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Review Article

EFFECT OF ADVANCE ORGANIZER MODEL OF TEACHING ON SCIENCE PROCESS SKILLS, SCIENTIFIC ATTITUDE AND ACADEMIC ACHIEVEMENT

***Dr. Sharmila L. Mascarenhas and Dr. SrLeonilla Menezes, A.C.**

St Ann's College of Education (Autonomous), Mangaluru, Dakshina Kannada District, Karnataka, India

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Abstract

In the present study, the researchers aimed to study the effect of Advance Organizer Model of Teaching on Science Process Skills, Academic Achievement and Scientific Attitude among the Higher Secondary School Students with different Levels of Intelligence. The experimental design was the post test only parallel group design. An instructional material was prepared using the Advance Organizer Model of Teaching. The sample included sixty six students of Second Year Pre University. ANCOVA was used for data analysis. The results were significant. The study has wide applications at the Higher Secondary level

Keywords: Advance Organizer Model of Teaching, Science Process Skills, Scientific Attitude, Academic Achievement, Intelligence, Pre-achievement.

INTRODUCTION

Science Education forms an integral part of our school curriculum and affords awareness of scientific knowledge, achieving a significant goal of education. Science learning and the development of Science Process Skills are integrated activities. Science should be an indispensable part of the curriculum since it is the subject which affords knowledge of certain facts and laws and thus aids in achieving a significant goal of education. Science learning and the development of Science Process Skills are integrated activities. At the Higher Secondary level, the students are engaged in learning branches of science as separate disciplines, with special emphasis on practical work and in activities and analysis on issues surrounding environment and health. For effective Science learning to take place, various techniques must be adopted by a teacher considering learners' contextual knowledge, environment and learning goals thus cater to multiple learning styles to help students retain information and build up their comprehension. The learner will more easily establish connections between the content and his own life experience. The learner will develop self-confidence and self-awareness when learning takes place in the conversational mode. The learner will more easily establish connections between the content and his own life experience. Enforced accountability will gradually give way to a sense of responsibility, which means that there should be more emphasis on self-assessment and shared accountability. Diverse philosophical schools of thought in science provide with a framework to the academicians and teachers to plan and implement the instructions in Science and observe it in terms of students' progress. These philosophies must complement with students' learning styles. Research shows that students retain knowledge for a longer period of time when they are involved in hands on activities. Students widen their comprehension of Science by combining Scientific Knowledge with inquiry, analysis and thinking skills. The major trends in Science Education arise out of the revolution in Science teaching and Education. The approach to teaching and learning of Science refers to the process of delivering knowledge and transmitting specific skills to pupils by their teacher. The goal is student comprehension and their ability to apply the content and process of Science to daily life situations. Through oral methods, a science teacher can carry on intelligent and meaningful dialogue between himself and his pupils. If Science teaching is to improve, the teachers must become more aware of the alternatives to teaching facts through rote memory geared to the lowest level of reflection. Teachers need to have vision of their students' potential to perform at higher levels. A review of the prevalent methods of Science Teaching at the Secondary and Higher Secondary Stage is essential. This poses a great challenge for the Higher Secondary School teachers to meet the needs of students in a classroom setting characterized by multiple abilities, achievement, and social development, leading to increased demands on teacher's time and effort. Therefore the researcher determined to study the Effect of Advance Organizer Model of Teaching on Science Process Skills, Academic Achievement and Scientific Attitude of Higher Secondary School Students with different levels of Intelligence.

Corresponding Author:** ***Dr. Sharmila L. Mascarenhas
St Ann's College of Education (Autonomous), Mangaluru, Dakshina Kannada District, Karnataka, India.

THEORETICAL FRAMEWORK

Advance organizer model of teaching: David P. Ausubel, an unusual educational theorist formulated the Advance Organizer Model of Teaching. The Learning Theory of Meaningful Verbal Learning provides the base for this theory. The main purpose is to help students acquire subject matter. The Advance Organizer Model of Teaching is a deductive, expository, sequential and interactive teaching strategy designed to teach hierarchically organized content by strengthening cognitive structure of learners. Broad concepts or more inclusive ideas are placed at the top and narrow or less inclusive ideas are arranged at a lower level of hierarchy. Ausubel conceptualizes the discipline as levels of hierarchically organized concepts that begin with perceptual data at the bottom and proceeds through increasing levels of abstraction until the most abstract concept appear at the top so as to include less inclusive concept at lower stages of organization (Ausubel, 1963). Ausubel believes that students

