CHAPTER - II

REVIEW OF RELATED LITERATURE

With a view to seek some guidelines from the previous researches, which could be helpful in formulating the present investigation, the results of some of the related studies are discussed below, to formulate hypotheses and get insight into variables.

2.1 TEACHING STRATEGIES AND ACHIEVEMENT

Todd (1972) developed and evaluated a module for individualized self-direction instruction at the college level. He found the modularized instruction better than the instructor's traditional method in another class.

Rousos, T.G. (1979) indicated that students taught using the traditional lecture/discussion mode of instruction did equally well in terms of achievement as the students taught using mastery learning and a tutorial laboratory strategy. The effect of mastery learning and a tutorial laboratory on achievement in and attitude toward algebra for college students at the community and Technical College of the University of Totedo is not positive.

Thompson, C.J.H. (1980) supported the mastery learning strategy as a highly favourable instructional component for enhancing student learning.

Ames, T.R.H. (1981) developed a module and found it to be a useful training instrument for parents of retarded
persons. College students in human service curricula as well as para professionals and professionals working with developmentally disabled adolescents and adults.

De Antelo (1981) tried to identify and validate appropriate individualized learning modules (ILM). He found that ILM could improve the understanding of the supervisors' role and their competencies, and it was a contribution to their professional development.

Mclemore, W.S. (1981) concluded that among the subject of the study, mastery learning instructional methods resulted in significantly higher achievement than non mastery instructional methods on a standardized test of vocabulary skills and on a criterion - referenced final test of vocabulary skills.

Mukhopadhyaya (1981) compared the effectiveness of microteaching and modular approach in developing selected teaching competencies. He concluded that both the treatments were equally effective.

Nanavati, U.R. (1981) studied the effectiveness of a Learning Package on population education. The major finding of the study was: The Learning package was more effective than the traditional method in teaching the content of population education 'to the pupils of class IX.

Hopper, W.A.F., (1982) developed modules in Biology for Class IX students. He used three modular approaches of teaching and found all of them to be effective in terms of mean gain in cognitive achievement.
Sharma, J.P., (1982) compared the effectiveness of three modules for civics teaching with the traditional teaching method in terms of achievement of student teachers on criterion test. He found that the mean achievement scores of the experimental group of students were significantly higher than that of the control group.

Khanna, K. (1983) studied the effectiveness of the reading materials on the girl dropouts living in Delhi Slums. The major findings of the study was: The girl dropouts who were fluent readers took an average, 75 minutes for reading the module and another 35 minutes for attempting the tests. Those who were poor readers took almost double the time. On the affective side it was found that after exposure to the module, the average score of the girl dropouts on opionnaire increased from 7.5 to 13.5, indicating a positive shift. When the module was discussed in the homes of the girl dropouts, a majority of them tried to introduce some change or the other. Majority of them expressed their desire for reading more of such material. The result of the follow up carried out with 12 girl dropouts selected from the original sample indicated that the module was remembered by all the 12 girl dropouts. They were able to recall not only the treatment given to them but also some of its content.

Kishore, L (1984) has reported that retention of students taught physics, using mastery learning strategy for senior secondary school students, was significantly higher
as compared to the control group, taught the same material through traditional method.

Yadav, P.S. (1984) employed pre-test and post-test experimental design involving two groups of students to find the effect of mastery learning strategy on achievement of students in mathematics. The experimental group was taught by mastery learning strategy and the control group using the conventional method of teaching mathematics. The design neatly controls all the factors affecting the internal validity namely maturation, instrumentation, statistical regression and experimental mortality. The treatment was spread over twelve weeks. The sample was chosen from six high schools of Haryana consisting of the students of IX grades. The experimental group in different schools were taught by different teachers. The two comparison groups did not differ significantly in respect of intelligence, socioeconomic status and previous knowledge in mathematics.

Blakmore, C.L. (1985) revealed the following major findings on the basis of statistical analysis (1) the achievement of the mastery group was significantly higher than the non-mastery group at the midtest. By the time of the posttest, however, the non-mastery group had improved to the point where both groups were found to be equal. It was evident that the conditions provided by the mastery learning model were effective for producing specific results quickly; (2) In particular, low aptitude students, females and
especially the low aptitude females benefited from the condition provided by mastery learning methods.

