

International Journal of Scientific Research and Reviews

Effectiveness of Concept Attainment Model on Academic Achievement in Science in Relation to Cognitive Styles Among IX Grade Students

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ABSTRACT

Concept attainment model is considered as an important instructional strategy to develop concepts among students. Not only instructional strategy is important but also Cognitive style contributes equally in higher achievement of students. Therefore, this study is designed to see the effect of Concept Attainment Model in Science in relation to cognitive styles of IX grade learners. In order to conduct the study, 2 senior secondary PSEB schools of Jalandhar city were selected randomly. From these two schools, 160 students of IX grade were taken as sample to conduct experiment. Group embedded figure test – GEFT by Philip K. Oltman, Evelyn Ruskin and Harman A. Witkin (1974), Achievement test on the segment of science prepared by investigator were administered on selected sample. Thus the data obtained was analysed using descriptive statistics. Relevant means, S.D's, and 2 X 2 ANOVA were computed to test the hypotheses. This study revealed that achievement of group taught through concept attainment model is higher than the achievement of group taught through conventional teaching method. This study also concluded that Field Independent group produced high achievement as compared to field dependent group. This study also indicated that there exists interaction effect of teaching of model and cognitive style on the achievement of IX grade students in Science.

KEYWORDS: Concept Attainment Model, Cognitive Style, Field independent and Field Dependent Cognitive Style, Achievement.

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INTRODUCTION

Education is a tri-polar process in which teacher student and curriculum are the three poles of education. The process of teaching and learning is complex one. Teacher plays an important role in teaching learning process. The teaching- learning process is the important that influences directly the achievement of the students. It is reason why the teacher plans this teaching learning process by keeping into objective of better learning of students. Effective teaching is only possible when the teacher has knowledge and skill of using proper instructional modes which includes teaching strategies, teaching techniques, and teaching models. The Educational objectives can be achieved by the teachers by using effective teaching strategies. Various strategies developed by using different learning theories, related principles and a number of models of teaching have been searched and researched by Joyce and Weil (1992).

TEACHING MODEL

In simple language a model of teaching is defined as a blueprint which contain necessary structure and directions which are used by teachers to achieve the specific objectives. Environment and stimuli for the student to attain the concepts can be created by models. Teaching model also develops inquiry skills. Development of models of teaching is the recent innovation in teaching. Joyce and Marsha Weil's (1980) described model of teaching as a plan or pattern that can be used to shape curricula (long-term courses of studies), to design instructional materials and to guide instruction in the classroom and other settings. An intelligent use of these approaches gives the assistance to teacher while selecting appropriate teaching model in accordance with learning needs of the students.

CONVENTIONAL TEACHING METHOD

Conventional teaching or traditional teaching refers to a teaching method involving instructors and the students interacting in a face-to-face manner in the classroom. These instructors start discussions in the classroom, and focus exclusively on knowing content in textbooks and notes. Students receive the information passively and reproduced the information memorized in the exams. Many teachers are still teaching their students in the same manner as how they were taught. Many lecturers are still using conventional teaching and have noted that in conventional teaching classrooms, while the lecturer is explaining and writing on the board, students will be copying the same thing onto their notes, some day-dreaming and some sleeping. It would be difficult to stop students from copying the notes from the board and at the same time ensured that every student was paying attention in the class because the lecturer was too busy explaining the lecture.

CONCEPT ATTAINMENT MODEL

Jerome S. Bruner and his associates are historically linked with concept attainment model. In this model, comparing and contrasting examples that contain the concept and that do not contain the concept are used to teach specific concept to students. He thinks that the complexity of environment can be reduced by using categorization of concept. Moreover categorization of the concept is necessary for concept learning. In concept attainment teaching model, concept is a category or class of stimuli (objects, events, ideas, people and except them) in one or more common characteristics or features. Learning concept means placing objects or issues in a class, thus it can identify the class members. Each concept has definition, title or name, concepts and principles constitute the bulk of the course content. Teacher uses this model to teach classification, to teach how to think and to teach how to receive the concept to students.

REVIEW OF LITERATURE - CONCEPT ATTAINMENT MODEL

Praveen (2018) revealed that the concept attainment model as a teaching strategy is more effective as compared to traditional method in fostering conceptual learning efficiency in social science. Goswami and Verma (2017) revealed that significant difference between the post-test mean achievement scores of the students when taught through concept attainment model and conventional teaching methods. The study of Swain (2016) indicated that the strategies of Concept attainment Model are found to be more effective than the Traditional Method. Latchanna and Swarnalatha (2016) reveal that there is not a significant difference between Concept Attainment Method and conventional method. Anjum (2014) revealed that concept attainment model is more effective than traditional method. Patel (2014) revealed that the achievement of students in chemistry is high when taught through concept attainment model.

