Chapter: 2

Review of Related Literature

2.0 Introduction

Science and technology has registered a remarkable share among other factors contributing in the economic, social and personal growth of an individual in particular and nation in general. Researches in the area of science and technology act as a light house for developing scientifically literate society but, "Researches to assess the scientific understanding of people have not been systematically done in India" (Mashelkar, 2005). Fewer researches conducted in the area of science education recommended for moving from 'imitating to innovating' while dealing in the science classrooms and ensuring learning in students in particular and quality of science teaching in general. Ensuring quality of teaching is not possible without ensuring qualities of science teachers and their abilities to motivate the students at secondary level (Shukla, 2005). Teacher, teaching and teacher education are closely related to each other. Their interrelation and interconnectedness is almost axiomatic. In order to arrive at the comprehensive picture of scenario of science teaching at school level and teacher education level two major areas; Science education and teacher education needed study. Researches conducted on pedagogical practices and innovative programs in the field have provided insight to the researcher for developing Activity Based Science Teaching programme. For that various research studies, policy documents and related literature in area of science education and teacher education were referred. Critical review of the referred studies and literature at length is presented in this chapter.

Chunavala (2006) reported that at the end of sixth survey there has been increase in the number of researches carried out in the area of science education which has increased from sixty one (fifth survey) to 120 (sixth survey) yet very less compared to the extensive growth in number of schools, colleges, universities etc. A total of seventy three studies were conducted in India specifically on science teaching as reported in the sixth survey which is very small number considering the importance of science teaching and its effect on society.

Mehpotra (2006) reported that a total of 319 studies were reported on 'teacher and training' out of which only twenty three studies have focused on teaching methods and their effect on students at various levels of Education. Sixteen studies out of

ninety eight studies reported in the area of teacher education have focused on programmes / strategies/interventions on teacher trainees. Most of these studies have confined to status survey or focused on correlation between/amongst various programmes at pre-service level. For the present doctoral work researcher has reviewed sixty five studies which were either from science education, teacher education or on activity based teaching at various levels. Out of which, forty one studies were reviewed and discussion of which is presented below. The reviewed studies are categorized in three broad areas for the ease of understanding.

- ❑ Studies related to science teaching at secondary level. (13)
- ❑ Studies related to teacher education for secondary level.(17)
- ❑ Studies related to activity based teaching at various levels.(10)

2.1.1 Studies related to science teaching at secondary level.

In this section total thirteen studies were reviewed related to science teaching at secondary level. Studies have either tried to examine the status of science teaching at secondary level and its impact on students' related variables or focused on development and use of instructional or multi-media strategies to teach science at secondary level.

Among the studies reviewed Shah (1981), Joshi (1987) and Vaidya (1991) investigated effects of various teaching-learning strategies, Ravindranath (1982), Vardhini (1983) developed and implemented multi-media instructional strategies to teach science content at school level. Mehna (1986), Mohparta (1986), Suthar (1998), and Umashree (1999) conducted a survey type of research focusing on the status of science teaching at secondary level. Whereas, Kwatra (2000) developed and standardized a tool for assessing the students' achievement in science and diagnosing the weakness in understanding the science processes. Rathod (2007) has focused on learning styles of students. Shrivastava (2002) conducted ex-post facto study for learning styles of secondary school students with scientific attitude and their achievement in science whereas Rathod (2007) moving one step ahead developed instructional strategies catering to the learning styles of students at secondary level. Cook (2007) studied the effectiveness of the constructivist science instructional methods on high school students' motivation. It was observed from the above studies that over a period of time focus of the studies have changed however instructional strategies remained consistent choice of the researchers in various forms. Over a period of time type of instructional strategies changed as per the learners learning

style from the general instructional strategies for whole class. Recent studies have shifted the focused on the constructivist learning.

Shah (1981), Ravindranath (1982), Vardhini (1983) focused on developing instructional strategies and Vaidya (1991) developed teaching learning strategies in the same line. Rathod (2007) also developed strategies for teaching science at standard VIII whereas Joshi (1987) developed instructional strategies for teaching science at standard IX. Mehna (1986) investigated factors affecting academic achievement in science of standard IX by conducting a survey. Suthar (1998) conducted a comparative study of science education of uttar buniadi schools and secondary schools of Gujarat and Umashree (1999) explored transactions of science curriculum in secondary schools of Vadodara. Both of them have selected samples from VIII, IX, X standards. Kwatra (2000) focused on standardizing the test of science processes for the students of eighth grade and selected samples from standard VIII. Mohparta (1989) conducted a descriptive study on dimensions of teaching-learning of science to identify the role of teacher and the learner in the teaching learning process while developing and modifying science concepts which was based on literature review in the area of science. Shah (1981) also sampled teachers of secondary schools to implement the strategy on the sample and studied their reaction also.

From the studies reviewed, sample size and sampling technique adopted by the researchers varied as per the type and nature of study. In most of the experimental studies; shah (1981), Ravindranath (1982), Vardhini (1983), Joshi (1987) purposive sampling was adopted except Vaidya (1991) who has adopted random sampling to select thirty three students. In the above studies sample size varied from forty five to ninety students from the schools in the case of experimental studies whereas in survey type of studies sample size ranges from 163 (Umashree, 1999) to 500 students (Suthar, 1998). Kwatra (2000) and Shrivastava (2002) had selected 500 students for their study through stratified random sampling and purposive random sampling receptively.