need to be trained in the conceptual structure of each discipline which has to be identified and they then become an information processing system, which serves as an intellectual map, which can be used to analyze particular domain and solve problems within those domains of activities. (Joyce, Weil and Calhoun, 1978). The importance of the process of meaningful learning is emphasized by Ausubel. Material has to relate to established ideas in the cognitive structure of the learner, which enable the material to be learned in a logically coherent way. In order to accomplish this, the learner needs access during the learning process to structure ideas that can subsume the new material to be learned and incorporate into the cognitive structure of the learner and provide him with anchors for the new material. Any material, which can be organized intellectually, can be taught with the application of Advance Organizer Model. It can be used in any of the core subjects at the Secondary and Higher Secondary level. Critical thinking and cognitive reorganization can be explained to learners and they can apply these techniques independently to new learning. To facilitate both stability and meaning, one needs to create ideational linkage between the students' own cognitive structure and that of the discipline to be taught.

Science process skills: In many countries attempts have been made to re-orient the curriculum so as to give due importance to processes in science education. National Committee on Science Education Standards and Assessment (1994 Draft) advanced inquiry as an important standard for grades 9 through 12. Inquiry in the classroom is a means for promoting and supporting students' curiosity and questioning spirit. The science criteria framed by the evaluation system of General Certificate of Secondary Education (GCSE) also emphasise the development of skills. The National Council of Educational Research and Training, (NCERT) while planning the integrated science curriculum for the middle school students, identified the process approach as one of the core elements of the course. While discussing the philosophy of the integrated curriculum, the document Integrated Science Curriculum - an introduction (NCERT, 1982) states:

"... a science curriculum must stress more on.. . these processes than the products of science. The knowledge of the product is useful in understanding the processes of science and for concretizing the processes for pedagogical use. But understanding of the processes is useful both for daily life as well as in furthering scientific knowledge".

Nedelsky (1965) has classified the objectives of a physical science course referred to as Learning of Abilities, those related with symbolic subject matter and those related with real phenomena. Verbal and mathematical knowledge and understanding, intuitive understanding, laboratory understanding of phenomena and learning from observation and experiments are the abilities identified. Nay *et al.* (1971) identified five steps of scientific inquiry such as Initiation, Collection of Data, Processing of Data, Conceptualization of Data and Open endedness. Shepardson (1990) investigated on problem solving phase, student interactions and thinking skills. UNESCO Source Book for Science Teaching (1992) lists out the indications of process skills summarised as Observing, Raising questions, Hypothesizing, Finding patterns and relationships, Communicating effectively, Designing and making, Devising and planning investigations, Manipulating materials and equipment effectively, Measuring and calculating. The Commission on Science Education of the American Association for the Advancement of Science launched a programme named Science - A Process Approach (SAPA). The processes are carefully analyzed into eight basic processes such as Observing, Using Space/ Time, Classifying, Using Numbers, Measuring, Communicating, Predicting, Inferring and five Integrated processes such as Controlling variables, Interpreting data, Formulating hypotheses, Defining operationally and Experimenting

RATIONALE AND SIGNIFICANCE OF THE STUDY

Joseph Jeena, D'Souza Flosy (2008) revealed from their study that the Inquiry Training Model of Teaching Science was significantly effective in developing Science Process Skills. AKTAMIS Hilal and ERGIN Omer (2008) from their study revealed that Scientific Process Skills improve Scientific Creativity and Academic Achievement The study of Aruna and Sumi (2010) revealed that the Process Approach Teaching was effective for proper development and understanding of Process Skills in Science and also to develop or increase the Attitude towards Science. Remziye ERGUL *et al.* (2011) from their study showed that use of Inquiry Based Teaching Methods significantly enhances Students' Science Process Skills and Attitudes. Dange Jagannath *et al.* (2008) proved from their study that the Advance Organizer Model of Teaching was effective. Shihusa Hudson and Keraro Fred N. (2009) from their findings indicated that students taught using Advance Organizers had a higher level of motivation than those taught using conventional teaching methods. The study of Zaman Tanvir (2010) revealed that the post lab exercises helped students to link new learning to the existing knowledge and understanding, substantially supported by giving the confidence in the nature of Ausubel's theory of meaningful learning. Jadhav Vandana (2011) concluded that the Advance Organizer Strategy can be effectively used for teaching of Science. The Study conducted by Hooda Jai Parkash and Rani Sushma (2012) indicated that the students who were taught Biology through Science Inquiry Model and Advance Organizer Model had shown significant improvement in the self concept than the students who were taught through the conventional method. Agrawal Archana and Chaurasia Shweta (2012) in their study proved the Advance Organizer Model to be more effective. BabuRajendraNath M. and Reddy Dayakara V. (2013) from their study proved that the Advance Organizer Model was more effective than the conventional method of Teaching on Achievement of Students in Mathematics.

