CHAPTER III

REVIEW OF RELATED LITERATURE

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Review of related literature implies locating, studying and evaluating reports of relevant researches, study of published articles, research abstracts, pertinent pages of comprehensive books on the subject and going through related manuscripts for a proper research activity, the availability and utilization of adequate scores of related information are essential. Knowledge of related research enables the investigator to define the frontiers of his field and helps to sharpen nebulous ideas. Turney and Robb (1971) explain that the identification of a problem, development of a research design and the determination of the size and scope of the problem all depend to a great extent on the care and intensity with which a researcher has examined the literature related to the individual’s work.

Review of related literature is the fertile source of research problem. For every research, there is a dire need for a review of related literature to help the investigator in the formulation of research question and procedures. According to Burns (2000), “the review of the literature can help in limiting the individual’s research problem and in defining it more clearly. It will give the investigator the knowledge needed to convert the tentative research problem to a detailed and concise plan of action. Thus, a survey of related studies and literature becomes inevitable for new investigators to guide them properly to find out correct procedure and solutions.

In the words of David (1969), literature is reviewed to create the content from the past for the new study to be conducted with new subjects and newly obtained data.
The advantage of the related literature is to provide insight into the statistical methods through which validity of the results is to be established. Hence, a survey of related literature is very helpful. It helps the research worker to find what is already known, what others have attempted to find out, what methods of attack have been promising and what problems remain to be solved. It furnishes him with indispensable suggestions about comparative data, good procedures, likely methods and tried techniques. It also prevents repetition of research. Above all, it contributes to the general scholarship of the investigator.

The studies available in the related area are summarised and presented under the following heads:

1. Studies related to Discovery Learning Model and Academic Achievement.
2. Comparison of Discovery Learning Model with Expository Model.
4. Instructional strategies and their effectiveness in Creativity.
5. Instructional strategies and their effectiveness in Scientific Creativity.
6. Instructional strategies and their effectiveness in Science Curiosity.

3.1 DISCOVERY LEARNING MODEL AND ACADEMIC ACHIEVEMENT

A number of research studies have drawn attention to Discovery Learning Model of teaching and academic achievement. A majority of studies have shown positive correlation between DLM model of teaching and academic achievement. These studies also revealed that Discovery Learning Model was superior to the traditional method or approach (Carole, 1990; Moss, 1964; & Deopuria, 1984).
Studies conducted by Ambili (1997) and Beena (1998) revealed that Discovery Learning Model is more effective than formal approach in terms of achievement in Mathematics and Biology respectively. In a contrasting study, Mulapo and Fowler (1987) argued that traditional approach is more effective in terms of achievement in chemistry than Discovery Learning Model. This study also revealed that discovery approach influence formal reasoners more than concrete reasoners which was evidenced by their higher test scores.

Xavier (2000) prepared and tested a discovery learning model for teaching zoology at higher secondary level. The study found that Discovery Learning Model was superior to traditional method of teaching with regard to academic achievement. This study also revealed that discovery learning model is more effective in enhancing science attitude in higher secondary school students.

Research studies conducted by George (2002) and Nayar (2003) have revealed that discovery learning model was superior to lecture method in realizing instructional objectives belonging to the categories – knowledge, understanding, application and skill. The studies also revealed that discovery learning model is more effective than traditional method in teaching Biology at secondary level.

Nair (1995) constructed and tested three Environmental-based Models for teaching Botany at degree level. One of the models constructed and tested was based on Discovery Learning Model. The study revealed that Discovery Learning Model was superior to Formal Approach in terms of immediate post-test achievement, delayed memory achievement and extent of forgetting scores. The study also
revealed that Environmental approach was effective in stimulating cognitive aspects, developing affective behaviour and psychomotor skills in students.