Shah (1981) used Lecture, Lecture, discussion, practical, audio-visual aids in various combinations as experimental intervention and studied its effect on students' achievement. Similarly, Vardhini (1983) and Joshi (1987) used above mentioned strategies along with guided discovery, biographical accounts, glossary, diagrammes, assignments, feedback as additional components of instructional strategies. Strategies

used by Ravindranath (1982) were team teaching, inquiry techniques, pupils' activities, demonstration, historical background of scientists and Programme Learning Material (PLM) apart from the above mentioned strategies. Rathod (2007) used various strategies based on internet, Encarta, textbook, Project Based Learning (PBL), power point presentations including lecture and discussion as per the requirement. Cook (2007) used constructivist learning strategies such as cooperative learning, problem based learning and inquiry questions. A shift in the strategies adopted by the researchers was observed from the teaching strategies to learning strategies and from traditional methods to constructivist methodologies.

Mehna (1998), Suthar (1998) developed criteria based tools and used for survey whereas Kwatra (2000) developed and standardized a tool for the study. Shrivastava (2002) used learning style inventory prepared by Kolb (1976) and scientific attitude scale by B. Kuppuswamy (1962). Rathod (2007) tried to translate the tool of learning style index in vernacular language Guajarati and developed scientific attitude test as per the requirement. Major tools used by the researchers to measure the effectiveness of the developed programmes were achievement test and scientific attitude scale. Various tools used by Ravindranath (1982) were reaction scale, questionnaire and Ravens' Progressive Metrics to study I.Q. of the students as a variable. Achievement test remained first choice of the researchers to find out effectiveness of the experimental interventions or studying correlation with attitude and intelligence of the students. As against this Cook (2007) used a constant and continuous classroom observation schedules and interview scheduled of the students after each of the activity sessions to study the process of implementation.

Shah (1981), Ravindranath (1982), Vardhini (1983), Joshi (1987), Rathod (2007) used 't' test to find out the effectiveness of the developed instructional strategy whereas Vaidya (1991), Cook (2007), used content analysis techniques to find the reactions of the students on developed strategies. For the analysis of the observations and interviews taken, researcher has used qualitative description after triangulation of the collected data. Suthar (1998) and Umashree (1999), and used frequency and percentage analysis of the responses collected by students. Kwatra (2000) computed correlation of select variables with science processes whereas Shrivastava (2002) found correlation of students learning style with attitude and achievement. Rathod (2007) categorized students in three different types as per their learning styles and found its correlation with achievement and attitude. 't' test was used by majority of

the researchers who have employed experimental design. In addition to these efforts were made to find out the relative effectiveness of the instructional strategies used in the experimentation.

All the experimental studies intending to study the effectiveness of the developed strategy have indicated positive result and the strategies were found effective in comparison to the traditional classroom teaching. All of them have considered lecture as a traditional approach and studied relative effectiveness. Findings of the studies conducted by Shah (1981), Ravindranath (1982), Vardhini (1983), Joshi (1987), Cook (2007) revealed that any instructional strategy having various types of learning modes is effective in learning science. Shah (1981) found that lecture supported by A.V.Aids followed by discussion and practical work is the most effective strategy among the used strategies which could cause significantly high achievement in student. Similarly Vardhini (1983) reported that combination of lecture, discussion, guided discovery, diagrams followed by exercise found to be effective. Adding to these Ravindranath (1982) endorsed that pupils' activity, teachers' demonstrations, discussions, audio visual presentations, team teaching, inquiry techniques followed by feedback and exercises results in the high achievement in science. Joshi (1987) further reported that instructional strategy could develop higher mental ability along with the achievement of the students. Above mentioned studies suggested that used of lecture method should be minimized and various modes could be used by the teachers to cause better learning in the students.

Studies focused on studying the factors affecting students learning in science have also been reviewed. Mehna (1986) identified six indicators which significantly affect the students learning in science; intelligence, motivation for learning, knowledge of general science, scientific attitude, liking for science teachers and interest in science. He further suggested that if teachers can develop interest in students and motivate them for learning it can enhance their level of learning. Kwatra (2000) found that creativity and intelligence together play significant role in students understanding about basic processes of science. Srivastava (2002) found the relation of the students learning style with their intelligence and found that students with high I.Q. prefer convergent learning style compared to the low I.Q. students who prefer Assimilative learning style. However it was emerged that convergent and accommodative learning styles were appropriate for science learning where as Assimilative Learning Style was inappropriate to learn science.

Rathod (2007) classified the students in the three types using learning style scale; visual learners, auditory learners and kinesthetic learners and provided various inputs as per their needs. It indicated that 17 percent of the students in the classroom were of auditory type and lecture is the most suitable method for them, 13 percent of them were visual learners and using visual aids and motion-pictures provide them more understanding about the concepts. Whereas 61 percent of the students are kinesthetic learner who learn by active involvement in the activities and manipulating the objects and materials and for them project work, group activities, field work are more suitable ways to generate meaningful learning experiences. It has also been noted that 13 percent of the students were comfortable with any of the learning style and prefer for understanding the curriculum in integrated manner.