The review of the literature gives an insight to study the development of Science Process Skills by adapting various methods of teaching. Due to the importance of science process skills, many researchers have focused on this subject matter. At the Higher Secondary Level, the students studying Science as a discipline are extremely examination oriented to enter into professional careers such as medicine, engineering, etc. In this context, the students and their respective teachers stress on memorizing the content rather than focusing on developing their related skills in Science and Scientific Methods. Teaching is a complex art guiding students through a variety of selected experiences towards the attainment of a widening field of learning. Traditional methods of teaching are not child centered and do not provide opportunities of interaction for teachers and fellow students. Educating scientifically literate individuals, however, is possible not through passing knowledge onto individuals, but through teaching them and

enabling them to reach scientific knowledge. In this respect, the place of science process skills is prominent and important to teaching ways of reaching knowledge. The use of science process skills by students increases the permanence of learning. The development of science process skills enables students to solve problems, think critically, make decisions, find answers and satisfy their concerns. The most important outcome of learning Science is development of Scientific Attitude and this can be achieved best through the learning of Science Process Skills. Academic Achievement also is enhanced when Science is taught with realistic, activity based and convenient learning experiences and the use of teaching methods which involves reflective thinking and inquiry mindedness.

A teacher should adopt teaching methods that focus on information processing strategies. Facts and concepts may also need to be grouped or organized in order to facilitate better understanding. Various teaching methods can be used to help students with memorization, or they can use graphic organizers, mind maps, or other ways to represent information visually. Therefore the researcher determined to study the Effect of Advance Organizer Model and Teacher Demonstration Method on Science Process Skills, Scientific Attitude and Academic Achievement of Higher Secondary School Students of Dakshina Kannada District with different levels of Intelligence.

Statement of the Problem

Effect of Advance Organizer Model of Teaching on Science Process Skills, Academic Achievement and Scientific Attitude of Higher Secondary School Students of Dakshina Kannada District with Different Levels of Intelligence

OPERATIONAL DEFINITIONS OF THE TERMS

Advance organizer model of teaching: An Advance Organizer is information that is presented prior to learning and that can be used by the learner to organize and interpret new incoming information; a Model of Teaching of the Information Processing Family developed on Ausubel's ideas. Here the researcher refers to presentation of the learning material in accordance with the syntax of the Advance Organizer Model given by Bruce Joyce and Marsha Weil (Joyce, Weil and Calhoun, 2011, pp. 256-257) into three phases of activity as given below.

Phase I Presentation of the Advance Organizer

- Elucidate the aims and objectives of the lesson.
- Present the organizer – identify essential characteristics, give examples, provide perspective, situation and context.
- Make the learners aware of relevant knowledge and experience through appropriate prompts and clues.

Phase II Presentation of the Learning Task or Learning Material

- Present the learning material
- Organize the learning material logically to make it unambiguous.
- The learning material has to be linked to the organizer.

Phase III Strengthening of the Cognitive Organization

- Integrative Reconciliation and Active Reception Learning: the teacher asks learners to summarize, to compare, to relate new examples with the organizer.
- Elicit critical approach to subject matter: the teacher makes learners think about inherent inferences in the learning material
- Clarify and apply the learning material.

Teacher demonstration method: Here the researcher refers to the traditional method commonly used by a Science teacher in his/her classroom for customary teaching.

Science process skills: The scientific method, scientific thinking and critical thinking have been terms used at various times to describe Science Process Skills. In the present study, the researcher refers to a combination of basic and integrated Science Process Skills as follows:

(a) Observing – The learner will use the senses to gather information about an object or event.
(b) Classifying - The learner will group or order objects or events into categories based on properties or criteria.
(c) Experimenting - The learner will be able to conduct an experiment and ask appropriate questions.
(d) Interpreting - The learner will organize data and draw conclusions from it, make statements to explain the meaning of the various data collected.
(e) Inferring - The learner will make an educated guess about an object or event based on previously gathered data or information. This is a process of making early conclusions by relating previous experiences with immediate observations.
(f) Predicting - The learner will forecast events based on observations and previous experiences or certain pattern of reliable data.

