Interactive effect of co-operative learning model and learning goals of students on academic achievement of students in mathematics

Shefali Pandya[*]

Department of Education, University of Mumbai, India

The study seeks to ascertain whether co-operative learning model is equally effective for students with mastery and performance goals. The study uses quasi-experimental and factorial design for conducting the experiment. The experiment was conducted on 153 students of standard IX studying in schools affiliated to the SSC Board and with English as the medium of instruction. It has used two tools, namely, achievement test in mathematics and learning goals inventory both developed by the researcher. The researcher has also developed an instructional programme for co-operative learning. The techniques used to test the hypotheses include the t-test, ANOVA and ANCOVA. The study found that the effect of the co-operative learning model on students' academic achievement is maximum. Co-operative learning model was found to be more effective for students with mastery goals whereas the traditional lecture method is found to be more effective for students with performance goals.

Keywords: Co-operative learning, learning goals, mathematics, Jigsaw Technique and Think-Pair-Share.

Co-operative Learning in Classrooms

Beginning in the late 1970s, research by Webb (1980) on group processes in classrooms and their effects began to provide evidence of their usefulness. Webb (1991) discovered, for example, that students tended to help one another when they worked together on small group activities; intellectually able students deepened their learning by explaining concepts to peers in need of support, redefining what is meant by self regulated learning. Lower achieving students benefited from the (typically effective) explanations provided by able peers, as well as from students who modelled good work habits. Early findings such as these have been enhanced by a next generation of theory-driven research on co-operative learning and many classroom interventions now exist for learning that is co-operative. Though the earlier findings focus on intellectual ability of students, one of the important variables influencing the benefits or effectiveness of co-operative learning could be students' learning goals. Co-operative learning is characterised by positive interdependence with structured goals, a clear accountability for individual's share of the group's work through role assignment and regular rotation of the assigned role, heterogeneous ability grouping, sharing of leadership roles, sharing of the appointed learning task(s), aiming to maximise each member's learning, maintaining good working relationship, process-orientation, teaching of collaborative skills, teacher observation of students' interaction and structuring of the procedures and time for the processing.

Goal Orientations

Achievement goal theory is used as the theoretical basis for the present study. According to achievement goal theory, goal orientations provide a framework for interpreting and reacting to

Correspondence: Department of Education, University of Mumbai, India profsrpandya@rediffmail.com

events (Dweck & Leggett, 1988). Literature in this area shows that there are two primary goals that provide the reasons why students engage in achievement behaviour: a mastery goal orientation, where the focus is developing one's competence, and a performance goal orientation, where the focus is demonstrating one's competence.

The orientation of our goal-setting mentality can completely change the way we approach life. Two of the main goal-orientations discussed in psychology are (a) performance and (b) mastery.

a) Performance goals seek to demonstrateability to others. People who set performance goals are often focused on winning, looking good (looking smart) and being evaluated well (getting good grades). Performance orientation is described as a student's wish to achieve highly on external indicators of success, such as grades or marks. The students' sense of satisfaction is highly influenced by their grades and so it is associated with discouragement in the face of low marks. Performance orientation is also associated with higher states of anxiety. In addition, the desire for high marks increases the temptation to cheat or to engage in shallow rote-learning instead of deep understanding. Performance orientation is thought to increase a student's intrinsic motivation if they perform well, but to decrease motivation when they perform badly. According to Ames' study (1988), when performance goals are involved, there is a concern with having one's ability judged. Success is evidence of ability, shown by outperforming others, or by achieving success with little effort. A student with predominant performance goals will want to avoid mistakes so that he/she can get a good grade. That is the reward for studying hard and feels that his/her performance should be better than other students.

b) Mastery goals, on the other hand, seek to improve and learn, no matter how awkward you might look to others. People who set mastery goals usually seek out challenges and persist in the face of difficulties (Woolfolk, 2008 : 415-416). Mastery orientation is described as a student's wish to become proficient in a topic to the best of his or her ability. The student's sense of satisfaction with the work is not influenced by external performance indicators such as grades. Mastery orientation is associated with deeper engagement with the task and greater perseverance in the face of setbacks (Ames, 1992). With a mastery goal, importance is attached to developing new skills. The process of learning itself is valued and the attainment of mastery is seen as dependent on effort. Mastery orientation is thought to increase a student's intrinsic motivation. For a student with predominant performance goals will try and understand the class materials rather than solely focus on earning a high grade and that is why he/she would work hard to learn. He/she will try to ensure that his/her performance is better than it was at the beginning of the semester.