Srivastava (2000) and Rathod (2007) suggested that teacher should take care of various learning styles and design the instruction accordingly. Rathod proposed for use of project methods, group learning and field trips for the students. Cook (2007) found that use of constructivist learning cater to need of various learners. It is reported that students feel more motivated in the activity which allow them to work with peers, contribute their own ideas and relate topics of their interest to their own reality. The researcher has suggested the use of cooperative learning, inquiry questions, active learning, experiential learning in science classrooms which reflect multiple intelligences and real world situations. Researcher has suggested that in order to create the learning community and motivate the learners' teachers should change their teaching pedagogies to create problem solvers and lifelong learners.

On the other hand the researches carried out to study the status of science teaching at secondary level portray a different scenario. According to Suthar (1998) lecture method was used by majority of science teachers at secondary schools of Uttar Pradesh. Few teachers used heuristic and Programmed Learning Method. Many teachers used Question Answer Method and audio visual aids in the classrooms. A very few teachers took students to the laboratory. Similar study was conducted by Umashree (1998) in secondary schools of Vadodara city. Researcher observed the science classes and reported that Lecture method was used in 70% of cases, lecture cum discussion method in 10% and lecture cum activity teaching strategy in 6% of the cases. Non conventional approaches were observed in the remaining 14% of the classes i.e. reading aloud, a brief explanation and silent reading. The instructional activities operating in the secondary schools at Vadodara in the classroom transaction

are centered on the textbook. Child cantered, activity based learning approach, and with the teacher acting as a facilitator is the instructional strategy in the predefined objectives. In none of the classes under observation, problem solving or inquiry based teaching had been noticed. Learners were not assigned any project work.

Mohpatra (1989) has shown the crucial role of the science teachers as one of the important dimensions affecting the learning science but, till date quality of science teachers remained one of the important issues related to science education. The first national science survey commissioned by Indian National Science Academy (INSA, 2005) and conducted by the National Council of Applied Economic Research (NCAER) intended to find out the status of science education all over India. The data were collected from 3, 46,000 people in rural and urban areas from different age group. The report presented provided a gloomy picture about science teaching in school and higher education that one third of students said that they were not motivated enough to continue studying science after leaving school. It further reported that Indian students lack in application level and focused group discussion session compare to knowledge and understanding level of questions and suggested "there is a need to strengthen the quality of science teachers, teaching methods employed by them in classrooms and the educational infrastructures."

2.1.2 Observations and implications

Total thirteen studies were reviewed in this section majority of which adopted developmental research design which intended to develop instructional strategies to improve the instructional process at in science subject secondary level. Studies reviewed have indicated required changes in the instructional strategies used over a period of time. Shah (1981), Ravindranath (1982), Vardhini (1983) and Joshi (1987) introduced multimedia instructional strategies to teach science at secondary level.

The strategies used were

- Lecture + discussion
- Lecture + discussion + practical
- Lecture + discussion + practical + A.V. Aids
- Team teaching
- Inquiry technique
- Pupils activities
- Teacher's demonstration
- Discussion sessions

- ❑ Audio visual presentation
- ❑ Historical back ground about scientists and
- ❑ Programmed learning material
- ❑ Criterion test and feedback
- ❑ Exercises and assignments
- ❑ Scientific inventions
- ❑ Guided discovery
- ❑ Biographical accounts
- ❑ Summaries
- ❑ Glossary
- ❑ Exercises and assignments
- ❑ Criterion test and
- ❑ Feedback.

Above mentioned strategies hold true in present context in 2010 only its expressions have changed. Ravindranath (1982) suggested that teachers are to be trained for using these strategies in the science classrooms. Vaidya (1991) focused on use of inquiry approach to teach science. Cook (2007) suggested for the orientation of teachers for the constructivist methods like cooperative learning, experiential learning, active learning and group activity. Kwatra (2000) focused on the science process skills to have better learning. Rathod (2007) also suggested for the use of project based learning and small group learning to meet the needs of majority of the learners in the classrooms.

In a nut shell, there is a scope for designing the science instruction with the above mentioned instructional strategies as all of them have shown positive results in the students. Umashree (1999) and Suthar (2000) indicated wide gaps in 'what should be there' and 'what is existing' in science classrooms. They have shown the real practices in the science classrooms, which call for preparing the science teachers for the same to reduce the existing gaps. Mehna (1986) suggested that adequate information and training for teachers of science in making science teaching interesting. Hence, training them in the techniques of arousing pupils' motivation for learning science is required.

It can be implied from the above

- ❑ Use of instructional strategies to teach science at secondary level enhance students' achievement, understanding and higher mental ability

- In creating interest in learners teacher is one of the important factors and his/her role is crucial.
- In majority of the schools teachers still confined themselves to the lecture method whereas various methods are possible to use
- The probable cause for confining to traditional method of teaching as given by teachers was due to lack of exposure, lack of confidence due to lack of practice about new methodologies of teaching science at secondary level.