Academic Achievement: Academic achievement is something an individual does or achieves at school, college or university - in class, in a laboratory, library or fieldwork. In the present study, the researcher refers to the scores obtained by the students of Second year Pre-university in the Achievement test administered that was constructed by the researcher on the selected content of the treatment material related to Biology on the topic Reproduction in Organisms.

Intelligence: Intelligence is a psychological variable that has a strong impact on the learning of Skills and Achievement of pupils. It also refers to the decision making ability of individuals and act according to the situation. In the study it refers to categorization of the sample as Above Average Intelligent, Average Intelligent and Below Average Intelligent based on the scores obtained by the students on the Standard Progressive Matrices test on Intelligence given by J.C. Raven.

Pre- achievement: Previous knowledge possessed by the learner that links or relates to the new learning is referred to as Pre-Achievement. In the present study, Pre-Achievement is a covariate. The scores obtained by the students in the First Year Final Examination in Biology are considered for the present study.

Higher secondary school students: The students studying at the Pre-University Level are referred to as Higher Secondary

School Students. In the present study, the Higher Secondary School Students are students studying in Second Pre-university of Dakshina Kannada District with Science Discipline.

Objectives of the Study

1. To study the effect of Methods of Teaching, Levels of Intelligence and their interaction effects on Science Process Skills among Higher Secondary School Students with Pre-Achievement as Co-variate.
2. To study the effect of Methods of Teaching, Levels of Intelligence and their interaction effects on Academic Achievement among Higher Secondary School Students with Pre-Achievement as Co-variate.
3. To study the effect of Methods of Teaching, Levels of Intelligence and their interaction effects on Scientific Attitude among Higher Secondary School Students with Pre-Achievement as Co-variate.

Hypotheses of the Study

$H_0$1.1 : There is no significant difference in the effect of Methods of Teaching on Science Process Skills with Pre-Achievement as Co-variate.

$H_0$1.2 : There is no significant difference in the effect of Levels of Intelligence on Science Process Skills with Pre-Achievement as Co-variate.

$H_0$1.3 : There is no significant difference in the interaction effects of Methods of Teaching and Levels of Intelligence on Science Process Skills with Pre-Achievement as Co-variate

$H_0$2.1: There is no significant difference in the effect of Methods of Teaching on Academic Achievement with Pre-Achievement as Co-variate.

$H_0$2.2: There is no significant difference in the effect of Levels of Intelligence on Academic Achievement with Pre-Achievement as Co-variate.

$H_0$2.3: There is no significant difference in the Interaction effects of Methods of Teaching and Levels of Intelligence on Academic Achievement with Pre-Achievement as Co-variate.

$H_0$3.1: There is no significant difference in the effect of Methods of Teaching on Scientific Attitude with Pre-Achievement as Co-variate.

$H_0$3.2: There is no significant difference in the effect of Levels of Intelligence on Scientific Attitude with Pre-Achievement as Co-variate.

$H_0$3.3: There is no significant difference in the Interaction effects of Methods of Teaching and Levels of Intelligence on Scientific Attitude with Pre-Achievement as Co-variate.

METHODOLOGY OF THE STUDY

The present study is an experimental study, followed the Randomized Control Group Pre-test Post-test Factorial Design. A 2X3 Factorial design was followed in the present study. The Advance Organizer Model of Teaching and Intelligence were considered as the independent variables. The Dependent variables in the present study were the Science Process Skills, Academic Achievement and Scientific Attitude. Pre-Achievement was selected as a control variable or a covariate as a measure of controlling the effect of Pre-achievement on Science Process Skills, Academic Achievement and Scientific Attitude. All the Higher Secondary School Students of Dakshina Kannada District studying Science Discipline under Government, private aided and private Pre-university institutions formed the Population of the study. The sample of the study consisted of 66 students of 2nd year Pre-University from Carmel Pre-University College, Modankap of Dakshina Kannada District, Karnatka State, India who studied Science with Biology combination. The Instructional Material based on Advance Organizer Model of Teaching consisted of twenty sessions was the facilitative tool. The Evaluative tools were,