Narayanan (1990) conducted a study on achievement in mathematics under Guided Discovery Learning and Reception Learning conditions. The investigator found that Guided Discovery Learning is better than reception learning. Shishta (1990) investigated the relative effectiveness of Guided Discovery Learning and conventional approach in the teaching of scientific concepts in Life Science and found that Guided Discovery Learning is more effective than conventional approach in teaching scientific concepts. Gurumurthy (1990) compared the effectiveness of Guided Discovery Approach over Instructed Performance Approach in doing physics experiments and found that the Guided Discovery Approach is superior to the Instructed Performance Approach in developing cognitive abilities and practical skills.

Eggen et al. (1973) conducted a study on acquiring cognitive structure of Discovery and Rule learning. The experiment was conducted on a sample of 57 students from the University of Michigan (29 in the Discovery group and 28 in the Rule group). The study revealed that Discovery group performed significantly better in the immediate post-test achievement.

Emex (1993) conducted a study on the effects of guided discovery style of teaching and graphic calculator use in differential calculus. Statistically significant differences were not found between the different treatment groups using the selected methods, viz., discovery style teaching. Byrne (1996) investigated the influence of
Didactic Guided Discovery instruction as related to surface and deep learning approaches and fact/recall and comprehension. The analysis of the data revealed that there is no significant difference between the groups with respect to achievement. George (1993) studied the effects of Guided Discovery style, Teaching and Graphing calculator use in different calculus. The study revealed that the development of interactive graphing technology resulted in a renewed interest in Discovery learning, since it is a very effective tool for studying experimentation and discovery.

The conclusions of the above studies reveal the fact that the Discovery learning is more effective in academic achievement in various subjects. These studies also revealed that Discovery learning model was superior to lecture method in realising instructional objects and developing science attitude.

### 3.2 COMPARISON OF DISCOVERY LEARNING METHOD WITH EXPOSITORY MODEL

The review of related literature has helped the investigator to obtain a close acquaintance with literature available in the area of the study undertaken. Review of studies pertaining to the comparison of DLM with Expository Model of survey are presented below.

Andrews (1984) constructed models for comparing the effect of Expository and Discovery learning which is applicable to a wide range of environmental problems. The analysis of results revealed that the experimental group discussed low transportation and population issues to a significantly great extent than control group. With respect to realizing the objective ‘application’, the expository method was more
effective than the guided discovery method for high intelligent group whereas the low intelligent group performed better on ‘application test items’ when taught using Guided Discovery Method. Bhalwankar (1988) found that the Guided Discovery and Expository methods were equally effective in realizing the objectives included under ‘knowledge’ and ‘comprehension’ dimensions with reference to both immediate post-test as well as retention test.

Worthen (1968) conducted a study on Discovery and Expository presentations for teaching mathematical concepts. The study revealed that the discovery group was superior to expository group on both oral and written heuristic transfer tests. Selim et al. (1983) compared the effectiveness of discovery and expository instruction on science achievement and attitudes of 5th grade pupils in Egypt. The results indicated that pupils taught by discovery learning scored higher in science achievement, both recall and application, and had developed a more positive attitude towards science than those who were taught by expository instruction. Rao (1988) revealed that there were no significant differences between the Guided discovery and Expository approaches with respect to achievement, concept attainment and problem solving.

3.3 INSTRUCTIONAL STRATEGIES AND THEIR EFFECTIVENESS IN SCIENCE PROCESS SKILLS

Since 1960, the emphasis on science process skills in science curricula has made its acquisition as one of the major goals of teacher education programme. Several studies have indicated that the teachers who are proficient in process skills use strategies that give children opportunities to learn those skills (Butts and Raun,
1969; Janus, 1975). Some of the other researchers who have specifically made attempt in the area of development of process skills for Biology are Tamir and Amir (1987), Germann (1989) and Ugru (1990).

Jordan (2000) revealed that experimental group was significantly better than that of the control group on the science process skills of Identifying experimental questions, Identifying variables, Designing investigations and Interpreting data. The study also found that the experimental and control groups showed no significant differences in adjusted post-test, means on the science process skills of formulating hypothesis and graphing data. The study showed that the activity based science curriculum was significantly superior to the traditional one. Khalwalia (1986) found that the concept based curriculum was more effective than the conventional curriculum in terms of acquisition of process skills as well as in developing better cognitive structures; the levels of intelligence did not affect mean scores on the process skills test and the high socio-economic status group and the low socio-economic status group did equally well in the acquisition of process skill in science.