2.2.0 Studies related to teacher education for secondary level

It is clear from the above discussion that science teaching has scope of including various methods in classroom transactions which can enhance students' achievement and understanding in particular and improve the status of science teaching in general. Teachers and teachers' training play important role in enhancing quality of teaching. Studies conducted on teacher education institutions are required to review to have a better understanding of type of instructions and inputs provided to the in-service and pre-service teachers' In this section studies conducted either on teachers or on teacher education programmes were reviewed. Seventeen studied conducted at teacher education level are reviewed discussion of which is presented below in detail in two different categories. In the first category studies which have focused either on examining the teacher education programmes for training teachers or focused on effect of training on in-service teachers. In the second category of this section deals with the studies conducted at pre-service teacher education level on would be teachers of science at secondary level.

- Studies conducted on teacher education programmes and in-service teachers.
- Studies conducted on teaching of science at pre service teacher education level.

2.2.1 Studies conducted on teacher education programmes and in-service teachers.

To have an idea of pedagogical practices and status Teacher Education Programmes (TEPs) in various institutions studies conducted either on in-service training or pre-service training are reviewed and presented in this section. Seven studies have focused on TEPs out of seventeen studies reviewed on teacher education are presented and discussed in this category.

Raijiwala (1975), Shaikh (1999) and Boyd (2007) focused on the in service teachers and related variables whereas Desai (1986), George (1999), Goswami (2003) and

George (2007) focused on the teacher education programmes and related issues. Desai (1986) and Boyd (2007) conducted explorative studies whereas study conducted by Raijiwala (1975) was experimental in nature. Shaikh (1992), George (1999) and George (2007) conducted survey of status of teacher education programme and Goswami (2003) had ex-post facto study on the effect of teacher education programme on students.

Raijiwala (1975) conducted a study on changing teacher behavior in the teaching of science and studying its effects on pupils whereas Shaikh (1992) conducted a study of teaching competency of secondary school science teachers of Dhaka city. Boyd (2007) conducted the study entitled "from learning science to teaching science: what transfers?" these three studies have focused on teachers behaviors. Desai (1986) conducted a study entitled "a critical study of science teaching programme at middle school level in Karnataka state and George (1999) studied innovations, issues and problems of teacher education in Bihar in recent years. Goswami (2003) conducted a study on effect of Participatory Teacher Education Program (PTEP) on the conceptual development and self development of student teachers whereas George (2007) studied use of modern instructional strategies: awareness and achievement of student teachers.

Raijiwala (1975) investigated the effect of the training and feedback provided to the in-service science teachers to perceive their own classroom behavior to modify and sustain the modified behavior. The researcher has also studied the effect of training on teachers in terms of increased academic achievement of respective students. Shaikh (1992) intended to identify the competencies of science teachers in teaching science and finding competent science teachers. Researcher further studied competent science teachers in relation to different attribute such as inherent capacity, environmental factors; home and academic background. Boyd (2007) explored the relation between teachers learning in science and the way they teach science. All the three studies have focused on science teachers competencies. Desai (1986) explored status of science teaching in terms of sufficiency of science teachers, qualifications' understanding of science concepts, effect of teachers work load, practical work, methods and aids of teaching science, evaluation procedure, co-curricular activities teacher reaction to the syllabus and its efficiency, sufficiency of laboratory and library facilities in-service training, effect of hand book, problems of syllabus implementation and suggestion for improving science teaching. George (1999) intended to evaluate admission procedures

followed by teacher training institutions, teaching learning process and innovative methods used by teacher educators, teachers' awareness on changing roles and responsibilities, relevance of the curriculum of teacher education, training and its duration and its effect on classroom transactions. Researcher also highlighted physical facilities available in training institutions, process of recruitment of teacher educators, their minimum qualifications, community out rich programmes, research culture in training colleges and the relationship between pre-service and in-service teacher education in the state. Goswami (2003) studied the involvement of student teachers in determining the goals, learning process, evaluation process as well as cognitive growth, participatory behavior and cooperation among them due to participatory programme. George (2007) intended to assess the infrastructure facilities and instructional resources available in primary teacher training institutes for using modern instructional strategies and understand the awareness of primary level student teachers about the use of modern instructional strategies. The study also tried to understand the opinion of primary level student teachers about the use of modern instructional strategies and analyzed the views and opinion of primary teacher educators about their use of modern instructional strategies.

The studies by Raijiwala (1975), Shaikh (1992) and Boyd (2007) have drawn teachers as their samples from the secondary schools. In addition to the teachers Raijiwala (1975) has also included students of the selected teachers for the purpose of study. Shaikh (1999) selected samples from the secondary schools of Dhaka city and from the selected samples competent teachers were drawn, Boyd (2007) had drawn the sample from the science teachers specifically having physics degree at graduation level. Desai (1986) collected information from teachers, head masters and supervisors of the secondary schools whereas George (1999) sampled out hundred teacher educators of PTCs, DIETs, 200 teacher trainees and twenty experts of DIETs, PG departments of education, SCERT and Bachelor of education programme, training collages from Northern, Southern, Eastern and Central zones of Bihar. Multi stage random technique was used for this purpose. Goswami (2003) selected 125 students enrolled in cooperative teacher education program for session 1999-2000 of faculty of education, Banasthali Vidyapith. George (2007) selected 530 elementary student teachers and five teacher educators from fourteen PTC collages of Kottayam district.