- **Standard Progressive Matrices:** Standard Progressive Matrices is a multiple choiceintelligence test of abstract reasoning, developed by Dr. John C. Raven in 1938.
- **Science Attitude Scale:** The Science Attitude Scale (SAS) is a standardized rating scale by Dr. Avinash Grewal (Bhopal) consists of statements about science. The subject is expected to rate the statements as Strongly Agree, Agree, Undecided, Disagree, Strongly Disagree based on their opinion about Science.
- **Science Process Skills Test:** The Science Process Skills test is a Multiple Choice type of test constructed by the investigator and then validated. The final draft of the tool consisted of **45 items**. Each correct answer could be scored one point. Hence a highest of 45 scores could be scored by each pupil.
- **Achievement Test:** The Achievement Test was constructed by the investigator to measure the Achievement in Science of Higher Secondary School Students. The final draft of the Achievement Test consisted of 60 questions.

The Randomized Control Group Pre test Post test Design was followed in the present study. According to this design two groups were formed, namely, Experimental and Control group based on their scores on Intelligence Test. The Experimental group was given a treatment of twenty sessions for duration of three months using the Instructional Material prepared by the investigator. The control group was taught using the existing method by their subject teacher. At the completion of the treatment both the groups were tested for the dependent variables. Pre- achievement of the sample was considered as a covariate of the study. The data thus collected was analyzed through statistical techniques.

Analysis and Interpretation of Data

Analysis and interpretation of objective one: The first objective of the study was "To study the effect of Methods of Teaching, Levels of Intelligence and their interaction effects on Science Process Skills with Pre-Achievement as Co-variate. To test this objective, three null hypotheses were formulated.

$H_0$1.1 : There is no significant difference in the effect of Methods of Teaching on Science Process Skills with Pre-Achievement as Co-variate.

$H_0$1.2 : There is no significant difference in the effect of Levels of Intelligence on Science Process Skills with Pre-Achievement as Co-variate.

$H_0$1.3 : There is no significant difference in the interaction effects of Methods of Teaching and Levels of Intelligence on Science Process Skills with Pre-Achievement as Co-variate

The VASSAR STATS online Software was used for ANCOVA analysis. The two factors in the analysis of this

objective are Methods of Teaching, Levels of Intelligence, and their Main and Interaction effects were found.

F Ratio 579.79 for Different Methods of Teaching was significantly greater than the theoretical value 7.08 for Degrees of Freedom 1, 59. Hence the null hypothesis 'There is no significant difference in the effect of Methods of Teaching on Science Process Skills with Pre-Achievement as Co-variate' was rejected and the alternate hypothesis, 'There is a significant difference in the effect of Methods of Teaching on Science Process Skills with Pre-Achievement as Co-variate' was accepted.

F Ratio 37.95 for Levels of Intelligence was significantly greater than the theoretical value 7.08 for Degrees of Freedom 1, 59. Hence the null hypothesis 'There is no significant difference in the effect of Levels of Intelligence on Science Process Skills with Pre-Achievement as Co-variate' was rejected and the alternate hypothesis 'There is a significant difference in the effect of Levels of Intelligence on Science Process Skills with Pre-Achievement as Co-variate' was accepted.

F Ratio 47.51 for Interaction of Different Methods and Levels of Intelligence was significantly greater than the theoretical value 7.08 for Degrees of Freedom 1, 59. Hence the null hypothesis 'There is no significant difference in the interaction effects of Methods of Teaching and Levels of Intelligence on Science Process Skills with Pre-Achievement as Co-variate, was rejected and the alternate hypothesis, 'There is a significant difference in the interaction effects of Methods of Teaching and Levels of Intelligence on Science Process Skills with Pre-Achievement as Co-variate' was accepted

Since the 'F' ratio for the Methods of Teaching and Levels of Intelligence was statistically significant, the relative interaction effect of Methods of Teaching and Levels of Intelligence. Therefore the further analysis of the data to find out the mean comparisons between the groups has been done using the **Protected t-test (LSD)** suggested by R. A. Fisher. The calculated value of LSD for df 59 and at Confidence Level 0.01 is 7.41. Hence the difference between any two cell means equal to or greater than 7.41 was considered as significant.

Analysis and interpretation of objective two: The second objective of the study was "To study the effect of Methods of Teaching, Levels of Intelligence and their interaction effects on Academic Achievement with Pre-Achievement as Co-variate. Three null hypotheses were formulated to test the objective.