Kumar and Mathur (2013) revealed that concept attainment model is more effective than traditional method. Mayer (2012) revealed that students' understanding of the concepts and thinking skills are increased by using concept attainment model. Lin and Atkinson, (2011) found that both the model (Concept attainment model and Multi Media Teaching) are significantly better and equally well but concept attainment Model helps the students to grasp the content in less time as compared to Multi Media Teaching Model. The study of Ahmed, Gujjar, and Ali (2011) proved that concept attainment model was an effective instructional strategy in teaching English. It was also found that trainee teachers taught through concept attainment model registered better performance on the posttest scores.

The study of Mukherjee (2011) indicated that Concept attainment model was effective in terms of achievement of students in science. Rani and Kaur (2010) revealed that concept attainment model was effective in terms of mathematics concept understanding as compared to traditional method of teaching. The study of Kalani (2009) indicated that concept attainment model was more effective in terms of attainment of concepts in science and in the retention of concepts as compared to traditional method of teaching. Kalani (2008) found that achievement of students taught through concept attainment model was better than those who taught by the control method. Sunjoy (2008) found that Concept Attainment Model had better effect than Advance Organizer Model in relation to mathematical reasoning. Bairagya, Ghosh and Meta (2005) found that Concept Attainment Model (CAM) was comparatively more effective teaching treatment than the traditional method of teaching economics at the higher secondary school level.

COGNITIVE STYLE

Riding and Rayner (1998) considered cognitive style as a preferred and habitual way to organize and represent information. Cognitive style affects the process of decision-making that subsequently affects the social attitude, thinking and responses to life events (Riding, 2000). Dornyei and Skehan (2003) differentiated between cognitive and learning style. Cognitive style is a predisposition to process information in characteristic manner while learning style is a typical preference for approaching learning in general. Ziętek, and Roehr (2011) referred cognitive style to “an individual’s preferred and habitual approach to organizing and representing information.

FIELD INDEPENDENT AND FIELD DEPENDENT COGNITIVE STYLE

Witkin (1977) was the first psychologist who coined the concept of field-dependent (FD) and the field-independent (FI) cognitive styles. Field-independent people are those who analyze the information and restructure it according to their needs and they are good at identifying objects or details. On the other hand, Field dependent people are those who perceive information and take it as it is presented to them and they are more sensitive to external clues. Field Independent learner is considered as one who does not limit his learning to the immediate environment and provided materials, can extend and his experience to the wider environment. Field Dependent learner is he/she a learner who is mostly dependent on the materials given to him in his environment (Muhammad 2010). According to Witkin, and Goodenough (1977), students with field-dependent learning styles learn better in Language and History compared to field-independent students. The students with field-independent learning styles were found to learn better in Mathematic and Sciences subjects (Biology, Chemistry, Physics).

REVIEW OF LITERATURE - COGNITIVE STYLE

Sharma and Pooja (2018) revealed that that cognitive styles, achievement motivation and academic achievement were highly and positively correlated. The study of Idika (2017) showed that there was significant main difference between on field dependent and field independent students' achievement in chemistry students with field independent level of cognitive style obtained higher mean score of chemistry achievement than those with field dependent level of cognitive style. Sudarman, Setyosari, Kuswandi, and Dwiyoogo (2016) showed that there are significant interactions between the use of learning strategies and cognitive style on learning outcomes. Daniel and Abdurauf (2015) revealed that that cognitive styles (Field dependence/Independence) is a significant predictor of scientific achievement in Male and Female student of Biology.

The study of Jantan (2014) showed that the correlation between students' cognitive styles and their mathematics achievement was found to be low. The findings of Umaru and Tukur (2013) are that performance of students having independent cognitive style students is higher than those having dependent cognitive style in Mathematics Achievement Test. Shoaie and Leila (2013) shows that there exists significance positive relationship between male and female students' field dependence and field independence and their academic achievements. This study also revealed that cognitive style is a significant predictor of academic achievement and the also found that girls outperform boys as regards to academic achievement. Ahmadzaide and Shoeje (2013) showed that there was significance relationship between Field dependence and academic achievement in men; but, a significance association between Field dependent and academic achievement in females were found; and Field Independent in women is significantly related to their academic achievement. Lemos et al. (2012) discovered that field independent students perform better than field dependent students. They observed this trend in cross culture studies as well. Sanker and Raju (2011) also found that students' self-efficacy was higher when the instructional style aligned with their personal cognitive style. Educational environments should keep cognitive styles and self-efficacy in mind when creating the best learning environment to promote academic success.

