over present method. Study found that Team-Pair-Solo Strategy of Cooperative Learning is more effective than Activity Oriented Method on Science Process Skills in Biology among students at Secondary Level. It is clear that Science Process Skills of students taught using Team-Pair-Solo Strategy is significantly higher than those taught using Activity Oriented Method among Secondary Level.

INTRODUCTION

Education, in a larger sense, has a formative effect on the mind, character or physical ability of an individual. The importance of learning emphasizes to enable the individual to put in one's potentials to optional use isself-evidentand without education, the training of the human mind is incomplete. Teaching Science is beyond scientific knowledge. There are three important dimensions. The first of these is the content of science, the basic concepts, and our scientific knowledge. The other two important dimension of science in addition to science knowledge are processes of doing science and the science process skills that scientists use in the process of doing science.

Science process skills are the most powerful tools we have for producing and arranging information about our world (Ostlund, 1992). They are, of course, established for students to learn and think like scientists. Science process skills are considered to be a separate group of skills to be imparted and teaching learning are designed based on scientific inquiry to impart science process skills. Science Process Skills are based on scientific inquiry and teaching science by inquiry involves teaching students science process skills, critical thinking, scientific reasoning skills used by scientists (Pratt & Hackett, 1998) and inquiry is defined as an approach to teaching, the acts scientists use in doing science and it can be a highly effective teaching method that helps students for understanding of concepts and use of process skills (Yager & Akçay, 2010).

Teaching is an interactive process where exchange of ideas takes place between the teacher and the taught. How effectively the pupils learn depends upon the method the teacher adopted. The process of interpreting the world of knowledge to the child's mind is called the method of teaching. To teach effectively, teachers must organize what they plan to teachregardless of the distant directives. Various strategies can be adapted to a variety of teaching situation.

Co-operative learning strategy may be defined as a teaching learning strategy in which the students of a class engage themselves in a variety of useful learning activities in a co-operative and non-competitive environment by forming a number of teams, each consisting of a

*Assistant Professor, Mangalam College of Education, Kottayam (Kerala)

small number of students of different levels of ability for their understanding of a subject.

Cooperative learning processes lessen individual competitiveness and foster cooperative small problem-solving group behavior (Johnson, Johnson, and Holubec, 1994). By having learners treat each other as resources and requiring learners to go beyond only superficial engagement with learning materials, cooperative learning provides the social context for students to actively learn and make deeper connections among facts, concepts, and ideas.

In Team Pair Solo, students are put into teams and each person in the group is given their own problem. They then work together and help each other to figure out their problem. After that, each person finds a partner and helps each other to figure out their problem. Then each student is to work on their own and figure out their problem. It is designed to motivate students to tackle and succeed at problems which initially are beyond their ability. Students learn to interact and help fellow classmates. In this strategy students help each other because what may be one student's weakness is another student's strength.

The investigative nature of science provides a unique setting for group work, particularly cooperative learning, to build its framework (Sherman, 1994). This nature of science is an aspect often neglected by science teachers in their normal teaching. It has a profound significance for building science literacy for students and therefore, its implication to the implementation of group work practice and assessment will be addressed.

Cooperative classrooms can effectively foster discussion, which is so essential for understanding in science, as well as in other subjects. Hands-on science activities are wonderful vehicles for the use and practice of the process skills. The combining of cooperative learning with science is seen as a natural union for many experienced science teachers who have worked extensively with small groups. When cooperative learning is properly implemented, it provides a vehicle for student teams to share materials and equipment, as well as ideas.

The process of science involves a number of skills that are important in scientific research. These process skills fit well into the cooperative framework. However, not every process skill is used in every lesson or activity, but every science learning task needs to focus on one or more of the skills. Teachers who employ a cooperative learning strategy should try to identify the science process skills that will be addressed in the lesson and build these into students' learning.

Science Process Skills are essential for teaching science content knowledge and scientific inquiry because teachers who have a poor understanding of the science process skills are less likely to have a positive attitude towards them and are, therefore, less likely to teach them to their students (Cain, 2002). Science Process Skills instruction also promotes positive attitudes toward science among students; thus, the avoidance of teaching the process skills can be detrimental (Bilgin, 2006). Many researchers stated that teachers who are deficient in the science process skills are less equipped to use inquiry in their classrooms (Aka et al., 2010). Similarly, teachers who are not familiar with science processes or have low interest in science processes are not likely to teach science by inquiry. Teachers' competence in the science process skills has also been found to promote a positive attitude towards science (Bilgin, 2006)

Team- Pair-Solo Strategy is one such strategy that helps students to develop science process skills. Students first perform in groups where each individual can donate their values and ideas on a topic. Then they practice it in pairs and finally by themselves. As a result the students will be able to express their ideas by themselves effectively. So the aim of the present study is to find out the effectiveness of Team-Pair-solo strategy of cooperative learning in developing science process skills among secondary school students.