Tools used by most of the researchers (Desai, 1986), (George, 1999), (Shaikh,1999) and (George,2007) were reaction scale, open-ended questionnaire, and checklist.

George (2007) also used Ravens' Progressive Metrics, interview schedule, computer assisted instructional software, cooperative learning method to collect the data. Raijiwala (1975) used observation sheet to record changes in teaching behavior of teachers and Goswami (2003) used participatory observation techniques to record the data required. Boyd (2007) prepared the classroom observation schedule and reflective thinking technique. In all the survey type of studies data were analyzed using frequency percent analysis and content analysis technique whereas Raijiwala (1975) employed 't' test. Data reduction, bracketing and triangulation were used by Boyd (2007).

Raijiwala (1975) found that the training and feedback given to the teachers of the experimental group have affected pupils class room trust positively and significantly. The training and feedback given to the teachers of the experimental group have affected the academic achievement of the pupils in science positively and was significant at 0.01 level. Similarly, Shaikh (1999) endorsed that Teachers' interest in their profession has the significant relationship with teaching competency. The teaching competency of science teachers substantially depends on the academic achievement of teachers. There is positive and significant relationship between professional training and teachers' competency. Supporting the above findings, Boyd (2007) found that teachers transferred only what they sought from the course. Findings of this study highlighted many different ways teachers could use which they learnt in content courses to teach science to elementary children. While some teachers transferred pedagogical practices along with the content, others transformed the content to be useful in already existing pedagogical frameworks, and still others show little or no evidence of transfer.

Study conducted by Desai (1986) revealed that in more than (76%) schools did not have science laboratory and science clubs. Experiments performed by teachers were helpful in learning. There was no help from higher authorities to improve the facilities regarding science teaching. Teachers were not trained to teach using laboratories effectively. Scientific knowledge given in the textbooks was suitable in day-to-day life. Study conducted by George (2007) also revealed that teacher educators under study were not fully satisfied with the adoption of instructional strategies in primary training institutes. The study pointed out the general poor awareness of student teachers about the significance and use of multi-sensory equipments and projection devices, E-learning and web based technology and the theoretical bases of modern

instructional strategies. Instruction using the Co-operative Learning Package (CLP) and prepared Computer Assisted Instructional Software (CAIS) were more effective than the conventional lecture method in the achievement of the total sample of primary level student teachers. Among the three strategies under study, CLP was the most effective on the basis of achievement of the total sample of primary level student teachers. When compared between the CLP and the CAIS for the total sample and sub samples, primary level student teachers who learnt using the CLP showed better delayed memory achievement.

George (1999) found that correct training in theory, skills, practice teaching are quite essential which will result in bringing about a commitment towards the learner, the society and his profession. Further, reported that the curriculum was useful as per 73% of the population. However, it can be improved further to make it more useful and effective. The study further reported that the curriculum was not sufficient. It must be associated with society; it should be gender sensitive to achieve the goal of universalization of education. The curriculum was vast for the year session. Goswami (2003) reported that the participatory teacher education programme was effective. The program increased involvement in relation to cooperation. The program made the student teachers responsible.

The studies discussed above give ideas about the teachers' attitude, competencies and type of training received and its effect on student performance. It also throw light about the physical facilities available in various teacher education institutions, methods used by trainers for teaching, innovative programmes, practice teaching programmes and its bearing on improving quality of instructions and enhancing quality of teacher education and empowering the teachers.

2.2.2 Studies conducted on Teaching of Science at pre service teacher education level.

Having viewed studies on the status of teacher education in the previous section, in this section ten studies were reviewed and presented below which are focused on pre-service teacher education. All these studies are conducted at B.Ed. level which prepare teachers for secondary and higher secondary level i.e. secondary teachers training institutions except the study conducted by Sharma (1999) which focused at both pre service and in-service teacher education programme. As focus of present investigation is to develop the science teaching programme for B.Ed. students studies conducted on would be science teachers are presented below for the discussion.

Studies reviewed under this category focused on teaching of science at B.Ed. Level, strategies or methods of teaching pre service science teachers, studying the variables affecting the performance of student teachers or experimental investigations studying the effect of various models/ teaching strategies or innovative approaches on student teachers.

Studies reviewed here are experimental, exploratory or survey types except one case study conducted by Heather (2007). Studies conducted by Singh (1989), Malik (1990), Gaikwad (1993), Shukla (2003), Hakan (2007) and Dimichino (2007) were experimental in nature whereas Anwer (1990) conducted ex-post facto research. Baland (1999) and Sharma (1999) conducted descriptive surveys of science teaching competencies and skills of student teachers.