Evans and Waring (2011) found that cognitive style was found to impact on trainees' conceptions of differentiation, trainees demonstrating higher levels of analysis and intuition had a more developed understanding of differentiation than other cognitive styles. Banner et al., (2010) established a relationship between the working memory and cognitive style. Student having low working memory inbuilt with an analytic cognitive style performed worst in English, math and science subjects. However, the students with high working memory and having analytical cognitive style and in Holistic cognitive style the working memory have little effect on learning

outcomes. Okwo and Otubah (2007) revealed that the performance of field independent students is better as compared to field dependent students in physics and biology respectively. The reason behind this result is that because field independent students are better problem solvers than the field dependent students. A study conducted by Altun and Cakan (2006) showed that social information such as conversation and relationships were retained better by field dependent individuals. Sternberg and Zhang (2005) broaden the sphere of cognitive style to assessment and instruction. They concluded that assessment and instruction should be matched with students thinking style otherwise; this mismatch may lead to poor performance in assessment and poor learning from instruction.

ACADEMIC ACHIEVEMENT

The term “Achievement” signifies a performance carried out by an individual or a group on the accomplishment of the task, whether it is in form of academic, personal, manual or social. Achievement implies the act of attaining a desired end or aim. Educationally, the word achievement means all those behavioral changes which take place in an individual as a result of learning experience of different kinds. Achievement refers to what a person has acquired or achieved after the specific training or instruction has been imparted. The term academic achievement refers to the degree of success or level of attainment by pupil in the scholastic or the curricular subjects prescribed within the syllabus in brief academic achievement is the amount of knowledge derived from learning in the classroom.

After reviewing literature, it is concluded that concept attainment model is quite helpful to increase students thinking skills and understanding of the concepts. The concept attainment model is an effective teaching method to engage students in creating their own concepts. Many studies revealed that the concept attainment model is better as compared to advance organizer model. Many studies also revealed that there are significant interactions between the use of learning strategies and cognitive style on learning outcomes.

STATEMENT OF THE PROBLEM

EFFECTIVENESS OF CONCEPT ATTAINMENT MODEL ON ACADEMIC ACHIEVEMENT IN SCIENCE IN RELATION TO COGNITIVE STYLES AMONG IX GRADE STUDENTS

OBJECTIVES OF THE STUDY

1. To develop lesson plan on the principles of Concept Attainment Model for IXth class learners in science subject.
2. To compare the academic achievement of IX grade students in Science when taught through Concept Attainment Model and Conventional teaching method.

3. To compare the academic achievement of IX grade students with Field Independent Cognitive Style and Field Dependent Cognitive Style in Science.
4. To study the interaction effect of teaching Model's approach and Cognitive Style on Academic Achievement of IX grade Students.

HYPOTHESES OF THE STUDY

H₁: Academic Achievement of IX grade students when taught through Concept Attainment Model and Conventional Teaching Method do not differ significantly in Science.

H₂: Academic Achievement of IX grade students with Field Independent Cognitive style and Field Dependent Cognitive Style do not differ significantly in science.

H₃: Instructional treatment and Cognitive Style do not have interaction effect on the academic achievement of IX grade students in Science.

METHODOLOGY

Sample

Initially, Two PSEB secondary schools , one is Govt. Senior Secondary School, and second one is Adarsh Nagar, Junior Co- Educational school, were selected randomly from Jalandhar city, Punjab state. From these two schools, all the 9th class students were taken as a sample in order to conduct experiment.

Design

In the present study, 2 X 2 factorial designs have been employed. Instructional treatment and cognitive styles are independent variables, whereas academic achievement of IX students in science is dependent variable.

Tools

1. Group embedded figure test – GEFT by Philip K. Oltman, Evelyn Ruskin and Harman A. Witkin (1974).
2. Instructional material in the Science subject is prepared in accordance with the principles of concept attainment model for IX grade students.
3. Achievement test is also prepared on designed instructional material for IX grade students in Science.