$H_0$2.1: There is no significant difference in the effect of Methods of Teaching on Academic Achievement with Pre-Achievement as Co-variate.

$H_0$2.2: There is no significant difference in the effect of Levels of Intelligence on Academic Achievement with Pre-Achievement as Co-variate.

$H_0$2.3: There is no significant difference in the Interaction effects of Methods of Teaching and Levels of Intelligence on Academic Achievement with Pre-Achievement as Co-variate.

'F' Ratio 248.28 for Different Methods of Teaching was significantly greater than the theoretical value 7.08 for Degrees of Freedom 1, 59. Hence the null hypothesis 'There is no significant difference in the effect of Methods of Teaching on Academic Achievement with Pre-Achievement as Co-variate' is rejected and the alternate hypothesis, 'There is a significant difference in the effect of Methods of Teaching on Academic Achievement with Pre-Achievement as Co-variate' was accepted.

F Ratio 31.86 for Levels of Intelligence was significantly greater than the theoretical value 7.08 for Degrees of Freedom 1, 59. Hence the null hypothesis 'There is no significant difference in the effect of Levels of Intelligence on Academic Achievement with Pre-Achievement as Co-variate' was rejected and the alternate hypothesis 'There is a significant difference in the effect of Levels of Intelligence on Academic Achievement with Pre-Achievement as Co-variate' was accepted.

F Ratio 16.98 for Interaction of Different Methods and Levels of Intelligence was significantly greater than the theoretical value 7.08 for Degrees of Freedom 1, 59. Hence the null hypothesis 'There is no significant difference in the interaction effects of Methods of Teaching and Levels of Intelligence on Academic Achievement with Pre-Achievement as Co-variate, is rejected and the alternate hypothesis, 'There is a significant difference in the interaction effects of Methods of Teaching and Levels of Intelligence on Academic Achievement with Pre-Achievement as Co-variate' is accepted.

Since the 'F' ratio for the Methods of Teaching and Levels of Intelligence was statistically significant, it was decided to test the relative interaction effect of Methods of Teaching and Levels of Intelligence on Academic Achievement. Therefore the further analysis of the data to find out the mean comparisons between the groups has been done using the **Protected t-test (LSD)** suggested by R. A. Fisher. The calculated value of LSD for df 59 and at Confidence Level 0.01 is 13.94. Hence the difference between any two cell means equal to or greater than 13.94 is considered as significant.

Analysis and interpretation of objective three: The third objective of the study was "To study the effect of Methods of Teaching, Levels of Intelligence and their interaction effects on Scientific Attitude with Pre-Achievement as Co-variate. Three following null hypothesis was formulated to test the objective.

$H_0$3.1: There is no significant difference in the effect of Methods of Teaching on Scientific Attitude with Pre-Achievement as Co-variate.

$H_0$3.2: There is no significant difference in the effect of Levels of Intelligence on Scientific Attitude with Pre-Achievement as Co-variate.

$H_0$3.3: There is no significant difference in the Interaction effects of Methods of Teaching and Levels of Intelligence on Scientific Attitude with Pre-Achievement as Co-variate.

'F' Ratio 77.79 for Different Methods of Teaching was significantly greater than the theoretical value 7.08 for Degrees of Freedom 1, 59. Hence the null hypothesis 'There is no significant difference in the effect of Methods of Teaching on Scientific Attitude with Pre-Achievement as Co-variate' was rejected and the alternate hypothesis, 'There is a significant difference in the effect of Methods of Teaching on Scientific Attitude with Pre-Achievement as Co-variate' was accepted.

F Ratio 58.43 for Levels of Intelligence was significantly greater than the theoretical value 7.08 for Degrees of Freedom 1, 59. Hence the null hypothesis 'There is no significant difference in the effect of Levels of Intelligence on Scientific Attitude with Pre-Achievement as Co-variate' was rejected and the alternate hypothesis 'There is a significant difference in the effect of Levels of Intelligence on Scientific Attitude with Pre-Achievement as Co-variate' was accepted.

F Ratio 4.08 for Interaction of Different Methods and Levels of Intelligence was lower than the theoretical value 7.08 for Degrees of Freedom 1, 59. Hence the null hypothesis 'There is no significant difference in the interaction effects of Methods of Teaching and Levels of Intelligence on Scientific Attitude with Pre-Achievement as Co-variate, was accepted.