Theoretical Framework of the Study

If the co-operative learning model is effective, the question arises as to what mediating variables are responsible for this effectiveness. The present study hypothesises that the co-operative learning model will have differential effectiveness for students with different learning goals. In comparison with direct instruction, there will also be a better chance to feel autonomous because students have more flexibility in structuring the learning process. However, for autonomy in learning to be effective, it is essential that one's learning goals suit the techniques and methods of teaching-learning. Besides, the co-operative learning model is hypothesised to have particular advantages as to the need for competence : the student's experience of responsibility for a segment of the material and of acting as an expert source for other students is conceived to give the student an experience of feelings of competence that is uncommon in conventional forms of instruction. However, it is difficult to hypothesise the precise nature of the interaction between learning goals and co-operative learning as studies on achievement goals in the late 1990s have produced inconsistent findings, particularly with performance goals. While mastery goals are found to

associate with deep processing, performance goals are sometimes found to associate with both surface and deep processing (Chan, Lai, Leung & Moore, 2005).Co-operative learning in the present study i*s* a teaching-learning strategy in which small teams, each with students of different levels of ability; use a variety of learning abilities; to improve their understanding of selected topics in Mathematics of standard IX.Academic achievement refers to the marks obtained in the test prepared by the researcher on selected topics in Mathematics of standard IX.Learning goals refers to what a student plans to do in a learning situation which may include either focusing more on learning, development, improvement and understanding or focusing more on doing better than others.

Aim of the Study

The broad aim of the research was to study the effects of co-operative learning model and learning goals of students on the Academic Achievement of students in Mathematics.

Research Questions

1) Do experimental and control group students' pre-test scores on academic achievement in the subject of Mathematics differ significantly?
2) Do experimental and control group students' post-test scores on academic achievement in the subject of Mathematics differ significantly?
3) Do students' post-test scores on academic achievement in the subject of Mathematics differ when students' pre-test scores are controlled?
4) What is the interactive effect of co-operative learning model and learning goals (in terms of mastery learning and performance goals) on the Academic Achievement in the subject of Mathematics?
5) What is the effect size of the treatment on the Academic Achievement in the subject of Mathematics?

Methodology of the Study

The present study is aimed at enhancing academic achievement of secondary students through the use of Co-operative Learning Model. The researcher attempts to provide answer to the question, "Is there an interactive effect of Co-operative Learning Model and the learning goals of students on academic achievement of secondary school students?" The researcher has manipulated the method of teaching to ascertain its effect on academic achievement of students in mathematics. Hence the methodology selected is the experimental one. In the present investigation, the following quasi-experimental design has been used:

The Pre-test - Post-test Non-Equivalent Groups Design which is described symbolically as follows:

0_1 X 0_2 0_3 C 0_4
Where,
0_1 and 0_3: Pre-test Scores
0_2 and 0_4: Post-test Scores
and
X: Experimental Group; C: Control Group.

The researcher has also used the 2×2 factorial design as follows :

	Experimental Group	**Control Group**
Performance Goal	Gain Scores	Gain Scores
Mastery Goal	Gain Scores	Gain Scores

Here, Gain Score = 0_3 -0_1 for the Experimental Group and 0_4 -0_2 for the Control Group.

Teaching Method

Instructional Material: In the present research, the researcher developed instructional plan based on Co-operative Learning Model and Conventional Lecture Method. In the present research, instructional plan on chapters on linear equations in two variables, graphs, ratio and statistics was developed. The techniques used under Co-operative Learning Model in the present investigation included Jigsaw Technique and Think-Pair-Share.

The researcher obtained permission from two selected schools for administering the tests and administering the treatment. The researcher first administered the pre-test and the Learning Goals Inventory to both, the experimental and control groups. After the pre-test, the experimental group was taught using the Co-operative Learning Model and the control group was taught using traditional lecture method. At the end of this, the post-test was administered on the students and scores were analyzed by using statistical techniques. The researcher has used this design as it was the most feasible one and the interpretation of the results has been cautiously done.

The students of standard IX of both the schools were taught selected topics in Mathematics subject. The content matter covered in both the schools was the same. The treatment was given on the basis of content from the text books prescribed by Maharashtra state text book production and curriculum research, Pune. In the experimental group, the researcher taught the content matter using the Cooperative Learning Model. Eighteen periods from the school time table were taken up to teach the content in each school. It was spread over fourteen working days. Six days per week were taken up for three weeks, teaching one to two school periods a day of thirty five minutes duration each. In the control group, the researcher taught using the traditional lecture method. The content was taught in both the schools in the mornings. The treatment included co-operative learning model in the experimental group and the lecture method in the control group.