Pappelis and Pohlmann (1980) made a study to determine whether science process skills of pre-medical and pre-dental students as measured by the Test of Science Processes could be improved by means of a semester long course modelled after the AAAS Science A Process Approach curriculum. Using the Test of Science Processes a pre- and post-test, improvement was demonstrated in the thinking skills of pre-medical and pre-dental students, when SAPA like activities were used in the curriculum. More specifically, significant improvement was made in the skill of
measuring, quantifying and inferring. No significant gains were made in observing, classifying, experimenting and predicting. With more time and emphasis placed on these particular skills, the score no doubt would also show significant improvement. Walkoz and Yeany (1984) indicated that emphasis on process skills in the laboratory can significantly improve process skill achievement. Students with lower levels of cognitive development had a lower level of process skill achievement. There was no sex difference in process skill achievement. However, statistical interactions indicated that females at the lowest level of cognitive development scored higher on some of the process skill measures than the males at the same level of cognitive development.

Doty (1986) revealed that subjects in inquiry group did not differ significantly from those in the traditional group in science integrated process skills and attitude towards science. This study also found that subjects in the inquiry group did differ significantly from those in the traditional group in science achievement. The relationship between process skills and the variables of sex, race, performance in science, intelligence and achievement was not significant in the inquiry course and a significant relationship was found to exist between the variables of sex, race, performance in science, intelligence, achievement and attitude towards science. Colley (1997) suggested that there were effects of gender in the acquisition of science process in a project-based science curriculum. Females achieve higher in science process skills than males. As they reach high school, males achieve higher in science process. According to Radhamonyamma (1986), the newly evolved method is more effective than the ordinary classroom method for developing scientific skills.
Brooks (1982) compared the effectiveness of mastery instruction to an equivalent time non-mastery mode of instruction for improving students’ learning and retention of selected science process skills. No significant differences were found in levels of achievement between mastery and non-mastery average or above-average students. The study also revealed that both average and above average mastery instructed subjects scored significantly higher than their non-mastery counterparts on an instrument measuring higher level process skills.

Ramesh (1984) revealed that the mean scores of the group taught through the objective-based curriculum was more with respect to acquisition of process skills test than the traditional curriculum group.

Dawson (2000) found that explicit instruction is effective in developing science process skill of hypothesising. Krieger (1997) studied the relationship among process skill development, knowledge acquisition and gender in microcomputer based laboratory. Analysis of Variance identified no significant effect on process skills attributable to treatment or gender.

Gillen (1990) investigated teachers’ acquisition of science process skills, teachers’ implementation of hands-on-process oriented science instruction and elementary school pupils’ acquisition of science process skills. Pupils’ acquisition of the science process skills was measured with the Test of Basic Process Skill (BAPS) among the primary grade pupils and the science process assessment among the upper elementary grade pupils. Students performed well on both tests, as indicated by central tendency measures.
Several researchers have attempted studies relating to discovery and non-discovery classroom climate on learning science processes and content. Haukoos (1981) examined effects of two different climates (discovery and non-discovery) on learning science processes and content. Results demonstrated that students in the discovery treatment scored significantly higher on the science process inventory. Personality characteristics with significant interactions with science process were achievement, order autonomy, affiliation, interception, succorance abasement and heterosexuality.

Haukoos and Penick (1985) revealed that students in discovery and non-discovery classroom climate achieved equally well, but students in the discovery climate achieved higher process scores as measured by the Welch Science Process Inventory. Shiney (2002) studied the effectiveness of Guided Discovery Learning Material on the selected Basic Science Process Skills among the pupils of Standard VIII. The skills considered were observation, classification, inference and prediction. Pre-test and post-test scores showed that Guided Discovery Learning Material had a positive effect on basic process skills. There was no positive significant difference between the scores of boys and girls.