Jayalakshmi, T. K. (1985) studied the effectiveness of the modules as instructional materials in respect of intelligence and English-reading comprehension. The main findings of the study were (i) The instructional strategy for learning educational psychology at the B.Ed level was quite effective, (ii) The instructional modules had potentiality for use in any instruction with marginal change in personnel, (iii) The modules as a whole had provided good motivation for the study of Educational Psychology at the B.Ed. level (iv) The PLM as a basic component, had been successful in giving the basic component, had been successful in giving the basic information (v) The different enabling activities had been effective in contributing to better achievement, (vi) Facility with language was found to be a significant factor effecting the performance of this group (vii) Learners were helped in acquiring a better knowledge about certain class room techniques like discussion.

Osborne and Freyberg (1985) outline fine techniques that teachers in activity-based programs have used successfully to get students to focus on strategies for learning how to learn through activities. For example, instruction or a particular task can be written on cards and handed to small groups of students for unscrambling. Five to ten minutes spent on this kind of activity ensures that students will think about what to do rather than merely go through mechanical motions.
Salim, M.I. (1988) studied the effects of mastery learning strategy on the chemistry achievement of secondary school students. The results of the study showed that the mastery learning students had significant achievement gains in chemistry across all achievement tests.

Kim I.Y. (1989) studied the validation of self-instructional food service inventory control system module. Because adjusted mean scores on the achievement pre-test between the two experimental groups were significantly different with the mean scores for the self-instructional treatment being higher, the inventory control self-instruction method was judged at last equally as good as the lecture method. The students' responses to the attitude inventory showed that students in the self-instruction group had overall favourable attitudes towards the module. Therefore, the self-instructional method appears to be an effective innovation. Further use and study of this method for teaching college students and practitioners seem justified.

Smith, M.W. (1989) conducted an evaluation of six learning modules based on industry-related Applied Mathematics problems. The major conclusions of this investigation were as follows: (i) Project AIM (Application In Mathematics) appears to give secondary schools a teaching resources that has a high degree of pedagogical flexibility, (ii) Students can successfully engage in real-world problem solving and exhibit use of reasoning, writing and mathematical abilities, (iii) Project AIM could be
instructional in bringing about unit in secondary schools by demonstrating that mathematics and its applications are inseparable. (iv) Project AIM learning modules were strongly aligned with the NCTM (National Council of Teachers of Mathematics) standards goal of having students engage in application.

Berger (1990) conducted a qualitative study of the process of self-directed learning and concluded that most of the participants judged the quality of their learning projects through both their own internal standards and external signs of recognition.

Clark (1990) found a significant relationship between teaching method and the dependent variables with the mean scores in clinical performance and self-directed learning higher than the traditionally taught groups.

Alspach (1991) studied the self-directed learning readiness of nursing students and found only a limited amount of self-directed learning opportunities for students and that faculty perceive that they promote self-directed learning opportunities much more, frequently than students perceive receiving them.

Lee (1991) concluded that the instructional strategies such as adjunct questions and visualization should be used with caution because they may not always facilitate self-paced prone learning for either high school students or adults.
Pecoraro, A.G., (1992) developed a module on interpersonal skills for home economics teachers and evaluated it in two teaching modes, he found the module effective in both the modes for the cognitive and affective development of teachers.

Singh (1993) investigated the relationship between group empowerment and self directed in learning small groups and observed the enhancement groups and observed for the either enhancement of competencies to be self directed learners to help the group become more empowering.

Cook, M.L., (1994) found the course module for addiction counsellors using a system approach to training (SAT) to be effective.

Misra, A.C.(1994) studied the effectiveness of self learning modules in Chemistry on achievement of polytechnic students in relation to their cognitive styles and found that

1) There was significant difference between field independent and field dependent students in terms of achievement in applied chemistry irrespective of method of teaching.

2) There was no significant interaction between cognitive styles and method of instruction.

Mahapatra, B.C.(1995) developed software package for teaching chemistry to class IX students of Madhya Pradesh and found the developed software package to be
effective in terms of achievement of students on criterion tests. Also the developed software package was significantly superior to traditional method.

Revoland, S., (1995) developed and implemented an instructional module to prepare preservice teachers to address the needs of students with Attention Deficit Hyperactivity Disorder (ADHD). The module was found to be effective in increasing knowledge and promoting awareness of ADHD with group of preservice teachers.

