Effects of Select Instructional Practices on Improving the Achievement of Low Achievers

Binulal.K.R

Assistant Professor in Education, Mount Tabor Training College, Pathanapuram, Kollam, Kerala

Abstract- The major goal of science education today is fostering students' intellectual competencies, such as independent learning, problem-solving, decision-making and critical thinking. In order to achieve this, science teaching must be shifted from traditional schooling to more constructivist-oriented instruction. The aim of this study was to find out the effects of various instructional practices such as problem based learning, 5 E model instruction and portfolio writing practices on enhancing the achievement of low achievers. Pre test- post test parallel group design was adopted for the present study. The sample consisted of 120 low achievers, where 90 students were categorised in three experimental groups and 30 students in control group. Instructional materials were prepared based on the topic from 8th standard science text book according to the nature of instructional strategies selected. The major finding of the study is that the select instructional strategies are more effective than the traditional method of teaching science. Among the instructional practices, the problem based learning practice is more effective in enhancing the achievement of low achievers.

Index Terms- Problem based learning, 5-E model instruction, portfolio writing, low achievers.

I. INTRODUCTION

This article guides a stepwise walkthrough by Experts for writing a successful journal or a research paper starting from inception of ideas till their publications. Research papers are highly recognized in scholar fraternity and form a core part of PhD curriculum. Research scholars publish their research work in leading journals to complete their grades. In addition, the published research work also provides a big weight-age to get admissions in reputed varsity. Now, here we enlist the proven steps to publish the research paper in a journal.

Rapid changes in the world including technological advancements influence the science and as a consequence the interaction between the science and the society has been changing as well. It has a large impact in developing the ethical and moral values of the society we live in. The research in this area finds wide scope as the scientific progress made the technological developments possible. In the present society, scientific and technological innovations increasingly permeate almost every aspects of daily life. In a world based on science and technology, it is education that determines the level of prosperity, welfare and security of the people.

It is essential to make science education effective and relevant for a large and necessarily more diverse fraction of the population. To do so, we need to transform how students think so that they can understand and use science like scientists do. Effective teaching facilitates that engaging students in thinking deeply about the subject at an appropriate level and then monitoring that thinking guiding it to more expert like. The achieving of scientific literacy should be considered to be almost as important as achieving basic literacy. Conventional science teaching relied heavily on lectures, reading, and teacher led demonstrations.

II. RATIONAL FOR THE STUDY

The major goal of science education today is fostering students' intellectual competencies, such as independent learning, problem-solving, decision-making and critical thinking (American Association for the Advancement of Science (AAAS), 1994; National Research Council (NRC), 1996). In order to achieve this, science teaching must be shifted from traditional schooling to more constructivist-oriented instruction. Teaching has to be restricted to posing questions for the student to answer and to creating situations to facilitate discovery by the student. The purpose of science education is not simply to produce the next generation of Scientist, but it can spread basic scientific literacy throughout our population so that wise decisions can be reached about how to address the problems-global as well as local- we are facing today. Traditional science instruction concentrates on teaching factual knowledge, but it lacks the mental organisational structure that facilitates the retrieval and effective application of that knowledge. A significant community of science education researchers is experimenting various approaches to the development and testing of new pedagogical methods. Here the investigator attempts to investigate the effect of select instructional strategies on improving the understanding of science concepts. And the target population is low achievers. Low achievers are neglected minority owing to their poor academic achievement in school (Coren, 1992). They often face discrimination from peers. In general, low achievers' self perception of academic ability is significantly lower than peers. Under the existing school system, school authorities did not arrange remedial programmes for low achievers to promote their academic excellence. Thus, teacher interaction with low achievers is less motivating and less supportive. Hence the investigator proposed to conduct the experiment on low achievers.

The significance of this study lies in its potential to contribute to the literature and to educational practice related to science teaching, with special focus on instruction aimed at promoting the cognitive processes of low achievers in the classroom.

Review of related literature

Ridlon (2009) used two different instructional approaches for teaching mathematics through problem centred approach. Year 1 involved low achievers, whereas Year 2 was mixed ability students. The experimental treatment was a problem-centered approach (PCL) where potentially meaningful tasks were posed to the class and solved in collaborative groups. The groups presented and defended their solution strategies to their peers. Regardless of perceived ability level, the PCL approach appeared to significantly enhance achievement and improve attitude towards mathematics. Low achievers seemed to gain the most, narrowing the gap between them and their mixed ability peers. PCL appeared useful with any curriculum if the teacher understood and properly implemented the components of the approach.