The review of related literature in this section highlights the fact that few researchers have attempted to explore the teaching strategies and its effectiveness in science process skills. Studies reported that teaching strategies are effective in developing science process skills (Jordan, 2001; Khalwalia, 1986; Pappelis and Pohlman, 1980; Walkoz and Yeany, 1984; Colley, 1997; Radhamonyamma, 1986;
Brooks, 1982; Ramesh, 1984; Dawson, 2000; Krieger, 1997; and Gillen, 1990). Very few studies as those of Haukoos (1981), Haukoos and Penick (1985) and Shiney (2002) revealed the fact that Discovery Learning Model is effective in developing science process and basic science process skills. The conclusion of the above section reveals the fact that modern instructional strategies are effective in improving science process skills than the traditional methods.

3.4 INSTRUCTIONAL STRATEGIES AND THEIR EFFECTIVENESS IN CREATIVITY

Instructional strategies and its effectiveness in creativity have been reported in recent studies on students studying in universities, colleges and schools by various researchers. Most of the studies revealed that instructional strategies are helpful for developing creativity.

Penick (1976) investigated the effects of two patterns of instruction in creativity. The two strategies were referred to as Student Structured Learning in Science (SSLS) and Teacher Structured Learning in Science (TSLS). This study indicated that a non-directive student structured science class can be developed with no loss or gain in student verbal creativity while students are able to make significant gain in figural creativity.

Kollof (1983) found that students who participated in the achievement programme got significantly high scores on measures of verbal originality, figural originality and verbal fluency. There were no differences between the two groups on figural fluency or on measures of self-concept. Juska (1988) studied the effectiveness
of word association exercises for training programmes in creativity. Two tests of creativity – the Remote Associates Test and the Universal Uses Test – were used. It was found that the performance of females was higher than that of males.

Meader (1992) investigated the effect of synectics (creativity training method) on gifted and non-gifted kindergarten students. The study showed a significant growth in creativity by both the gifted and the non-gifted experimental groups as a result of the training. French et al. (2002) investigated the relationship between creativity and self-directed learning among adult community college students. The study revealed that there is a relationship between creativity and self-directed learning readiness among adult community college students. In Bertrand et al.’s (2005) study, the meta-analysis result showed that creativity ability can be moderately enhanced by training but the real strength of current programs appears to be the improvement of verbal rather than figural creative ability.

A number of research studies have drawn attention to the effect of brainstorming on the development of creativity (Sharma, 1982; Malhotra and Chopra, 1985). They have reported that brainstorming sessions enhanced scientific creativity among science students. They also revealed that brainstorming enhances divergent thinking or creative thinking.

Mahapatra et al. (1999) found that Synectics Model and Gaming Strategy were superior to the traditional method in enhancing self-concept, creativity and achievement of the learners whereas synectics model was found superior to the gaming strategy treatment. Jaya (2001) concluded that Synectics Model is more
effective than the Lecture Method in enhancing creative thinking among the students learning civics at secondary level.

Singh (2008) found that Jurisprudential Inquiry Model is effective in improving the word fluency of low intelligent and expressional fluency of high intelligent students.

Walker (2006) studied the impact of nurturing creativity in language, arts classrooms for improving students’ creative products. This study utilised quasi-experimental, pre-test – post-test design with two intact samples separated into-treatment (special education clusters) and control groups. The study revealed that the treatment group displayed statistically higher post-test scores compared to the control group after the intervention. With regard to the impact of nurturing creativity, the results support the position that creativity can be enhanced through conscious and creative efforts, improving both male and female students’ creative products.

Miyan (1982) examined the effectiveness of three methods of teaching mathematics, namely, tell and do, guided discovery and pure discovery in developing mathematical creativity and found that the Guided discovery method was the most effective method in enhancing originality as compared to the other two methods.