Singh (1989) identified certain skills of science teaching and their effectiveness in relation to student teachers' creative ability whereas Baland (1999) investigated the study habits, reading interest, attitude towards teaching and their effect on student teachers' achievement with certain variables such as urban and rural area ,gander, and finding correlation among above mentioned attributes. Anwer (1991) studied the effect of short term content enrichment programme to overcome the deficiencies of trainees in science subjects. Gaikwad (1993) studied effect of mastery over theory and planning skills upon teacher trainees' performance on Concept Attainment Model (CAM). Malik (1990) studied impact of investigatory approach upon student teachers cognitive appraisal and its implications for science teachers training programme, Dimichino (2007) studied impact of inquiry based curriculum and its relationship to students' interest and achievement in science. Purpose of the investigation was to investigate the development and changes in constructivist behaviors of pre-service science teachers of the IOWA-secondary science teacher education programme over the four semester sequence. Hakan (2007) studied the impact of Science Technology Society (STS)/Constructivist Approach (CA) on the beliefs and attitudes of pre-service science teachers. Sharma (1999) compared science teaching methods used by the B.Ed. student teachers and trained graduate teachers of science in Agra city. Shukla (2003) tried to study the effectiveness of video programmes with discussion, without discussion and traditional methods on the achievement of student teachers in context to certain variables. All the above mentioned studies were quantitative in nature. Heather (2006) conducted a case study entitled "profiles of pre-service teacher

education: An investigation into the nature of selected exemplary programmes in Jamaica and Michigan" which was purely qualitative in nature.

Singh (1989), Malik (1990), Gaikwad (1993) and Hakan (2007) selected single group experimental design and sampled out forty one student teachers except the study of Malik (1990) where the sample size was thirty six. Against this Anwer(1991) selected experimental and control group and selected 160 student teachers from five different teacher training institutions of Mysore city. In survey type of studies sample size vary from 160 to 450 as per the nature of study. Sharma (1999) for the purpose of study selected 207 teachers of pre-service and in-service teacher education for secondary level. Baland (1999) selected sample of 450 student teachers from the regular colleges of education, M.D. University, Rohtak. Heather (2007) interviewed five categories of stakeholders from three different institutions regarding the perception and expectations in general as well as in the context of their programme.

Among the tools for data collection achievement test and attitude test towards teaching were the most commonly used by the researchers in experimental studies. Questionnaire developed by researcher themselves was the common tool used for survey type of researches. Singh (1989) used Flanders Interaction Analysis Category System (FIACS) developed by Flander, Verbal and non-verbal test of creativity by Mehndi, and science classroom teaching competence cum observation scheme developed by the investigator. Gaikwad (1993) used Concept Attainment Model by Bruce, plan evaluation scale by Sansanwal and Sharma, Willingness Scale by passi and Sansanwal, reaction scale and intelligence test by Mehta, General Mental Ability test by Gyan Probodhini, Pune. Baland (1999) used study habits scale developed by Mathur, Attitude towards teaching developed by Alluhwalia, Reading interest inventory by Chadda and achievement test developed by researcher himself. Sharma (1999) developed reaction scale towards science teaching method and understanding test towards method of teaching science. Dimichino (2007) used three instruments for data collection; constructivist learning environment survey, philosophy of teaching-learning, video tape portfolio evaluated with the reformed teaching observation protocol.

Data Analysis techniques used by the researchers were mean, frequency percentage, SD, correlation among various variables and 't' test in the case of quantitative studies. Malik (1990), Anwer (1990), Gaikwad (1993), Baland (1999), Sharma (1999) Shukla (2003), Dimichino (2007) and Hakan (2007) formulated null hypotheses and

calculated 't' value. Sharma (1999) and Singh (1989) used correlation among various attributes. Heather (2006) analyzed collected information by qualitative content analysis technique.

Singh (1989) suggested that, quality of science teachers could be raised through competent science teachers preparing through training of identified teaching skills in Microteaching setting. Sharma (1999) found that the use of science teaching methods by student teachers as well as in-service teachers make their teaching methods more effective than those who did not use any of them. The overall reaction, understanding and teaching competence of student teachers as well as in-service teachers determined the nature of effectiveness of their methods of teaching science. There existed a significant positive correlation among student teachers scores with regard to their reaction and understanding, understanding and teaching competence; and reaction and teaching competence about the methods of science teaching. The same trend was seen in case of in-service teachers. Findings of the comparative study conducted by Shukla (2003) are as follows. The methods of teaching had significant effect on the achievement of the student teachers. The student teachers who were taught through the video programmes with discussion were better in achievement than the student teachers who were taught through video programmes without discussion. The student teachers who were taught through the video programmes with discussion were better than the student teachers who were taught through the traditional methods as far as their achievement was concerned. The student teachers who were taught through the video programmes without discussion were better than the student teachers who were taught through the traditional method as far as their achievement was concerned.

All the studies having single group pre-test post test design has a positive difference in the results except the study conducted by Gaikwad (1993) to study the effect of mastery over theory and planning skills upon students performance on CAM which indicated that independent reading of instructional material on theory of CAM had no significant effect on the teacher trainees acquisition of theory of CAM. Investigatory approach showed a positive reaction of science student teacher in the study conducted by Malik (1990). Learning of investigatory approach through viewing live demonstration resulted in the improvement of the cognitive appraisal about the approach. Learning the investigatory approach shows significant improvement in the cognitive appraisal. Anwer (1991) reported that after the training of short term enrichment programme there was no significant difference regarding content

enrichment but there was a significance of difference between both the groups in the learning of science subjects and in practice teaching after the enrichment programme. According to Baland (1999) there is a positive high correlation between the study habits and achievement of pre-service teachers, moderate positive correlation between the reading interest and achievement of pre-service teachers, moderate positive correlation between the attitude towards teaching and achievement of pre-service teachers. The study further found that achievement is affected by forty six percent of study habits, twenty one percent by reading interest and fourteen percent by attitude towards teaching. The remaining nineteen percent of achievement is attributed due to some other factors like environment, economic factor, Family conditions, background.