Wu and Tsai (2005) conducted a study to explore the effects of long-term constructivist-oriented science instruction on elementary school students' process of constructing cognitive structures. Furthermore, such effects on different science achievers were also investigated. The findings showed that the students in the constructivist-oriented instruction group attained significantly better learning outcomes in terms of the extent and integration of their cognitive structures, metacognition engagement and the usage of information processing strategies. Moreover, it was also revealed that both high achievers and low achievers benefited from the constructivist-oriented instructional activities, but in different ways.

Wolf (1989) pointed out that students need time to study their works and to select the pieces that best exemplify what they have learned; thus the writing portfolio represents what learning has taken place during the duration of the class. Murphy (1998) claims that the time students spend selecting writings to be included in portfolios leads to reflection, a necessary part of portfolios. Further, portfolios give a more accurate representation of the writing accomplishments or shortcomings of a student and a teacher.

Hawkins (1988) studied the changing practices in classrooms to improve the behavior of low achievers. The effects of a package of instructional methods on the academic achievement, behaviour and social bonding of 77 experimental and 83 control students in grade seven who were low achievers in math are described. The potential for preventing discipline problems through promoting sound teaching practices in mainstream classrooms is reviewed in the study.

III. STATEMENT OF THE PROBLEM

Review of related literature revealed that there are limited studies associated with the academic performance of low achievers. Further, the investigator, as a teacher educator experienced many behavioural and academic problems faced by the slow learners during the school visits. Hence the present study is an attempt to analyse the influence of various instructional strategies for improving the academic performance of low achievers.

The problem for the present study can be entitled as 'Effects of select instructional practices on improving the achievement of low achievers'.

Here the select instructional practices are problem based learning, 5-E model instruction and portfolio writing practices.

Theoretical Framework

Problem-based learning *(PBL)*: It is an instructional method in which students learn through facilitated problem solving. In problem based learning, student learning centers on a complex problem that does not have a single correct answer. Students work in collaborative groups to identify what they need to learn in order to solve a problem. They engage in self-directed learning and then apply their new knowledge to the problem and reflect on what they learned and the effectiveness of the strategies employed. The teacher acts to facilitate the learning process rather than to provide knowledge. Research studies suggest that problem based learning is an instructional approach that offers the potential to help students develop flexible understanding and lifelong learning skills.

5-E Model Instruction: It helps the students to use the process skills of science to develop an understanding of the scientific concepts. It involves engage, explore, explain, elaborate and evaluate.

Engage: Brings the student's mind into the frame to learn something new

Explore: Provides a common experience for all students and helps the teacher identify prior knowledge

Explain: Here the student constructs an explanation. The teacher provides information to increase the accuracy of the explanation.

Elaborate: Builds on current understanding to increase the depth and breadth of understanding

Evaluate: Provides an opportunity for students to assess their own understanding and be able to demonstrate the depth and breadth of that understanding to others.

Portfolio Writing: Portfolios invite 'introspection'. They are both receptacles and vehicles for individual reflection. But reflection in learning is much more than introspection. Portfolio reflection provides a way to 'make learning visible'. This 'visible learning' becomes the basis for conversations and other interactions among students and teachers and parents. Portfolios have an audience, so does reflection. Reflection involves more than just 'looking back'; it occurs before, during, and after reading and writing or learning process.

IV. RESEARCH QUESTIONS

1. How do the instructional practices affect the achievement of low achievers?
2. Which instructional strategy has the most significant effect on the achievement?
3. Whether the instructional practices have any effect on gender?

V. RESEARCH METHODOLOGY

Design*:* In the present study the investigator adopted experimental method- pre test post test parallel group design. Here the investigator used three experimental groups, receiving

the treatment based on three instructional practices problem based learning, 5-E model instruction, portfolio writing practices respectively. And the control group had the traditional way of teaching.

Sample: At the initial stage of the sample selection 300 8th standard students were selected from two schools from Kollam district. They were exposed to the pre test and 120 low achievers were identified using 'sigma distances' (M-σ). Out of the 120 low achievers, 90 students were randomly selected and allotted in three experimental groups and 30 in control group, giving due representation to gender.

Instruments: Personal data sheet, achievement test based on the selected topic from science, teaching-learning materials based on select instructional practices.

