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SUMMARY, CONCLUSIONS AND SUGGESTIONS

This chapter presents the summary of the study. It gives an outline about various aspects such as, procedure adopted for the study, conclusion based on the findings in brief, together with suggestions for improving educational practice and for further research.

6.1 THE STUDY IN RETROSPECT

The present study aims to experiment the reflective thinking strategy of teaching, and measures its impact on certain cognitive and affective variables among secondary school students.

6.2 PROCEDURE OF THE STUDY

The study conducted aimed to experiment on the effectiveness of reflective thinking strategy of teaching over conventional method of direct instruction on certain cognitive and affective variables among secondary school students. The procedure adopted for the study is as given below:

i. Application of achievement test in chemistry, metacognitive awareness inventory, test on innovative attitude and test on fear of success as Pre test for both experimental and control group.
ii. Learning through reflective thinking strategy of teaching by the experimental group.

iii. Learning through conventional method of direct instruction by the control group.

iv. Application of achievement test in chemistry, metacognitive awareness inventory, test on innovative attitude and test on fear of success as post test for both experimental and control group.

v. Application of test on creativity as post tests for the experimental group alone.

**Pre Test Conducted**

Before starting the experiment, the investigator administered the achievement test constructed in chemistry, metacognitive awareness inventory, test on innovative attitude and test on fear of success as pre test to both experimental and control groups on same days in adjacent periods. The scores collected from the answer sheets after evaluations were subjected to statistical analysis.

**Learning by Experimental Group**

The study comprised of two groups experimental and control. The experimental group was instructed through
reflective thinking strategy of teaching. At the outset, the investigator described the modus operandi of reflective thinking strategy of teaching, the way to administer the reflective thinking tool after each class and also briefed about the contents to be studied using the new strategy.
Learning by Control Group

The control group was taught through conventional method of direct instruction. Equal efforts and interest were taken to complete the teaching of the control group as in the experimental group.

Post Test Conducted

Immediately after the completion of teaching in both experimental and control groups the investigator once more administered the same achievement test in chemistry to both groups. Prior information regarding the date of conducting the test was given and the tests were administered to both the groups on the same days in adjacent periods under the supervision of the investigator. The scores obtained after evaluation of the answer sheets were then subjected to statistical analysis. The investigator finally administered a test on creativity as post test to experimental group alone to find out whether reflective thinking strategy of teaching is equally effective for children with different levels of creativity.

6.3 OBJECTIVES OF THE STUDY

The present study aimed to achieve the following objectives.
1. To prepare ‘lesson transcripts’ based on reflective thinking strategy of teaching – chemistry – at secondary school level.

2. To prepare ‘reflective thinking tool’ to support the reflective thinking strategy of teaching – chemistry – at secondary school level.

3. To find out the effectiveness of reflective thinking strategy of teaching on certain cognitive variables among secondary school students.
   a. To compare the effectiveness of reflective thinking strategy of teaching with that of conventional method of direct instruction in terms of ‘achievement in chemistry’ among secondary school students.
   b. To compare the effectiveness of reflective thinking strategy of teaching with that of conventional method of direct instruction in terms of ‘metacognitive awareness’ among secondary school students.

4. To find out the effectiveness of reflective thinking strategy of teaching on certain affective variables among secondary school students.
a. To compare the effectiveness of reflective thinking strategy of teaching with that of conventional method of direct instruction in terms of ‘innovative attitude’ among secondary school students.

b. To compare the effectiveness of reflective thinking strategy of teaching with that of conventional method of direct instruction in terms of ‘fear of success’ among secondary school students.

5. To verify whether the reflective thinking strategy of teaching is equally effective on the performance of secondary school students with different levels of creativity.

6.4 HYPOTHESES OF THE STUDY

The hypotheses formulated for the present study are:

1. Achievement in cognitive variables among secondary school students taught through reflective thinking strategy of teaching is higher than that of students taught through conventional method of direct instruction.

2. Achievement in affective variables among secondary school students taught through reflective thinking strategy of
teaching is higher than that of students taught through conventional method of direct instruction.

3. Reflective thinking strategy of teaching is equally effective on the performance of pupils with different levels of creativity.

6.5 METHODOLOGY IN BRIEF

The present study aims to test the effectiveness of reflective thinking strategy of teaching over conventional method of direct instruction, with special emphasis on certain cognitive and affective variables at secondary school level.