Procedure

In order to conduct study, two PSEB secondary schools were selected randomly from Jalandhar city, Punjab state. All IX grade students from selected schools were taken as a sample. Sample consisted of 160 IX grade students. Firstly, in order to identify students having field

dependent and field independent cognitive style, Group embedded figure test was administered on 160 students and divided the sample into two groups. One group consisted of 80 IX grade students who have independent field Cognitive style, and Second group consisted of 80 IX grade students who have dependent field Cognitive Style. After that, to match control and experimental group on the basis of Achievement, Achievement test was administered on these two groups and, further divided these two groups into four sub group- field independent control group, field independent experimental group, field dependent control group, field dependent experimental group. So, in this study, there were four sub-groups. Two sub-groups were considered as experimental group who receive experimental treatment, and other two sub- groups were considered as control groups.

STATISTICAL TECHNIQUES

Mean, Standard Deviation and 2X2 ANOVA were employed to treat the raw scores and arrive at the result.

RESULTS AND DISCUSSION

The means of sub group for 2X2 factorial design on the academic achievement have been presented below in the table 1

Table 1 2x2 Analysis Of Variance On Performance Gain Scores

	CAM	CTM	
FI	M ₁ = 235 S.D ₁ = 131.6	M ₂ = 156 S.D ₂ = 92.4	M _{FI} = 195.5
FD	M ₃ = 119 S.D ₃ = 93	M ₄ = 111 S.D ₄ = 117	M _{FD} = 115
	M _{CAM} = 177	M _{TM} = 133.5	

This table represents mean and standard deviation of four subgroups. The first sub-cell of this table shows that the mean and standard deviation of IX grade students who have field dependent cognitive style, and taught through concept attainment model is 235 and 131.6 respectively. The next sub- cell indicates that 156 and 92.4 is mean and standard deviation of IX grade for sub- group having field independent cognitive style, and taught through conventional teaching method. The students of IX grade who have field dependent cognitive style, and taught through concept attainment model have mean 119 and standard deviation 93. The last sub- cell shows that mean and standard deviation of IX grade students who have field dependent cognitive style, and taught through conventional teaching method is 111 and 117 respectively.

In order to analyze the variance, the obtained scores were subjected to ANOVA. The results have been presented below in the table 2

Table 2 Summary of Anova For 2x2 Designs On Achievement Scores

Sources of Variance	SS	Df	MSS	F-Ratio
Models Of Teaching (A)	47.3	1	47.3	17.01**
Cognitive Styles (B)	161.99	1	161.99	58.26**
Interaction (AXB)	31.51	1	31.51	11.33**
Within	433.94	156	2.78	

**Significant at 0.01 level of confidence

The table 2 indicated that means square variance and degree of freedom for models of teaching are 47.3 and 1 respectively. F-Ratio for the difference between means of two treatment groups namely, CAM and CTM is 17.01 which are significant at 0.01 level of confidence. This indicated that model of teaching effects the academic achievement of IX grade students in science. The examination of their corresponding group means from table 1 suggests that CAM was found to be more effective than CTM with respect achievement of IX grade students in science. This indicated that the achievement of IX grade students who taught through concept attainment model is higher than the achievement of IX grade students who taught through conventional teaching method Thus, the results did not support the hypothesis (1) namely; “Academic Achievement of IX grade students when taught through Concept Attainment Model and Conventional Teaching Method do not differ significantly in Science”.

The table 2 revealed that means square variance and degree of freedom for different cognitive style is 161.99 and 1 respectively. F-Ratio for the difference between means of two sub-groups namely, FI and FD was found 58.26 which are significant at 0.01 level of confidence. This indicated that Cognitive style effects the achievement of IX grade students in science. The examination of their corresponding group means from table 1 suggests that FI group performed better that FD group. It means that the achievement of IX grade students who have field independent cognitive style is higher than the achievement of IX grade students who have field dependent cognitive style. Hence, the hypothesis (2) namely; “Academic Achievement of IX grade students with Field Independent Cognitive style and Field Dependent Cognitive Style do not differ significantly in science” was not accepted.

The table 2 indicated that means square variance and degree of freedom for interaction of instructional treatment and cognitive style is 31.51 and 1 respectively. F-Ratio for interaction effect of model of teaching and cognitive style was found to be 11.33 which are significant at 0.01 level of confidence. This indicated that interaction of model of teaching and Cognitive style effects the achievement of IX grade students in science. The achievement of IX grade students who have field independent cognitive style taught through concept attainment model is higher than the achievement

of IX grade students who have field dependent cognitive style taught through conventional teaching method. The examination of their means suggest the difference in the mean performance gain scores for the two groups i.e. field independent and field dependent groups were not same for traditional model and CAM. Hence, the hypothesis (3) namely; “teaching model and Cognitive Style do not have interaction effect on the achievement of IX grade students in Science.” was not accepted.