Topic: The investigator has selected the topic 'Force-internal force, external force, balanced force, unbalanced force, Newton's First law, Inertia' for preparing instructional materials for the present study (8th standard science text book).

Procedure*:* The achievement test in science was administered (pre test) on the students under study and low achievers were identified. The identified low achievers were grouped into three experimental groups and one control group. The experimental groups were taught using the select instructional practices, while the control group was taught using the conventional method.

Problem based learning: Students are at the center of learning when teachers implement problem based learning. First, a problem or a topic of discussion is presented to stimulate student interest. Then students were asked to work in small groups to investigate the problem. As the process progresses, the students were given opportunity to challenge their ideas by other group members or by the teacher if necessary. The process is cyclical and repeated several times as new information is learned and ideas have been modified to generate new learning needs. Thereby the scientific facts and concepts were taught indirectly by integrated within the scientific process.

5-E model instruction: The 5 E learning cycle model requires instruction to include the following discrete elements: engage, explore, explain, elaborate and evaluate. The *engage* component in the model is intended to capture students' attention. Here the teacher engages students by creating surprise or doubt through a demonstration.

The *explore* phase of the learning cycle provides an opportunity for students to observe, record data, isolate variables, design and plan experiments, create graphs, interpret results, develop hypotheses, and organize their findings. Here the teacher frame questions, suggest approaches, provide feedback and assess understandings.

Students are introduced to models, laws, and theories during the *explain* phase of the learning cycle. Then the teacher guides students toward coherent and consistent generalizations, helps students with distinct scientific vocabulary and provides questions that help students use this vocabulary to explain the results of their explorations.

The *elaborate* phase of the learning cycle provides an opportunity for students to apply their knowledge to new domains, which include raising new questions and hypotheses to explore. Here the teacher includes related numerical problems for students to solve.

The *evaluate* phase of the learning cycle continues to include both formative and summative evaluations of student learning. Here teacher use tests to evaluate the concepts discussed. Tests include questions from the lab and ask students questions about the laboratory activities. Students were asked to interpret data from a lab similar to the one they completed and also to design experiments as part of their assessment.

Portfolio writing practices: Portfolios are known as the thinking journals, because it reflects the whole thinking process of a student in the class. It helps the student to think upon their activities while learning. Once the instruction was over, the investigator asked the students think on what they have learned in the class. Then the students were trained to write their understandings, suggestions and doubts they came across while learning .There by the students were able to recapitulate the content. In order to practice the students in writing portfolios, the teacher asked them to write it after each class. Thus the students were aware of the importance of writing portfolios. Also by reviewing the portfolios the teacher understood that students were tuned in such a way that portfolios enhanced their understanding of the concepts.

The same tests were administered again and the pre test-post test scores were compared to test the effectiveness of the select instructional practices implemented. The data thus obtained were analysed using appropriate statistical techniques and interpreted accordingly.

VI. RESULTS

Table 1- Significance of difference between mean pre test scores of the control and experimental group 1 (Problem Based Learning)

Group	N	Mean	S.D	t-test	Level of significance
Control group	30	4.93	1.01	1.08	NS
Experimental group 1	30	5.23	1.13		

NS- Not Significant

Table 2- Significance of difference between mean pre test scores of the control and experimental group 2 (5-E model instruction)

Group	N	Mean	S.D	t-test	Level of significance
Control group	30	4.93	1.01	0.38	NS
Experimental group 2	30	5.03	0.99		

NS- Not Significant

Table 3- Significance of difference between mean pre test scores of the control and experimental group 3 (Portfolio writing practices)

Group	N	Mean	S.D	t-test	Level of significance
Control group	30	4.93	1.01	0.64	NS
Experimental group 3	30	5.10	0.99		

NS- Not Significant

From tables 1, 2 and 3, the obtained t-values 1.08, 0.38 and 0.042 are less than the critical value 1.96 at 0.05 level of significance. It implies that the difference in the achievement test scores is not significant. This reveals that there is no difference in the achievement scores of control group and experimental groups before giving treatments.

Table 4- Significance of difference between mean post test scores of the control and experimental group 1 (Problem Based Learning)

Group	N	Mean	S.D	t-test	Level of significance
Control group	30	12.3	1.74	11.8	0.01
Experimental group 1	30	17.9	1.92		

The calculated t-value 11.83 is very much greater than the critical value 2.58 at 0.01 level of significance. It implies that the difference between mean is statistically significant. This reveals that experimental group 1 is superior to the control group in post test achievement scores.