Heather (2006) identified distinguishing features of exemplary/effective pre-service teacher education programs whether they are university or college based. Programs of this sort should pusses eight basic features: (a) coherent program vision, (b) cultural competence. (c) collaborative partnership, (d) contextualization. (e) quality standards. (f) well planned an implemented field experiences. (g) continuous assessment, (h) experienced committed faculty, and (i) a harmonious blended of theory and practice. These features enhanced the performance of graduates from these institutions. Dimichino (2007) reported that the classroom environment structured by the cooperating teacher was an important factor making use constructivist strategies. Cooperating teachers' science teaching and learning philosophy has influenced pre-service science teachers' beliefs and practices. Hakan (2007) found that pre-service science teachers showed significant growth over the semester in their perceptions concerning STS/CA, beliefs about science teaching and learning and attitudes toward science and technology, and their implications for society. These significant changes were not affected by gender nor grade elementary or secondary level. Pre-service science teachers gain in understanding of how students learn with STS/CA. They also increased their use of STS/CA which were developed and applied to teaching science for all students. Pre-service science teachers showed statistically significant growth toward an STS/CA of science teaching and learning in terms of student actions in the classroom, as well as their increased understanding of science processes and content. An STS/CA provides student-centered learning environments that are relevant, motivational, and meaningful for pre-service science teachers. Further, it encourages them to interact and to participate more actively in science classrooms.

Heather (2006) suggested that to be effective, pre-service teacher education programs have to prepare prospective teachers to adequately meet the challenges of teaching in the schools and classrooms of today. The programs' structure may vary according to their institutions' guiding principles, beliefs features that will characterize all programs that are operating to prepare the caliber of teachers that the society demands. To bring social change, quality teachers are needed, and to produce quality teaches, quality preparation is a necessity.

All the above mentioned studies tried to highlight the status of pre service teacher education in terms of pedagogical practices, instructional inputs, effect of various programmes and their effectiveness with respect to pre decided variables.

2.2.3 Observations and implications

Examining the studies on teacher education programmes, in-service teachers and related variables, it is observed that the one category of studies deals with studying the status of various programmes for teacher education and its effect on student's achievement via teacher's competencies. Another category of studies focused on the status of pre service teacher education special focus to the teaching of science at B.Ed. level.

Researchers have conducted surveys to find out the status of teacher education institutions, in-service teachers training institutions, infrastructural facilities available and its correlation with students achievement, innovations, issues and concerns, teaching competencies of teachers. George (1999) evaluated the existing criteria of admission procedure, teaching learning process, practical work, practice teaching and innovative methods of teaching at secondary teacher training institutions. Study conducted by Desai (1989) revealed a sorry state of science education and indicated a lack of science laboratory, lack of infrastructure, lack of confidence in teachers for doing live demonstration. Various experimental studies showed a positive result in terms of enhanced level of student teachers after undergoing treatment. Findings of the studies reveal that student teachers are having poor understanding about significance and use of multi sensory software, computer assisted software cooperative learning package etc. If comparison among the various types instructional inputs are made George (2007) indicated that cooperative learning package is more useful and could produce significantly higher achievement. It has been discussed in the studies that there exist a positive impact of professional training of teachers and student achievement in respective courses. As per Shaikh (1999) teachers' interest in

their profession has the significant relationship with their teaching competencies. The teaching competencies of science teachers substantially depend on their academic achievement. The findings of Boyd (2007) and George (2007) support the view that correct training, theory, skills and practice teaching is quit essential towards the learners and societal development.

It is clear from above discussion that expectations from teacher education institutions and teachers are much more than what exist in the field. Teachers are expected to know about the new methodology of curriculum transactions and use of information and communication technology instruments in education. But the existing really in the field depicts that infrastructural facilities and pedagogical training of teachers are not satisfactory. Correct training is essential for developing the humane teachers as reflected in NCFTE(2009).

In another category of studies, ten studies on status of preservice teacher education are presented above. Studies at preservice level on development of intervention/instructional strategy/programme/packages using various models are common. A single group pre test post design with forty one student teachers are a quite common combination having 't' test for testing the null hypothesis for studying the effect of developed programme. Four studies conducted were descriptive surveys which tried to identify the teaching competencies, study habits, reading interest, intelligence, attitude towards teaching and relation of these variables with achievement. One study was on ex-post facto impact of a training programme on student teachers.

As far as science method teaching at teacher preparation stage is concerned concept attainment model, inquiry approach, computer assisted instruction, cooperative learning package are the approaches and programs which were developed by the researchers in India. The emerging areas explored in science are science technology society approach, inquiry approach, constructivist approach; constructivist learning environment studies which provide would be science teachers to change the conventional method of instructions from teaching methods to learning methods.