Investigator in the present study has adopted a non-equivalent pre test - post test design. Subjects cannot be randomly assigned to any condition in this type of experiment but are assigned to a particular condition based on some inherent characteristics. This design uses two non-equivalent groups, one group named as the experimental group - taught through reflective thinking strategy of teaching and the other as control group - taught through conventional method of direct instruction. In classroom experiments where experimental and control groups are intact classroom groups, this design is normally used.
6.6 MATERIALS AND TOOLS EMPLOYED IN THE STUDY

The tools and materials prepared and used by the investigator in the present study consisted of ‘lesson transcripts’ and ‘teaching materials’ for the reflective thinking strategy of teaching and conventional method of direct instruction, an ‘achievement test’ on chemistry units ‘solutions’ and ‘acids and bases’ from the VIII standard science text book of Kerala state, ‘reflective thinking tool’, ‘metacognitive awareness inventory’, ‘test on fear of success’, ‘test on innovative attitude’ and ‘test on creativity’.

6.7 CONCLUSIONS BASED ON FINDINGS

The major conclusions arrived at on the basis of the statistical analysis of data is comprehended below under different subheads.

1. Reflective thinking strategy of teaching is more effective than conventional method of direct instruction for the achievement of cognitive variables among secondary school students.

a) Reflective thinking strategy of teaching is more effective than conventional method of direct instruction for the achievement in chemistry among secondary school students.
Summary, Conclusions and Suggestions

This conclusion is substantiated by the following findings of the study.

I. The analysis of post test scores of experimental group and control group on the basis of critical ratio (CR = 3.12; p < .01) showed that the difference between their means is statistically significant. The mean post test scores of experimental group taught through reflective thinking strategy of teaching ($M_1 = 38.39$) was found to be greater than that of control group taught through conventional method of direct instruction ($M_2 = 35.58$). This shows that the experimental group is superior to control group.

II. The gain in scores of experimental group and control group when subjected to analysis of critical ratio (CR = 3.34; p < .01) showed that there is significant difference between their achievements on the mean gain scores, ($M_1 = 33.68$; $M_2 = 31.01$). The data thus emphasises the superiority of experimental group over control group.

III. The analysis of variance of pre test and post test scores of pupils in experimental and control group showed that there is significant difference between the two groups, ($F_\gamma = 9.77$;
p < .01). This indicates the supremacy of experimental group over the control group.

IV. The analysis of covariance of pre test and post test scores of pupils in experimental group and control group showed that there is significant difference between the means of the post test scores of the two groups (F_{yx} = 10.90; p < .01). This implies that the experimental group excels control group in achievement.

V. The comparison of the adjusted means of the post test scores of pupils in experimental group and control group shows that the difference between them is statistically significant. (The adjusted mean of the posttest scores of experimental group is 38.30 and that of the control group is 35.66). The obtained t value is significant (t = 3.30; p < .01) and this confirms that the experimental group overpowers the control group in their performance.

b) **Reflective thinking strategy of teaching is more effective than conventional method of direct instruction for improving metacognitive awareness among secondary school students.**

This conclusion is substantiated by the following findings of the study.
I. The analysis of post test scores of experimental group and control group on the basis of critical ratio (CR = 2.14; p < .05) showed that the difference between their means is statistically significant. The mean post test scores of experimental group taught through reflective thinking strategy of teaching ($M_1 = 291.68$) was found to be greater than that of control group taught through conventional method of direct instruction ($M_2 = 279.82$). This shows that the experimental group is superior to control group.

II. The gain in scores of experimental group and control group when subjected to analysis of critical ratio (CR = 3.29; p < .01) showed that there is significant difference between their achievements on the mean gain scores, ($M_1 = 46.91$; $M_2 = 18.01$). The data thus emphasises the superiority of experimental group over control group.

III. The analysis of variance of pre test and post test scores of pupils in experimental and control group showed that there is significant difference between the two groups, ($F_y = 4.57$; $p < .05$). This indicates the supremacy of experimental group over the control group.
IV. The analysis of covariance of pre test and post test scores of pupils in experimental group and control group showed that there is significant difference between the means of the post test scores of the two groups ($F_{yx} = 11.00; \ p < .01$). This implies that the experimental group excels control group in metacognitive awareness.

V. The comparison of the adjusted means of the post test scores of pupils in experimental group and control group shows that the difference between them is statistically significant. (The adjusted mean of the post test scores of experimental group is 292.95 and that of the control group is 278.55). The obtained t value is significant ($t = 3.32; \ p < .01$) and this confirms that the experimental group overpowers the control group in performance.

2. Reflective thinking strategy of teaching is more effective than conventional method of direct instruction for the achievement of affective variables among secondary school students.

a) Reflective thinking strategy of teaching is more effective than conventional method of direct instruction for the development of innovative attitude among secondary school students.
This conclusion is substantiated by the following findings of the study.

I. The analysis of post test scores of experimental group and control group on the basis of critical ratio (CR = 2.19; p < .05) showed that the difference between their means is statistically significant. The mean post test scores of experimental group taught through reflective thinking strategy of teaching ($M_1 = 37.94$) was found to be greater than that of control group taught through conventional method of direct instruction ($M_2 = 36.34$). This shows that the experimental group is superior to control group.