OBJECTIVES OF THE STUDY

1. To find out effectiveness of Team-Pair-Solo Strategy of Cooperative Learning in developing Science Process Skills over Activity Oriented Method.
2. To compare the total development of Science Process Skills of students who were

taught through Team-Pair-Solo Strategy of Cooperative Learning with that of students who were taught through Activity Oriented Method.

HYPOTHESIS OF THE STUDY

There is significant difference in Science Process Skills among Secondary School Students taught through Team-Pair-Solo Strategy of Cooperative Learning and Prevailing Activity Oriented Method.

METHODOLOGY

In the present study, experimental design was used to find out the effectiveness of Team-Pair-Solo Strategy of Cooperative Learning in developing Science Process Skills of Secondary School Students. So the investigator selected the control group taught through activity oriented method and the experimental group taught through Team-Pair-Solo Strategy of Cooperative Learning for the present study. Pre-test, post-test non-equivalent group design was used for the study.

The sample of the study consisted of 60 students of class VIII of Mount Carmel H.S.S, Kottayam. As it was difficult to get two equivalent group the investigator conducted a study on two non-equivalent groups; experimental group consisting of thirty students and control groups consisting of thirty students. Two classes were randomly selected as experimental group and control group to study the effectiveness of Team-Pair-Solo Strategy of Cooperative Learning on science process skills of Secondary School students.

Tools are the instruments employed for collecting the necessary data. The tools used in the present study are:

1. Lesson transcripts based on Team-Pair-Solo Strategy of Cooperative Learning: Investigator selected the units 'An address for living beings' and 'The Beauty of Nature 'from Biology text book of VIII Standard. For teaching 15 lesson plans with 45 minutes duration was taken to complete the content. Students actively participated in the activities and the investigator gave proper instructions to them.

2. Science Process Skills Test in Biology: Science Process Skills test was developed in order to measure the Science Process Skills of the students of standard VIII. The test was developed and standardized by the investigator herself. To measure the Science Process Skills of the students 5 main skills out of the 13 skills specified by American Association of Advancement of science (1971) were taken. The skills are.

1. Observation
2. Classification
3. Reasoning
4. Predicting
5. Inference

3. Lesson transcripts based on Activity Oriented method: Activity oriented Method is the existing method of teaching learning process. It is a lecture cum demonstration method. Here teaching learning process occurs with the help of different activities in accordance with the subject matter. Students learned themselves by the help of these activities. Investigator prepared 15 lesson transcripts from the same unit.

Teaching strategy was the independent variable which has two levels viz, the Team-Pair-Solo Strategy of Cooperative Learning and the existing method of teaching. The dependent variable was Science Process Skills in biology of secondary school students. In order to determine the entry behavior of the students, a pre-test was administered to both the groups. The experimental group was then introduced to the Team-Pair-Solo Strategy of Cooperative Learning while the control group received the normal treatment of classroom teaching. The effect of the independent variable was tested by administering a post-test. The scores obtained by the students of the control group and the experimental group were analyzed by the statistical procedures like mean, standard deviation and ANCOVA.

ANALYSIS AND DISCUSSION

Comparison of Science Process Skills in Biology of Experimental and Control Groups based on Pre-test and Post-Test Scores Using Analysis of Co-variance (Total Sample)

The scores of the experimental and control groups were subjected to Analysis of Covariance to determine the effect of Team-Pair-Solo Strategy over Activity oriented Method on

Science Process Skills in Biology. Before proceeding to Analysis of co-variance, Analysis of variance was done. Total sum of squares, mean square variance and F-ratio for pre-test and post-test scores of the Experimental and Control groups were computed. The Summary of Analysis of variance of pre-test and post-test scores of pupils in the experimental and control Groups are given in the following Table 1.

Table 1
Summary of Analysis of Variance of Pre-test and Post-test Achievement scores of the Experimental and Control Groups (Total Sample)

Source of variance	df	SSx	SSy	MSx	MSy
Among group mean	1	14.02	326.7	14.02	326.67
Within group mean	58	732.57	1098.3	12.63	18.12
Total	59	746.58	1425.0	-	-

Fx = 1.11, Fy = 17.73
F at 0.05 level = 4.03: F at 0.01 level = 7.17
The obtained Fx and Fy ratio were tested for significance. The table values of F for 1/58 are 4.03 at 0.05 level and 7.17 at 0.01 levels.

The calculated value of Fx is 1.11, which is less than the table value of F at 0.05 level. So there is no significant difference between the pre-test scores of experimental and control group. The obtained value of Fy is 17.73 which is also greater than the table value of F at 0.01 level.So it is highly significant. Hence it can be tentatively concluded that there is significant difference between the post-test scores of these two groups.

The final (Y) scores were corrected for difference in initial (X) scores. For that the SSy have been adjusted for any variability in Y contributed by X. The adjusted sum of squares for Y, that is SSyx were computed and the F-ratio (Fyx) was calculated. The summary of analysis of co-variance of pre-test scores of pupils in experimental and control groups are given in table 2.