The obtained 't' value 0.004 is lower than the table value 2.66 with respect to Scientific Attitude for df 59, was statistically not significant at 0.01 level. Hence it can be concluded that the Methods of Teaching had no significant effect in enhancing Scientific Attitude among Higher Secondary School Students.

DISCUSSION AND INTERPRETATION OF THE RESULT

The related studies are in agreement with the findings of the present study that the Advance Organizer Model of Teaching is effective in enhancing Academic Achievement in relation to the Teacher Demonstration Method of Teaching. Studies indicate that Science Process Skills could be enhanced through learner friendly learning strategies. Further the study has also revealed that Science Process Skills could be enhanced through Advance Organizers. Scientific Attitude is also enhanced through the use of Advance Organizer Model of Teaching and the Teacher Demonstration Method.

MAJOR FINDINGS OF THE STUDY

- Methods of Teaching had differential effect on developing Science Process Skills.
- Levels of Intelligence had a significant effect on enhancing the Science Process Skills.
- Interaction effect of Methods of Teaching and Levels of Intelligence showed Differential effect in the development of Science Process Skills after partialling out the effect of Pre-Achievement.
- Advance Organizer Model of Teaching was significantly more effective than the Teacher Demonstration Method on developing Science Process Skills after partialling out the effect of Pre Achievement.
- Advance Organizer Model of Teaching is more effective for students with Above Average Intelligence on Science process Skills when compared to Below Average Intelligence students after partialling out the effect of Pre-Achievement.
- Advance Organizer Model of Teaching is more effective than the Teacher Demonstration Method on Science process Skills for students with Above Average Intelligence after partialling out the effect of Pre-Achievement.
- Advance Organizer Model of Teaching is more effective than the Teacher Demonstration Method on Science process Skills for students with Average Intelligence after partialling out the effect of Pre-Achievement.
- Advance Organizer Model of Teaching is more effective than the Teacher Demonstration Method on Science process Skills for students with Below Average Intelligence after partialling out the effect of Pre-Achievement.
- Advance Organizer Model of Teaching is more effective for students with Above Average Intelligence on Science process Skills when compared to Below Average Intelligence students after partialling out the effect of Pre-Achievement.
- Teacher Demonstration Method is more effective for students with Above Average Intelligence on Science process Skills when compared to Average Intelligence students after partialling out the effect of Pre-Achievement.
- Teacher Demonstration Method is more effective for students with Above Average Intelligence on Science process Skills when compared to Below Average Intelligence students after partialling out the effect of Pre-Achievement.
- Teacher Demonstration Method is more effective for students with Average Intelligence on Science process Skills when compared to Below Average Intelligence students after partialling out the effect of Pre-Achievement.
- Methods of Teaching had differential effect on enhancing Achievement.
- Levels of Intelligence had a significant effect on the Achievement.
- Interaction effect of Methods of Teaching and Levels of Intelligence showed Differential effect in enhancing the Achievement after partialling out the effect of Pre-Achievement.
- Advance Organizer Model of Teaching is more effective than the Teacher Demonstration Method on Academic Achievement after partialling out the effect of Pre-Achievement.
- Advance Organizer Model of Teaching is more effective than the Teacher Demonstration Method on Academic Achievement for students with Average Intelligence after partialling out the effect of Pre-Achievement.
- Methods of Teaching have no effect on Academic Achievement for students with Average Intelligence after partialling out the effect of Pre-Achievement.
- Advance Organizer Model of Teaching is more effective than the Teacher Demonstration Method on Academic Achievement for students with Average Intelligence after partialling out the effect of Pre-Achievement.
- Teacher Demonstration Method is more effective on Academic Achievement for students with Above Average Intelligence when compared to Below Average Intelligence students after partialling out the effect of Pre-Achievement.
- Teacher Demonstration Method is more effective on Academic Achievement for students with Above Average Intelligence when compared to Average Intelligence students after partialling out the effect of Pre-Achievement.
- Advance Organizer Model of Teaching has no significant effect on Academic Achievement for students with various levels of Intelligence after partialling out the effect of Pre-Achievement.
- Methods of Teaching had a differential effect in enhancing the development of Scientific Attitude.
- The Levels of Intelligence also has a significant effect on enhancing the Scientific Attitude.