Robinson, Daniel H.; Kiewra, Kenneth A. (1995) conducted two experiments involving 153 college students and found that, given enough time, students studying graphic organizers learned more hierarchical and coordinate relations. As a result, they were more successful in applying the knowledge and in writing integrated essays than were students studying outlines or text alone.

Pant (1997) revealed that students achievement in book keeping and accountancy increases significantly by making use of the guided self-learning modules.

Reddy, G.L and Ramar, R. (1997). Studied the effectiveness of multimedia based modular approach in teaching English to slow learners and found a significant difference between the pre test and post-test mean scores of experimental group slow learners when English subject was taught through multimedia based modular approach. Further their achievement was higher in post-test scores than in pre test.
Narula, T.R. (1999) studied the effectiveness of self learning modules in applied physics on achievement of students in relation to gender and personality of polytechnic students and found self learning modules as superior strategies of teaching compared to conventional method of teaching.

Umar, I.N. (1999) investigated the interactions between the cognitive styles of field dependence (field dependent, field neutral, field independent) and learning strategies on students’ performance in a hypermedia environment.

The findings of the study were:
1 There was no significant interaction between cognitive styles and learning strategies
2 Field independent students scored significantly better than field dependence
3 No significant difference were found among different learning strategies.

B. Gauss and L. Urbas (2003) developed and evaluated a prototype for a learning module and found that interaction with the module had a strong positive effect on learning outcome.

and science academy were assigned to either a lecture-based instructional strategy or a problem based instructional strategy. Both treatment groups received 18-week instruction through the assigned instructional strategy. Results revealed that lecture-based group performed significantly better on near transfer posttest problems. The problem based group performed significantly better on far transfer post test problems. In addition the results indicated the learners in the lecture -based instructional treatment were significantly more likely to employ data driven reasoning in the solving of problems, whereas learners in the problem based instructional treatment were significantly more likely to employ hypothesis driven reasoning in the solving of problems. A significant positive correlation was detected between self-regulatory skills scores and problem solving performance scores in the problem based group but not in the lecture based group.

Cameron, Brian H. (2004) investigated the effects of instructional gaming, cognitive style and feedback type on the achievement of different learning objectives. A total of 422 subjects participated in this study. The subjects were given the Group Embedded Figures test to determine their level of field dependence in the first session. The four treatment groups, all containing field dependent and field independent subjects, were formulated. Subjects in treatment group A received no further instructional strategies while subjects in treatment groups B, C, and D received an online instructional game with different forms of
feedback. The research findings indicate that subjects preferred to receive the treatment with the instructional game that contained elaborative answers to questions, considering such a rehearsal method as most effective and most motivational. The findings also suggest that the subjects that received the treatment with the instructional game that contained questions with no feedback desired more information about their answers and the correctness of their answers more so than the other gaming treatments. In addition, the findings suggest that subjects that received the treatments with the instructional game with questions with knowledge of response feedback and the subjects that received the treatments with the instructional game with questions with elaborative feedback both felt similar time pressures from the game. The research findings further indicate that the subjects that were exposed to the elaborative feedback treatment experienced overall higher study satisfaction than was evidenced in the other treatments.

Roberts, Stanley E. (2004). Examined the different effects of Traditional (TT) versus Programmed Learning Sequenced (PLS) versus Contract Activity Packaged (CAP) instruction on approximately 93 sixth-grade students' achievement- and attitude-test scores on three, grade-level science modules. Each group of students was taught three different units using three different instructional strategies. Significance was evidenced on grade-level achievement as well as on students' attitudes favoring instruction with a PLS over either a CAP or Traditional Teaching. Each of the
three units demonstrated significantly higher test scores when students were instructed using the PLS versus the CAP and TT. Results illustrated when pair wise comparisons were made between the instructional conditions that the PLS revealed more significant gains over the TT and the CAP. Females made significantly more gains when the TT method or the PLS approaches were used. Males had a slight edge over the females when a CAP instructional approach was used. Furthermore, it was demonstrated from the analyses of the data that Traditional Teaching (TT) was the least effective way to teach; CAPs produced better results than TT; and PLSs produced better results than TT.