Table 2
Summary of analysis of co-variance of 'X' (pre-test) and 'Y'(post-test) scores of pupils in experimental and control group taken separately.

Source of variance	df	SSx	SSy	SSxy	SSyx	MSyx	SDyx
Among group means	1	14.02	326.7	67.67	250.23	250.25	
Within group means	57	732.57	1098.3	411.33	836.81	14.68	3.83
Total	58	746.58	1425.0	479.00	1087.04		

Fyx = 17.04, From table F for df 1/57
At 0.05 level = 4.03: At 0.01 level = 7.17
The calculated Fyx ratio was tested for significance. The table values of F for df 1/57 are 4.03 at 0.05 level and 7.17 at 0.01 level. The calculated values of Fyx is17.04. Since the calculated value of Fyx is greater than the table values of F at .01 level, it is significant at 0.01 level. It is clear from the significant Fyx ratio that the two final means, of the experimental and control group differ significantly, after they have been adjusted for initial differences.

The adjusted means of post-test scores (Y-means) of pupils in the experimental and control group were computed. The difference between the adjusted Y means was tested for significance. The data for adjusted means of post-test scores of pupils in experimental and control groups are given in table 3.

Table 3
Data for adjusted means of post-test scores of pupils in experimental and control group

Groups	N	Mx	My	Myx adjusted
Experimental	30	11.57	21.8	21.56
Control	30	10.60	17.2	17.44
General means	30	11.06	-	-

SEM between adjusted means $= SDyx \sqrt{\frac{1}{N1} \quad \frac{1}{N2}}$

$= 3.83 \sqrt{\frac{1}{30} \quad \frac{1}{30}} \quad 0.91$

Obtained difference between mean

$$= 21.56 \quad 17.44 = 4.12$$

$$\text{Calculated 't' value} = \frac{\text{Difference between y menas}}{SE_{\bar{y}}}$$

$$= \frac{4.12}{0.91} \quad 4.52$$

Table value of t
't' at 0.05 level = 2.01
't'at 0.01 level = 2.68

The table value of 't' is 2.01 at 0.05 level and 2.68 at 0.01 level. The calculated value is 4.52 which is greater than that of the table values of t at 0.01 levels. Hence it is significant at 0.01level. The significantly greater adjusted Y means of the experimental group than that of control group indicate that experimental group is superior to the control group, the development of Science Process Skills. It may therefore be interpreted that the pupil taught through Team-Pair-Solo Strategy has better achievement than those taught by the activity oriented method.

From the analysis of total scores of pupils in experimental and control groups by using the statistical techniques of analysis of co-variance it became apparent that the Team-Pair-Solo Strategy more effective than the prevailing activity oriented method of teaching in developing Science Process Skills among secondary school students.

EDUCATIONAL IMPLICATIONS

On the basis of above conclusion the following suggestions are made to improve the teaching learning process.

1. The study has shown that Team-Pair-Solo Strategy is superior to the prevailing activity oriented method on the development of Science Process Skills in Biology. Hence teachers must be encouraged to apply this method while teaching.
2. Science teachers should contribute to narrowing the gap between class room science and its application to daily life by emphasizing the contributions that laboratory activities could make in raising the learners' various intellectual and procedural skill that are likely to be useful in their future careers.
3. Through constant motivation and encouragement during the teaching-learning activities in science the students can re-conceptualize their perceptions about science learning and they will be more involved in the activities.
4. Innovative and creative instructional styles may aid in facilitating a fun filled and enjoyable science environment.
5. Teachers should be thorough with the theory and practice related to co operative learning in order to implement this suggestion.
6. Curriculum designers should also develop awareness on the different co operative learning strategies .

REFERENCES

Aka, E. I., Guven E., & Aydogdu, M. (2010). Effect of Problem Solving Method on Science Process Skills and Academic Achievement. Journal of Turkey Science Education. 7 (4),13-25.

Cain, S. (2002). Sciencing. (4th ed). Upper Saddle River, NJ: Pearson Education.

Bilgin, I. (2006). The effects of hands-on activities incorporating a cooperative learning approach on eighth grade students' science process skills and attitudes toward science. Sci. Educ, 1,27-36.

Johnson, D.W., Johnson,& Holubec.J. W. (1994). The new circles of learning: Cooperation in the classroom and school. Alexandria, VA: Association for Supervision and Curriculum Development.

Ostlund, K. L. (1992). Science process skills: assessing hands-on student performance. New York: Addison-Wesley.

Pratt, H., & Hackett, J. (1998). Teaching science: the inquiry approach. Principal, 78 (2), 2-20.

Sherman, S. J. (1994). Cooperative Learning and Science. In Handbook of Cooperative Learning Methods (Ed. Sharan, S.). 226-244.

Yager, R.E., & Akçay, H. (2010). The advantages of an inquiry approach for science instruction in middle grades. School Science & Mathematics, 110, 5-12.