II. The gain in scores of experimental group and control group when subjected to analysis of critical ratio (CR = 3.80; p < .01) showed that there is significant difference between their achievement on the mean gain scores, ($M_1 = 5.25$; $M_2 = 4.91$). The data thus emphasises the superiority of experimental group over control group.

III. The analysis of variance of pre test and post test scores of pupils in experimental and control group showed that there is significant difference between the two groups, ($F_y = 4.84$;
p < .05). This indicates the supremacy of experimental group over the control group.

IV. The analysis of covariance of pre test and post test scores of pupils in experimental group and control group showed that there is significant difference between the means of the post test scores of the two groups ($F_{yx} = 12.49; p < .01$). This implies that the experimental group excel control group in test on innovative attitude.

V. The comparison of the adjusted means of the post test scores of pupils in experimental group and control group shows that the difference between them is statistically significant. (The adjusted mean of the post test scores of experimental group is 38.23 and that of the control group is 36.06). The obtained t value is significant ($t = 3.55; p < .01$) and this confirms that the experimental group overpowers the control group in performance.

b) **Reflective thinking strategy of teaching is more effective than conventional method of direct instruction for dropping fear of success among secondary school students.**

This conclusion is substantiated by the following findings of the study.
I. The analysis of post test scores of experimental group and control group on the basis of critical ratio ($CR = 3.13; p < .01$) showed that the difference between their means is statistically significant. The mean post test scores of experimental group taught through reflective thinking strategy of teaching ($M_1 = 2.50$) was found to be greater than that of control group taught through conventional method of direct instruction ($M_2 = 1.44$). This shows that the experimental group is superior to control group.

II. The gain in scores of experimental group and control group when subjected to analysis of critical ratio ($CR = 2.46; p < .05$) showed that there is significant difference between their mean gain scores, ($M_1 = 3.47; M_2 = 3.02$). The data thus emphasises the superiority of experimental group over control group.

III. The analysis of variance of pre test and post test scores of pupils in experimental and control groups showed that there is significant difference between the two groups, ($F_y = 9.73; p < .01$). This indicates the supremacy of experimental group over the control group.
IV. The analysis of covariance of pre test and post test scores of pupils in experimental group and control group showed that there is significant difference between the means of the post test scores of the two groups ($F_{yx} = 10.75; p < .01$). This implies that the experimental group excels control group on dropping fear of success.

V. The comparison of the adjusted means of the post test scores of pupils in experimental group and control group shows that the difference between them is statistically significant. (The adjusted mean of the post test scores of experimental group is 2.51 and that of the control group is 1.44). The obtained $t$ value is significant ($t = 3.24; p < .01$) and this confirms that the experimental group overpowers the control group in performance.

3. Reflective thinking strategy of teaching is equally effective on the performance of secondary school students with high, average and low levels of creativity.

This conclusion is substantiated by the following findings of the study.

The analysis of variance of gain scores of the three groups of pupils with high, average and low levels of creativity showed
that there is no significant difference between the groups with regard to their achievement. The obtained F value is not significant \( F = 0.036; \) \( df = 2, 103, p > .10 \) and this confirms that the reflective thinking strategy of teaching is equally effective for pupils irrespective of their level of creativity.

### 6.8 TENABILITY OF THE HYPOTHESES

The first hypothesis formulated by the investigator states that “Achievement in cognitive variables among secondary school students taught through reflective thinking strategy of teaching is higher than that of students taught through conventional method of direct instruction”. The gain scores of students in the experimental group in both the cognitive variables ‘achievement in chemistry’ and ‘metacognitive awareness’ are significantly higher than that of the students in the control group. The findings of the study thus substantiate the first hypothesis, and the hypothesis stands accepted.

The second hypothesis formulated by the investigator states that “Achievement in affective variables among secondary school students taught through reflective thinking strategy of teaching is higher than that of students taught through
conventional method of direct instruction”. The gain scores of students in the experimental group in both the affective variables ‘innovative attitude’ and ‘fear of success’ are significantly higher than that of the students in the control group. The findings of the study thus substantiate the second hypothesis and the hypothesis stands accepted.

The third hypothesis formulated by the investigator states that “Reflective thinking strategy of teaching is equally effective on the performance of pupils with different levels of creativity”. The gain scores of the three groups of pupils with high, average and low levels of creativity showed that there is no significant difference between the groups with regard to their achievement. The findings of the study thus substantiate the third hypothesis and the hypothesis stands accepted.
6.9 DISCUSSION BASED ON FINDINGS

Based on the above findings of the study, reflective thinking strategy of teaching is found useful to learners in mounting their attainments in both cognitive and affective variables. The study proved the impact of reflective thinking strategy in raising the students’ attainment in cognitive variables such as achievement in chemistry and metacognitive awareness. In case of affective variables, the study proved to be useful in raising their innovative attitude and in reducing their fear of success. The study also proved that the reflective thinking strategy of teaching was of equal help to students having different levels of creativity.