2.2 STUDY HABITS AND ACHIEVEMENT

Michael and Reedes (1952) found that scores in the study habit inventory which they had constructed for college students correlated significantly with the weighted grade average.

Carter (1953) found significant correlation between study habits and academic achievement varying from .46 to .51.

Diener (1960) observed that over-achievers and under-achievers differed significantly in respect to their study habits.

Jain and Robinson (1969) revealed that good achievers have always good study habits. Working habits was found to be most important.
Entwhistle and Entwhistle (1970) in their study with the help of correlation technique found that better study methods have positive but low correlation with better attainment.

Cazelle (1971) found that study habits scale appeared to be one of the useful instruments in differentiating between academically and unsuccessful students.

Jamuar (1973) in his latest studies investigated study habits in relation to their intelligence and academic achievement, personality and background. He found statistically significant relationship between study habits and achievement.

Walia's (1975) findings revealed insignificant difference between study habits of high and low achievers similarly no difference between the study habits of male and female students of XI grade was found.

Elliott, Timothy R. et.al (1990) Examined relations among problem-solving appraisal, self-reported study habits, and academic performance for 63 college students enrolled in developmental course for academically unprepared students. They found problem-solving appraisal significantly predictive of study habits and semester grade-point average.

Jain, S.P. (1995) conducted a study on 400 students of class X from south Delhi government schools to investigate the relationship of achievement in Sanskrit with intelligence and study habits, the study habits did not
emerge as significant contributor to the scholastic achievement in Sanskrit

Rawat, Leela (1995) studied the effect of parental absence on the study habits and found that parent present students do not differ on study habits from the parent absent students except on comprehension & concentration.

Robinson, Amy E.; et al (1995). Conducted a study entitled “Gender Roles and Study Habits” to examine the relationship between gender identity and study skills in undergraduates from a Mid-South University. Masculine characteristics were more strongly related to effective study habits than were feminine characteristics. Moreover, this relationship was more true for females than for males. Thus females having more masculine traits than feminine traits more than likely utilize effective study habits; however, in males, masculine traits are no better a predictor of effective study habits than are feminine traits. Gender-related characteristics, especially instrumentality, appear to be important for academic achievement.

Patel, M.R. (1996) Studied the impact of study habits upon academic achievement of pupils and found that those pupils who had good study habits did get significantly more achievement scores than those of poor study habits.

Verma, B.P. (1996) found that study habits had significant main effects on academic performance in Hindi, English and Social Studies.
Rozd, Glenda P.; et.al. (1992) conducted a survey to investigate “Is Depression Related to Study Habits.” Results of survey showed that up to 39% of adolescents and college students may be affected by non clinical depression. However, current data do indicate that depressed individuals may show a general malaise about studying and utilizing effective study habits. This study investigated the relation between study habits and depression in college students (n=129). Students with more depressive symptoms did not have greater difficulty with specific study behaviors, but did with off-task behaviors (i.e. with getting focused on studying). Females reported significantly more depressive symptoms than did males, which in turn significantly lowered the productivity of their study habits.

Hazard, Laurie Lynn (1997) studied the effect of locus of control and attitudes toward intelligence on study habits of college students and found that study skills mediate in achievement of the students.

Rasor, Lori T.; Rasor, Richard A. (1998) conducted a study on community college students in order to determine the correlational values among the variables of test anxiety and study behavior, and the student characteristics of age, gender, and ethnicity. Students enrolled in introductory psychology and English classes at American River College and Sacramento City College in California participated in the study by completing the Study Behavior Inventory (SBI) and Sarason's Test Anxiety Scale (TAS). Principle findings of the study include (1) non-white students may need more
instruction about study habits and help with combating test anxiety than whites; (2) younger students, especially males, may need additional instruction about study habits; (3) female students are in greater need for help than males with overcoming test anxiety; and (4) the best predictor of higher levels of test anxiety is lower study skills.

Caken Mehtap (2000) found that study habits of FD and FI students differ significantly.

2.3 COGNITIVE STYLES AND ACHIEVEMENT

Thumann (1982) investigated that students who exhibited reflective reasoning patterns achieved higher science achievement scores.

Mrosla (1984) investigated that low achieving mathematics students were more field independent than high achieving mathematics students in both traditional high school and in the high school for dropouts and that there would be a significant interaction on the achievement variable and the sex variable with respect to field dependence in both schools.