- Interaction of Methods of Teaching and Levels of Intelligence showed no differential effect in the development of Scientific Attitude.
- Advance Organizer Model of Teaching is more effective than the Teacher Demonstration Method in developing Scientific Attitude among all the Higher Secondary School Pupils.
- Methods of Teaching had no significant effect in enhancing Scientific Attitude among Higher Secondary School Students.

Educational Implications of the Study

The findings of the study have wide implications to the present system of education specifying its application to classroom teaching and learning.

- The present study revealed that Advance Organizer Model of Teaching was significantly more effective than the Teacher Demonstration Method on developing Science Process Skills after partialling out the effect of Pre Achievement.
  - Science Process Skills are important for every individual to carry out research and experiments in particular and in general they are required for every person to lead a skillful life.
  - It is at the Higher Secondary Level, the students develop the intellectual ability to comprehend the Science Process Skills. Therefore teachers could use this as a strategy of teaching at the Higher Secondary level, thus facilitating the learner to advance their Science Process Skills.
  - The product aspects of Science such as facts, concepts, theories, principles and generalizations could be transacted more meaningfully thus assisting in the development of Science Process Skills
  - The development of Science Process Skills can provide a framework for the development of a stimulating and dynamic Science Education in Higher Secondary Schools.
  - The rational followed in developing instructional plans of Science Teaching can be improved by using Science Process Skills, by giving enough scope for observation, comparison, classification, inference, prediction and interpretation.
  - The present study revealed that Advance Organizer Model of Teaching is more effective than the Teacher Demonstration Method on Academic Achievement for students with Average Intelligence after partialling out the effect of Pre-Achievement.
  - Since Advance Organizers are primary means of strengthening cognitive structure and enhancing retention of new information the Advance Organizer Model of Teaching would help teachers in accomplishing their challenging task of teaching abstract concepts in Science.
  - Academic Achievement can be better ensured with the assistance of Advance Organizers learners and thus can facilitate into meaningful learning.
  - A teacher could make better use of illustrations, which may include drawings, diagrams, concept maps and pictures as Advance Organizers. Advance Organizers call for a deal of interaction between the teacher and the students which encourages for a kind of dialogue to clarify ideas that need further elucidation. This would result in greater student involvement.
  - Since this model is useful to structure extended curriculum sequences and to instruct students systematically in the key ideas of a field, they support in expanding students' knowledge about the particular content. The curriculum planners could sequence the curriculum in a manner, such that each successive learning could be related to what has been presented before.
  - Skills of effective reception learning, critical thinking and cognitive reorganization can be developed in the learners, where they can apply these techniques independently to new learning.
  - Teachers can develop the lesson with deductive approach followed by inductive activities that motivates the students for better Achievement and acquisition of the learning material.
  - Teachers should give significance to meaningful learning and discourage rote learning enhancing in better retention.
- The present study has revealed the differential effect of Intelligence on developing Science Process Skills. The significant effect was high on the Above Average intelligent students, followed by Average intelligent and Below Average Intelligent students, for both the Methods of Teaching. Teachers should identify the intelligence level of students and accordingly and focus on developing specific Science Process Skills based on their intelligence levels.
- The present study has revealed the differential effect of Intelligence on enhancing Achievement. The significant effect was high at the Above Average intelligent students, followed by Average intelligent and Below Average Intelligent students, for both the Methods of Teaching. To enhance achievement of the learners with respect to intelligence levels, teachers should plan their teaching so as to provide opportunities for learners towards inquiry skills and habits of precise thinking.
- The study revealed that Advance Organizer Model of Teaching is more effective than the Teacher Demonstration Method in developing Scientific Attitude among the Higher Secondary School Pupils. Hence, teachers could make use of this Model of Teaching to develop Scientific Attitude in Students.
- Since the Advance Organizer Model of Teaching was found to be effective, it is necessary to be included as a part of the Teacher Training Programme with special emphasis on practice of the Model.
- Workshops and seminars should be organized for the in service Secondary and Higher Secondary School Teachers to get acquainted with the innovative techniques of teaching that lead to meaningful learning in the learners.

Suggestions for Further Research

- A study on Standardization of Science Process Skills emphasizing Basic, Integrated and Advanced skills can be undertaken.
- Development of Science Process Skills through other strategies and methods of teaching could be studied.
- The Effect of Advance Organizer Model of Teaching on other variables such as Retention, Inquiry and Meta-cognition can be studied.

- Effect of special emphasis on Process Skills in teaching may be studied on the general achievement of pupils.

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