The findings of the study are in tune with the expectations of the investigator. Reflective thinking strategy of teaching is an answer to the problems faced by the present day teachers; this strategy offers teachers new ways to make students active in the learning process. It helps pupils to understand their own thought processes and the ways through which each one learn. This strategy helps students understand that learning is learning to learn. Thus, the findings of the study make it clear that this strategy will be of great help to both teachers and students in improving their teaching and learning processes and is of great
help in developing the cognitive aspects of the students like achievement in chemistry and metacognitive awareness.

Reflective thinking strategy of teaching provides opportunities for individual as well as co-operative activities and this would help students develop their affective variables. This strategy offers students first hand opportunities to understand how others think and act. Definitely, this might have helped them in developing innovative attitude and in reducing their fear of success.

The investigator tried out both individual and group type activities in the study and the results show that these ‘simple and easy to use’ strategies can enhance students’ learning, as well as make classroom teaching impressive, simple and effective. The type of reflective activities used in the present study can make any normal classrooms alive in a short span of time and this might have helped in intensifying the performance of students.

The reflective thinking tool used in the study was of great use in helping students reflect systematically and deliberately. This type of tools if prepared can promote reflective practices in classrooms and will definitely lead to better achievement.
Any resource material ranging from technological to improvised, which can facilitate student reflection can be easily adapted to this strategy of teaching. Thus, it dose not restrict teachers freedom of choice in selecting teaching learning materials and this would have been one of the factors that contributed to the excellence of students.

6.10 EDUCATIONAL IMPLICATIONS

The findings of the study show that, reflective thinking strategy of teaching is effective in enhancing achievement, metacognition, innovative attitude and in reducing fear of success. This finding has great importance in the teaching of science; it helps to reduce the number of under achievers, dropouts and failures.

The study also proved that reflective thinking strategy of teaching is equally effective for students having different levels of creativity. This finding of the study implies that this strategy is effective for learners irrespective of their initial abilities.

Reflective thinking strategy of teaching gives teachers enough freedom to choose activities and materials of varying forms, and this help in planning the classroom activities according to the needs and interest of the pupils.
Experience from individual as well as group activities helps students to gain insight about one’s own thought processes as well as of others, this help student’s gain new perspectives in learning processes.

Almost all reflective strategies are easy to adopt and curriculum framers should consider this, addition of reflective activities to the existing curricula is easy during periodic revisions, a serious outlook on this point would definitely enhance the effectiveness of the existing curricula.

The study thus recommends the following.

i. Pre-service and in-service teacher training programmes should focus on the importance of reflective practices in order to make our schools better in the future.

ii. National and state level, curriculum framers should take steps to make educators aware of the potential of reflective practices by arranging seminars and workshops.

iii. Professional organisations should take initiative to spread the significance of reflective practices in teaching and learning by organising training programmes.

iv. Computer based instructional materials can easily be made incorporating the views of reflective practices, steps should
be taken by educational bodies to incorporate this idea while preparing educational software.

v. Reflective classroom practices has to be given prominence, it has to be deliberately infused before, during and after every classroom activity.

vi. Our text books are to be revamped, incorporating systematic before, during and after reflective sessions.

6.11 SUGGESTIONS FOR FURTHER RESEARCH

The present study is a limited one due to many reasons like lack of time, sample size, subject, standard etc. Keeping in view the limitations of this study and the constraints under which it was conducted, the findings do not claim for wide generalisation. It is therefore suggested that:

i. Studies on a larger sample is needed to arrive at a more reliable and precise result.

ii. Studies based on achievement have to be conducted by differing: age groups, subjects, medium of instruction etc.

iii. Studies at other levels like lower primary, upper primary, higher secondary and university has to be conducted.
iv. Similar studies can be conducted on high school physics or chemistry as a whole widening the sample size so that the study would help to get a clearer picture of the effectiveness and adaptableness of reflective thinking strategy of teaching.

v. Studies on on-line and web enhanced learning based on reflective activities have to be attempted.

vi. Effect of reflective thinking strategy on some other cognitive and affective variables can be tested.

vii. Studies to enquire about the attitude of teachers towards reflective classroom practices have to be undertaken.

viii. Studies seeking opinion about the reflective practices can be undertaken to find out the opinion of authorities, teachers, students, parents etc.

ix. Studies can also be undertaken to find out the effect of reflective practices on professional development among teachers.