Table 5- Significance of difference between mean post test scores of the control and experimental group 2 (5-E model instruction)

Group	N	Mean	S.D	t-test	Level of significance
Control group	30	12.3	1.74	7.11	0.01
Experimental group 2	30	15.1	1.27		

The calculated t-value 7.11 is very much greater than the critical value 2.58 at 0.01 level of significance. It implies that the difference between mean is statistically significant. This reveals that experimental group 2 is superior to the control group in post test achievement scores.

Table 6- Significance of difference between mean post test scores of the control and experimental group 3 (Portfolio writing practices)

Group	N	Mean	S.D	t-test	Level of significance
Control group	30	12.3	1.74	6.21	0.01
Experimental group 3	30	14.6	1.04		

The calculated t-value 6.21 is very much greater than the critical value 2.58 at 0.01 level of significance. It implies that the difference between mean is statistically significant. This reveals that experimental group 3 is superior to the control group in post test achievement scores.

From tables 4,5 and 6 it is also clear that highest mean value (17.9) obtained for the treatment, problem based learning. Hence it can be considered as superior to other two treatments in improving the achievement of low achievers.

Table 7- Significance of difference between the post test scores of experimental groups with respect to Gender

Experimental Groups	Variable	Category	N	Mean	S.D	t-test	Level of significance
Group 1	Gender	Boys	16	17.5	1.86	1.23	NS
		Girls	14	18.3	1.94		
Group 2	Gender	Boys	18	15.1	1.47	0.23	NS
		Girls	12	15.2	0.94		
Group 3	Gender	Boys	16	14.5	1.26	0.56	NS
		Girls	14	14.7	0.73		

NS- Not Significant

The calculated t-values 1.23, 0.23 and 0.56 are less than the critical value 1.96 at 0.05 level of significance. This indicates that the difference in the post test achievement scores the three experimental groups is not significant. That is the treatments have no effect on gender.

Summary of Findings

The major finding of the study is that the select instructional strategies are more effective than the traditional method of teaching science. Among the instructional practices, the problem based learning practice is more effective in enhancing the achievement of low achievers. Also the treatments have no effect on the variable, gender.

VII. EDUCATIONAL IMPLICATIONS

The present study revealed that problem based learning can be considered as one of the most viable technique to individualise instruction in improving the academic performance of low achievers. In the light of research findings, it is felt that the results may contribute to alleviation of difficulties of the students in approaching science concepts. Students start to see how the knowledge they learn helps them to solve problems in life, therefore giving them a love for learning and turning them into lifelong learners. As education learns to embrace this new type of teaching, teachers will have to learn to give the control of the problem and the classroom to the students. The challenge in the present day science is to develop a mindset to boost up the standards of scientific research. And it is the sole responsibility of the stakeholders and researchers in all fields to make it happen by implementing more effective pedagogical practices.

REFERENCES

[1] Best, J.W & Kahn, J,V. (2004). Research in Education. New Delhi: Prentice Hall of India Private Ltd.

[2] Bruner, J. (1960). The process of education. Cambridge, MA: Harvard University Press.

[3] Cardelle-Elawar, M. (1995). Effects of metacognitive instruction on low achievers in mathematics problems. Teaching and Teacher Education, 11(1), 81-95.

[4] Hawkins, J. David. (1988). Changing Teaching Practices in Mainstream Classrooms to Improve Bonding and Behavior of Low Achievers. American Educational Research Journal. Vol. 25(1). P31-50. EJ383263.

[5] Marklin Reynolds, Jeanie & Hancock, Dawson. (2010). Problem based learning in a higher education environmental biotechnology course. Innovations in Education and Teaching International. V 47(2), p175-186.

[6] Resnick, L. B. (1987). Learning to think. Washington, DC: National Academy Press. Ridlon, L. Candice. (2009). Learning mathematics via problem cantered approach: Two year study. Mathematical thinking and learning: An international journal. Vol.11(4). P188-225. EJ870639.

[7] Wu, YingTien and Tsai, ChinChung. (2005). Development of elementary school students' cognitive structures and information processing strategies under Long-Term Constructivist-Oriented science instruction. Science Education. Vol. 9(5). P822-846. EJ759943.

AUTHORS

First Author – Binulal. KR, Assistant Professor in Education, Mount Tabor Training College, Pathanapuram, Kollam, Kerala