Budhdev Parvina V. (1990) studied the effect of cognitive variables on achievement in mathematics of secondary school students and stated that from the beginning of formal education great emphasis is placed on academic achievement. Variable which affect the academic achievement can be identified as cognitive and non-cognitive.
Lata Manju (1990) in her investigation studied the relationship of cognitive style with scholastic achievement and intelligence and found that intelligence plays a significant role in every sphere of life.

Gargi, G. (1992) conducted on investigation on the effect on inquiry training model on achievement of adolescents studying economics in relation to their cognitive style and found that inquiry training model of teaching was more effective than traditional model of teaching in terms of achievements in economics and the interaction between teaching models and different levels of cognitive style was found to be significant.

Nimrat Bal (1992) studied the effect of Reception learning strategy on language achievement in relation to cognitive styles and found that variable style had a non significant effect on acquisition of language.

Custer, Thomas Alan (1994) indicated that studied with strong independent learning styles showed significantly higher chemistry achievement and greater achievement gains.

Kumar, Sudeesh, P.K, (1994) studied the interaction effect of intelligence, Cognitive styles and approaches to studying on achievement in biology of secondary school students and found that there was no significant main effects of cognitive style on achievement in biology for the total sample of boys. For girls, the variable had significant main effect on achievement in biology and in comprehension category.
Antonietti and Gioletta (1995) found that field independent participants were more likely to be analogical solvers than field dependent ones. Males tended to use analogical solutions more frequently than females.

Kumar, D. (1995) studied effectiveness of mastery learning strategies on achievement in economics in relation to cognitive style and found that field dependent and field independent students did not differ significantly on the achievement of economics concepts.

Hota, Narayan, (1995) Compared the performance of field independent and field dependent boys and girls in mathematics and verbal reasoning test among 288 children from some rural and high schools of Puri district, Orissa He found that the Field independent subjects had obtained higher scores on arithmetic reasoning and verbal skills than field dependent subjects

Mehar, R (1997) studied the role of advance organizer model in learning and retention with respect of cognitive style and learning types in geography and found that there is no difference in the gain scores yielded by the subjects having field dependent cognitive styles.

Tinajero, C. and Paramo, M.F. (1998) reviewed research into possible effects of Field dependence-independence (FDI) on achievement at school and concluded that in general Field independent perform better than Field dependent subjects whether assessment is of specific disciplines or across the board.
Caken, Mehtap (2000) revealed that cognitive style had a statistically significant effect on students' performance.

Salmani M.A. (2000) found that Field-(in)dependence is related to L2 achievement especially in formal school settings. Another interesting point is that the mean score of the FD (field-dependent) subjects is well above that of the FI (field-independent subjects. This suggests that the FD subjects have performed better on the two tests (both the CT and the IELTS). On the basis of the results of the t-test statistic, a trend can be reported in favor of field-dependent subjects. In other words, FD subjects are potentially better performers, according to the results of this study.

Tang, Hua (2003) investigated the relationship between students' cognitive styles and learning environments and its impact on students' performance. Data analysis revealed no difference in the students' performance in relation to cognitive styles and learning environments.

Archer, Lynn K. (2004) examined the relationships between instructional aids, specifically concept maps and content outlines, and level of field dependence-independence in terms of achievement from web-based instructional systems. Participants from a private suburban college (n = 97) were administered the Group Embedded Figures Test to determine their level of field dependence-independence. The sample was then stratified into three levels, including field dependent, field neutral and field independent. Participants were randomly assigned to one of three instructional...
treatments, including a concept map, a content outline, and no instructional tool. The participants then navigated through a text-based instructional hypermedia system differing only in the type of instructional tool included in the software. Immediately following navigation, participants completed an assessment test, and several questionnaires. The assessment scores were analyzed using a $3 \times 3$ Analysis of Variance (ANOVA). The results of this study indicated that there was no interaction between level of field dependence-independence and instructional aid treatment ($F = 1.202, p = .316$). There was also no main effect for level of field dependence-independence ($F = 2.622, p = .078$), and no main effect for treatment ($F = .047, p = .954$). A second ANOVA was conducted using only the data from the field dependent and field independent participants. These results indicated statistical significance for level of field dependence-independence ($F = 4.889, p = .031$). With the exception of the field neutral concept map treatment group, field dependent participants generally had lower mean scores on the assessment. Additionally, although there was no main effect for treatment, field dependent participants had lower assessment scores for each treatment than did the field independent participants.