The investigator reviewed a number of related studies and literature and found that the instructional strategies are effective in enhancing creativity. Very few researchers found that brainstorming enhances creative thinking. Research studies in this section found that Guided Discovery Method was the most effective one in enhancing mathematical creativity than pure discovery and tell and do methods.
3.5 INSTRUCTIONAL STRATEGIES AND THEIR EFFECTIVENESS IN SCIENTIFIC CREATIVITY

Individual differences in scientific creativity are correlated with specific development experiences. Some of these experiences are associated with the home environment, whereas others are linked with education and training. Scientific creativity requires much more formal training than do the other types of creativity, viz., artistic creative, etc. (Simonton, 1986 a, Terman, 1954).

Researches on scientific creativity were carried out in many countries. But America is much progressed among them in this field of research. In India, investigations on scientific creativity have been started very recently. All these investigations have thrown light upon various aspects that influence scientific creativity. Those highly researched aspects affecting scientific creativity are reviewed here.

McCormach (1971) found that science education majors improved in creativity when inquiry-teaching methods involving demonstrations and structural discussions were used, and homework assignments that encouraged divergent thinking were given. His work implies that teaching for creativity in chemistry involves the elaboration of the teaching science by process approach that already proved successful. Misra (1980) found that home and school environment had a significant positive relation with scientific creativity.

Baby (1989) found that (i) the relation between ‘Science learning environment’ and ‘Divergent thinking in science’ is positive and significant at 0.01
level; (ii) there is no significant difference based on sex in the ‘r’ between ‘Science learning environment’ and ‘Divergent thinking’ in science; (iii) there is a significant rural-urban difference when ‘Science learning environment and ‘Divergent thinking in science’ are correlated.

Devi (1992) concluded that ‘Attitude towards Science’ have certain role in the development of creativity in science among pupil.

The conclusions arrived at by the above research studies reveal the fact that most of the studies in India are on General Creativity and these studies include cognitive, psychological and environmental variables. Very few studies (Misra, 1980; Devi, 1992) have reported that instructional strategies were effective for developing creativity in science.

### 3.6 INSTRUCTIONAL STRATEGIES AND THEIR EFFECTIVENESS IN SCIENCE CURIOITY

Science curiosity is an important attribute and influencing factor with respect to human learning. Very few studies have been conducted in science curiosity, which are concerned with elementary school-age youngster’s science curiosity. Jenkins (1969) revealed that the number of structured science experiences influence elementary school student’s curiosity but necessarily do not increase curiosity level; also, student intelligence and other intervening experiences were found to be significantly related to curiosity. Koran and Longino (1982) found that many science activities can be designed to encompass several of the factors making up curiosity, and further alluded to the NSF-supported elementary science programs (ESS, SAPA,
and SCIS) as containing ‘novel and sometimes complex’ laboratory activities planned to stimulate curiosity.

**DISCUSSION**

The review of related literature helped the investigator to get a clear idea of the research problem and its crucial aspects, regarding what was already been done in the selected area, as well as about what should be done in the context of the problem. The review has also helped her considerably, in deciding the specific objectives as well as in the formulations of hypotheses for the present study. It has also helped her to select the most appropriate tools for data collection, sample and appropriate methodology for executing the present study. The review had helped her to realize the imminent need for developing an instructional material based on discovery learning model and find out its effectiveness for fostering science process skills, scientific creativity and science curiosity through the teaching of Biological Science.

Review of related studies revealed that Discovery Learning Model is more effective than the traditional method with regard to academic achievement in various subjects. The conclusion of one study reported that discovery learning model is effective for developing scientific attitude of higher secondary students. Very few studies highlight the fact that the instructional strategies help in improving science process skills. Several researchers have reported that Discovery Learning Model is more effective than the Expository model with regard to academic achievement. Several researchers have reported that instructional strategies are effective for developing general creativity and very few studies have reported instructional
strategies are effective for developing scientific creativity. Very few studies highlight the fact that the structured science experiences and activities influence students’ curiosity. Moreover, in Kerala, no attempt has ever been made to conduct studies in science curiosity. Through the review of the related literature, the investigator could understand that no study was conducted for finding out the effectiveness of an instructional material in Biological Science based on Discovery Learning Model for fostering science process skills, scientific creativity and science curiosity in higher secondary students.