Participants

In the present research, the sample selected consisted of 153 students – both boys and girls from standard IX of English medium schools situated in Greater Mumbai. The experimental group had 76 students out of which 40 (52.63 %) were boys and 36 were girls (47.37 %). The control group had 77 students out of which 39 (50.65 %) were boys and 38 (49.35 %) were girls. The schools selected for the study were affiliated to the SSC Board, Mumbai with English as the medium of instruction. The schools were selected randomly using lottery method. However, the experiment was conducted on intact classes due to reasons beyond the researcher's control.

Instruments

1. Researcher- made Achievement Test: The researcher prepared a pre-test to know the initial level of the students and a post-test to verify the result of the effect of co-operative learning model on the academic achievement of students. Each test consisted of 30 marks. The content and face validities of the achievements tests (pre-test and post-test) were ascertained and established. The discrimination index of both, the pre-test and the post-test were computed and were found to be ranging from 0.33 to 0.76. The difficulty index for the pre-test and the post-test were found to be ranging from 0.15 to .80.Its internal consistency reliability using Cronbach's Alpha and test-retest reliability were found to be 0.85 and 0.82 respectively for the pre-test and 0.82 and 0.78 respectively for the post-test. The parallel-form reliability between the pre-test and the post-test was found to be 0.88.

2. Learning Goals Inventory (Pandya, 2004) : This consists of 15 items each measuring students' learning goals, viz., performance v/s mastery goals. Its internal consistency

reliability using Cronbach's Alpha and test-retest reliability were found to be 0.81 and 0.79 respectively. The response categories of the inventory included Strongly Agree, Agree, Disagree and Strongly Disagree. The minimum and maximum possible scores on this inventory were 15 and 60 for each of the goals.

Data Analysis

Techniques of Data Analysis

The present research used statistical techniques such as the t-test, ANCOVA, two-way analysis of variance and wolf's formula. To compare the pre-test and post-test scores on academic achievement, the t-test was used. To compare the post-test score on academic achievement of students after partialling out the effect of pre-test scores, the technique of ANCOVA was used. Wolf's formula was used to measure the extent of effectiveness of the Co-operative Learning Model on the dependent variable, namely, academic achievement of students in Mathematics. Two-way ANOVA was used to study the interactive effect of Co-operative Learning Model and students' learning goals on the dependent variable, namely, academic achievement of students.

Major Findings of the Study

1. In case of comparing pre-test scores on academic achievement of students, the t-ratio was found to be 1.31 (Not significant at 0.05 level). Hence it may be said that the Mean pre-test score on academic achievement of students from EG (Mean = 5.28) and CG (Mean = 4.97) do not differ significantly.

2. In case of comparing post-test scores on academic achievement of students, the t-ratio was found to be 15.73 (significant at 0.01 level). Hence it may be said that the Mean post-test score on academic achievement of students from EG (Mean = 22.34) is significantly greater than that of the CG (Mean = 15.46).

3. When the technique of ANCOVA was applied to compare the post-test scores on academic achievement of students after partialling out the effect of pre-test scores, the F-ratio was found to be $F_{y.x} = 20.71$ (significant at 0.01 level). The Mean post-test score on academic achievement of students from the experimental group ($M_{y.x} = 26.91$) was found to be significantly greater than that of the control group ($M_{y.x} = 13.85$) (after controlling for the pre-test scores using ANCOVA.

4. For comparing the Mean academic achievement scores of students by treatment and learning goals, the technique of two-way ANOVA was used. Gain Scores in Mathematics were computed in terms of the difference between Post-Test Scores and the pre-test Scores and used for further analysis. The Mean Gain Score on AAMS of the experimental group (EG) for students with Performance Goal was 17.33 and that of the students with Mastery Goal was 25.96. The Mean Gain Score on AAMS of the control group (CG) for students with Performance Goal was 20.42 and that of the students with Mastery Goal was 13.74.The F-ratios for Treatment (F= 7.34), Learning Goals (F = 9.02) and Interaction Effect (F = 12.49) are significant at o.01 levels. Since the F-ratio's were found to be significant, the t-test was used to compare the Mean AAMS of students from the experiment and control groups and with different learning goals. It was found that the Mean AAMS (M = 17.06) of the experimental group is significantly greater than that of the control group (M = 10.49). The Mean AAMS of students with mastery goals (M = 16.47) is significantly greater than that of the students with performance goals (M = 12.81). The Mean AAMS of students with performance goals from the control group (M = 20.42) is significantly greater than that of experimental group (M = 17.33). The Mean AAMS of students with mastery goals from the experimental group (M= 25.96) is significantly greater than that of control group (M

=13.74). In other words, co-operative learning model is found to be more effective for students with mastery goals whereas the traditional method is found to be more effective for students with performance goals.