Ng, Sokling (2004) investigated cross-cultural differences in brand cognitive structures. It was proposed that differences in field dependency across cultures suggest that Easterners and Westerners would structure brand information differently in their minds. Specifically, it was argued that since Westerners are more (or global). They are
more likely to generalize information from product experiences to the entire brand category. In contrast, as Easterners are more field dependent, their brand cognitive structures should be more concrete (or local). They are more likely to focus on individuating information and to store separate beliefs for each product. In addition, it was also proposed that product similarity (more specifically, taxonomic similarity and relational similarity), need for precision, and expertise moderate this structural difference across cultures. To test the hypotheses, four studies were conducted. Using property verification tasks, the analysis examined the extent to which priming participants with context products facilitated their responses to target products. Results from all four experiments demonstrated strong support for the hypotheses.

2.4 DEVELOPMENT OF PROCESS SKILLS

Barufaldi and Swift (1977) concluded that children’s involvement with process skills enables them to recognize more easily the contextual and structural dues in attacking new words and better equip them to interpret data in a paragraph. Science process skills are essential to logical thinking as well as to forming the basic skills for learning to read.

Padilla, Cronin, and Twiest (1985) surveyed the basic process skills of 700 middle school students with no special process skill training. They found that only 10% of the
students scored above 90% correct, even at the eighth grade level.

Several researchers have found that teaching increases levels of skill performance. Thiel and George (1976) investigated predicting among third and fifth graders, and Tomera (1974) observing among seventh graders. From these studies it can be concluded that basic skills can be taught and that when learned, readily transferred to new situations (Tomera, 1974). Teaching strategies which proved effective were: (1) applying a set of specific clues for predicting, (2) using activities and pencil and paper simulations to teach graphing, and (3) using a combination of explaining, practice with objects, discussions and feedback with observing.

Wideen, (1975;) and McGlathery (1970) in their Studies focusing on the Science Curriculum Improvement Study (SCIS) and SAPA indicate that elementary school students, if taught process skills abilities, not only learn to use those processes, but also retain them for future use. Researchers, after comparing SAPA students to those experiencing a more traditional science program, concluded that the success of SAPA lies in the area of improving process oriented skills (Thus it seems reasonable to conclude that students learn the basic skills better if they are considered an important object of instruction and if proven teaching methods are used.
Quinn and George (1975) and Wright (1981) found that students can be taught to formulate hypotheses and that this ability is retained over time.

Padilla, Okey and Dillashaw, (1983) conducted a study to find out the relationship between science process skills and formal thinking abilities. The results show that experimenting abilities they are closely related to the formal thinking abilities described by Piaget. A positive correlation of .73 between the two sets of abilities was found in study.

Padilla, Okey and Garrard (1984) systematically integrated experimenting lessons into a middle school science curriculum. One group of students was taught a two week introductory unit on experimenting which focused on manipulative activities. A second group was taught the experimenting unit, but also experienced one additional process skill activity per week for a period of fourteen weeks. Those having the extended treatment outscored those experiencing the two week unit. These results indicate that the more complex process skills cannot be learned via a two week unit in which science content is typically taught. Rather, experimenting abilities need to be practiced over a period of time.

Ramesh (1984) developed objective based curriculum and studied its efficacy in the acquisition of process skills among 150 class X students from government and privately run schools of districts Ropar. He found that the mean scores of the group taught through the objective based
curriculum more with respect to acquisition of process skills than the traditional curriculum group.

Khalwania, N.S., (1986) studied the effectiveness of concept based curriculum in developing acquisition of process skills among high school students. Pretest/posttest randomized group design was employed. The sample of the study consisted of 160 students divided into two groups of 80 students each. These groups were assigned to two different types of curriculum, viz., the concept based science curriculum and the conventional one. From the study the concept based curriculum was found to be more effective than the conventional curriculum in terms of acquisition of process skills.

Haslam & Gunstone, (1996) provides evidence that students tend to view observation as a teacher-directed process rather than a self-directed pursuit of evidence.