Further t- ratio has been calculated for four sub groups in order to identify in which sub groups difference exist.

Table 3 T-Ratio Between The Difference In Achievment Means Scores Of Four Sub Group

Sun- group	Mean	SD	t-ratios
$M_1 - M_2$	79	25.42	3.11**
$M_1 - M_3$	116	23.26	4.99**
$M_1 - M_4$	124	27.84	4.45**
$M_2 - M_3$	37	20.73	1.78
$M_2 - M_4$	45	23.57	1.91
$M_3 - M_4$	8	23.63	0.34

**Significant at 0.01 level of confidence

It may be observed from the table 3 that t- ratio for various sub – groups namely, $M_1 - M_2$, $M_1 - M_3$, $M_1 - M_4$ are found to be significant at 0.01 level of confidence.

This suggest that

1. The students with field independent cognitive style when taught through concept attainment model have high achievement score in Science as compared to students with field independent cognitive style when taught through conventional teaching method.
2. The students with field independent cognitive style when taught through concept attainment model have high achievement score in Science as compared to students with field dependent cognitive style when taught through concept attainment model.
3. The students with field independent cognitive style when taught through concept attainment model have high achievement score in Science as compared to students with field dependent cognitive style when taught through conventional teaching method.

FINDINGS OF THE STUDY

1. Academic Achievement of IX grade students when taught through Concept Attainment model and Conventional Teaching Method differ significantly in Science.
2. Academic Achievement of IX grade students with Field Independent Cognitive style and Field Dependent Cognitive Style differ significantly in science.

3. Instructional treatment and Cognitive Style have interaction effect on the achievement of IX grade students in Science.
4. The students with field independent cognitive style when taught through concept attainment model have high achievement score in Science as compared to students with field independent cognitive style when taught through conventional teaching method.
5. The students with field independent cognitive style when taught through concept attainment model have high achievement score in Science as compared to students with field dependent cognitive style when taught through concept attainment model.
6. The students with field independent cognitive style when taught through concept attainment model have high achievement score in Science as compared to students with field dependent cognitive style when taught through conventional teaching method.

DISCUSSION ON FINDINGS AND EDUCATIONAL IMPLICATIONS

This study revealed that the achievement of group when taught through concept attainment model is higher than that group taught through conventional teaching method. This result is in tune with study of Kalani (2008), Mayer (2012), Kumar, and Mathur(2013), Anjum (2014), Patel (2014), Swain (2016), Bhargava (2016), Goswami, and Verma (2017) which indicated that performance of group taught through concept Attainment model of teaching was significantly higher as compared to the control group. The probable reason for this result may be Concept Attainment Model helps the students to strengthening the cognitive structure of the students. It provides deep understanding of the concept. In Concept Attainment Model, students get opportunity to think openly and freely. Student learns quickly when they actively participate in learning, by conducting an experiment, participate in group work. Pupils need concrete first hand experiences as basis of concept formation which helps in better achievement of students. The second result of this study that Field Independent group enhanced achievement gain scores than field dependent group. This finding is in tune with Umaru, and Tukur (2013), Idika (2017). These studies showed that there was significant main difference between on field dependent and field independent students' achievement in chemistry students with field independent level of cognitive style obtained higher mean score of chemistry achievement than those with field dependent level of cognitive style. The probable reason for this study may be that Field Independent learner is one who does not limit his learning to the immediate environment and provided materials, can extend and his experience to the wider environment. They go to other resources to explore the given knowledge.

Field independent people are those who analyze the information and restructure it according to their needs and they are good at identifying objects or details. These skills help the student to

understand the concept in better way as compared to field dependent cognitive style student. The last finding is that the performance through different models of teaching interacts with cognitive styles. The probable reason may be that field independent style means student uses other learning resources to explore his knowledge which helps in developing concept. Besides this, in concept attainment model uses moreover all skills which inculcate field independent learner. It is the reason that this cognitive style and concept attainment interact which result in better achievement.

The first educational implication is that teacher should identify the cognitive style of IX grade students. From this study, it is concluded field independent cognitive style is better than field dependent cognitive style. Teacher should develop field independent cognitive style among the students of IX grade students. Teacher should select teaching material and teaching method which develop field independent cognitive style among IX grade students. The second educational implication is that teacher should teach science concepts through concept attainment model to enhance the achievement of IX grade students in Science. Principal should encourage teachers for teaching through the concept attainment model. Orientation programmes and workshops should be organized to train and acquaint the teachers with the concept attainment model and its application.

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