The following figure shows the interactive effect of the co-operative learning model and learning goals on the academic achievement of students in mathematics.
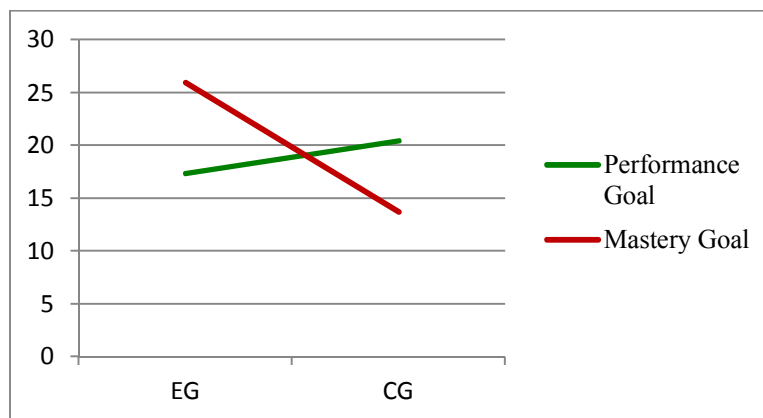
5. Computation of the Magnitude of the Effect Size Using Wolf's Formula

Dependent Variable	Effect Size
Academic Achievement	1.72

The effect of the treatment on academic achievement of students is maximum since the effect size computed using Wolf's formula is more than 0.8.

Conclusions

It may be concluded that: The Mean pre-test score on academic achievement of students from the experimental group does not differ significantly from that of the control group.

The Mean post-test score on academic achievement of students from the experimental group is found to be significantly greater than that of the control group.The Mean post-test score on academic achievement of students from the experimental group is found to be significantly greater than that of the control group even after partialling out the effect of the pre-test scores.i.e. the co-operative learning model has been found to be effective in enhancing academic achievement of students. The Mean academic achievement score of students with mastery goals is significantly greater than that of the students with performance goals. Co-operative learning model is found to be more effective for students with mastery goals whereas the traditional lecture method is found to be more effective for students with performance goals.The effect of the co-operative learning model on students' academic achievement is maximum.

Discussion and Implications of the Study

This present study contributed to an understanding of how Co-operative Learning Model could be used effectively for teaching of Mathematics. Students with performance goals are usually more competitive and rely on rote learning and therefore benefit more by the traditional lecture method which is teacher-centred and does not require independent thinking and efforts from the students. Also, performance goals have been associated with less adaptive patterns. Thus, students

with performance goals have found the traditional method of teaching to be more effective. On the other hand, students having predominantly mastery goal are more intrinsically motivated and try to understand the class materials rather than solely focus on earning a high grade and that is why they would work hard to learn. Since mastery goals have been associated with adaptive patterns of behaviour such as adaptive motivation, emotional well-being, cognitive engagement and achievement, the co-operative learning model is found to be more effective for students with mastery goals. Prior research has shown that help-seeking behaviour (a way to consider peers as a resource) is linked to mastery goal orientation (Karabenick, 2003; Middleton &Midgley, 1997; Ryan &Pintrich, 1997). Help seeking also appears more frequently and is more efficient in mastery contexts (Butler &Neuman, 1995; Ryan, Pintrich&Midgley, 2001). Co-operative learning involves seeking help from peers and thus, co-operative learning model is found to be more effective by students with mastery goals. In contrast, performance-focused individuals perceive the other as a threat (Jagacinsky& Nicholls, 1987; Ryan &Pintrich, 1997). Therefore, they consider help-seeking behaviour as an indication of low ability (Butler &Neuman, 1995), and avoid this behaviour (Karabenick, 2003; Ryan &Pintrich, 1997). Thus, the traditional method of teaching is found to be more effective in students with performance goals.

As the teacher education institutions in India advocate constructivist approach to teaching-learning process, of which, co-operative learning is an important part, it is imperative that nurturing mastery approach goal orientations in teacher education courses emerges as a significant theme to highlight. For teachers to create educational environments supporting mastery approach goal orientation, encouraging academic interest in classroom materials and improvement in students' performance as compared to their own previous performance and being flexible about failures and mistakes (Fryer and Elliot, 2008) can provide much better academic, social and psychological benefits to students.

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