White, Terri Renee (1999) in his study found that there was no significant differences in science process skill abilities of females and males in grade five, seven and nine.

Chun-Yen Chang and Yu-Hua Weng (2000) determined the relationship between tenth-grade students' problem-solving ability and their science-process skills. The sample consisted of 153 tenth-grade students enrolled at four senior high schools in the Ta ipei area. The investigations employed both quantitative and qualitative methods. The quantitative methods utilized correlation statistics to determine the relationship between these two abilities while the qualitative methods involved semi-structured interviews to explore the relationships in more depth. The Problem-Solving Ability Test (PSAT), Science-
Process Skills Test (SPST), and Interviewing Question were used to assess students' respective ability and skills. Quantitative analyses indicated that a significant correlation existed between students' problem-solving ability and their science-process skills ($r = 0.35-0.57$, $p < .01$). In addition, significant mean differences were found on the students' skills of data interpretation, observation, and hypothesis formulation between higher-ability and lower-ability problem solvers ($p < .01$). Moreover, the qualitative analyses revealed that higher-ability problem solvers performed better on problem solving processes than lower-ability problem solvers. The results suggest that incorporating problem-solving activities and science-process skills into instruction might be used as a primary vehicle to improve students' problem-solving abilities.

Tammye Jordan Turpin investigated the effect of an integrated, activity-based science curriculum conscience content achievement, science process skills, and attitudes toward science. The research was conducted in seven integrated science (IS) classrooms using IS for the first time and seven traditional science classrooms. The instrument included the Iowa Test of Basic Skills (ITBS) to Measure science achievement, the South Eastern Regional Vision for Education (SERVE) Science Process Skills Test to measure science process skills, and the SERVE Science Attitude Survey to measure student attitudes.

In the experimental group, 532 seventh grade ITBS Science scores were matched to same student ITBS sixth grade scores. In the control group, 450 matches of seventh grades ITBS Science
scores were matched to same student ITBS Science sixth grade scores. Analysis of Covariance was used to determine group differences with the sixth grade score serving as the covariate. The experimental group had a significantly higher ITBS Science adjusted posttest mean when compared to the control group. Students were given the SERVE Process Skills Test as a pretest at the beginning of the school year and were post tested with the same test at the end of the school year. In the experimental group 531 matches were made pretest while 398 matches were made in the control group. The experimental group adjusted posttest means score on the process skills test was significantly higher than the control. When specific science process skills were examined, the experimental group adjusted posttest mean score was significantly higher than that of the control group on the science process skills of Identifying Experimental Questions, Identifying Variables, Designing Investigations, and Interpreting Data. The experimental and control groups showed no significant differences in adjusted posttest means on the science process skills of Formulating Hypotheses and Graphing Data.

Risa L. Reyes (2003) determined the different ways high school students performed the thinking skill of inferring within a biological context. Their written answers to a standardized, open-ended questionnaire and audio taped self-reports on how they went about answering the thinking skills constituted the raw data. The researcher’s observation and the subjects’ verbal answer to clarificatory questions in the course of one-on-one interviews complemented such data and became the bases for analysis and conclusions drawn in this study. Four different ways of answering the question on inferring emerged from the data, one of them actually classifiable as an exercise in generating and testing alternative hypotheses. In answering the
question on generating and testing alternative hypotheses, the subjects exhibited five different ways depending on their analysis (of plant parts) and proposed tests for each hypothesis. Recommendations by the investigator include specific suggestions for the deliberate teaching of thinking skills in the classroom.

Ferreira, Louise Brandes Moura (2004) conducted a study entitled “The role of a science story, activities, and dialogue modeled on Philosophy for Children in teaching basic science process skills to fifth graders” Some of the key findings were that the story, activities and dialogue facilitated the children's learning in a number of ways. The story modeled the performance of classification, observation and inference skills for the children as well as reflection on the meaning of inference.

A critical appraisal of above studies revealed certain specific research trends in the areas of methods of teaching. A number of methods of teaching have been developed for teaching different subjects at different levels but very few studies have been conducted to develop self-learning modules. In the recent years there has been a growing realization of the importance of process skills among students. Review of researches conducted in India and abroad indicates that although much research work has been conducted into the methods of teaching but little is currently known about methods to acquire process skills. Owing to the importance of process skills there is a need to conduct more research in this field.