Constructivist learning provides better opportunities to a teacher to create cooperative and creative learning environment through experiential and field based learning. The new assessment areas introduced are basic science process skills test, understanding of science method, attitude for science teaching, science competencies test and new techniques used by the researchers are video tape portfolio, rubrics. Heather (2006)

identified features for effective teacher education institution at preservice level which are given below

(a) coherent program vision (b) cultural competence

(c) collaborative partnership (d) contextualization

(e) quality standards (f) continuous assessment

(g) well planned and implemented field experiences (h)experienced committed faculty

(i) a harmonious blended of theory and practice.

A pre-service teacher education programme found effective for students and nation. Studies on science method teaching indicates that video tapes, discussion, inquiry approach, teacher demonstration created a significant positive effect on student teachers interest, attitude and academic performance in comparison to traditional methods of teaching. An STS approach could generate better learning environment in the science classrooms. Most of the researches under this section are experimental. However a change is observed in the studies conducted after 2001; studies attempted to study the effect in the natural classroom setting rather controlling the variables. Measurement of no measurable skills, understanding is a new positive change.

Implications can be drawn from this section for present investigation as follows:

- Professional training of teachers has a positive impact on students' achievement.
- Science method teaching though aspires to change yet not realized to the fullest.
- If proper training is given to the pre-service teachers their competencies can be enhanced for teaching science.
- New methodologies like inquiry approach; experiential learning can be utilized to train the science teachers.

Any teacher education programme at pre-service level can be made effective by incorporating above implications. To prepare would be science teachers with methodologies like inquiry approach, experiential learning and cooperative learning has wider scope considering the nature of science. This will provide them exposure to various methods and give them feel of their effect. Report of NCFTE (2009) recommended for the preparation of humane teachers which can be achieved by cooperative learning methods and providing scope of active involvement of student teachers.

2.3.1 Studies related to Activity Based Teaching at various levels.

Present investigation aimed to develop an activity based teaching programme hence attempt is made to review the studies related to activity based teaching. Researcher could reach out to a very few studies directly related to activity based teaching at school level or at teacher education level. Studies pertaining to various non conventional methods, activities and inquiry based teaching were reviewed for this section. Most of the studies reviewed in this section are latest and conducted outside India. In this section total ten studies have been reviewed and discussion is presented in proceeding lines. Five studies have focused on different activities at various levels starting from primary students to school teachers including student teachers and three studies have focused on effects of inquiry based curriculum. Two studies attempted to investigate the course teaching of science at pre-service level by various modes.

Studies conducted by Jones (2002) and Department of Education, University of Louisiana at Monroe (DOE, Monroe 2004) concentrated on activity based instruction for students. Jones (2002) conducted a study on "The effects of video-based and activity based instruction on high school students' knowledge, attitudes and behavioral intentions related to seat belt use". DOE, Monroe (2004) studied the effect of an integrated, activity based science curriculum on students' achievement, science process skills and attitude towards science. Ganapathi (1993) carried out factor analysis of the Para academic activities in improving science teaching at secondary school and Rosso (2004) studied observation as an experience activity whereas Dee (2006) investigated outdoor effect of outdoor educational activities, visits of nature in the study entitled "Towards an understanding of an educational program: Listening participants' stories."

Jones (2005) developed and implemented an Inquiry based kits within a professional development school model. It was conducted on two science teachers during 2002-2003. These two teachers were supported by a co-teaching model, which included pre-service teachers for each teacher as well as a supervising professor. and Joseph (2006) investigated instructional practices and students learning during the enactment of an inquiry based chemistry unit. Vijayakumari (2002), Morrison (2005) and Volsey (2006) focused on preparation of science teachers. Vijayakumari (2002) studied the effect of different methods of teaching science on the achievement, basic science process skills and scientific attitude of pupils with different achievement level. It intended to compare the lacking processes in terms of interaction patterns associated

with the teacher demonstration, guided discovery and co-operative learning methods of teaching science and Find variation in interaction patterns due to change in prior achievement levels of pupils with respect to Teacher Demonstration Method (TDM), Guided Discovery (GD) and Cooperative Learning Method (GDLM & CLM) of teaching science. Volsey (2006) compared the ways to prepare the new teachers to teach science. The comparison was made between traditional teacher preparation and experimental science methods of preparing teachers. Department of Education, university of Louisiana at Monroe (2004) intended to investigate the effect of the IASC (Integrated Activity-based Science Curriculum).Morrison(2005) in the case studies try to investigate science teacher's belief, implementation practices of inquiry based science method including barriers and facilitators of successful implementation by studying three different science teachers. Jones (2002), DOE-Monroe (2004), Jones (2005) and Morrison (2005) have adopted experimental design for their study. Vijayakumari (2002) tried to investigate correlation among methods of teaching, achievement, basic science process skills of student teachers. Ganapathi (1993) conducted a survey to identify para academic activities organized in teaching science at secondary level and evaluated them in improving science teaching at secondary level through factor analysis technique. Rosso (2004), Morrison (2005), Volsey (2006), Dee (2006) and Joseph (2006) adopted qualitative research designs for the purpose of study.

Ganapathi (1993) with stratified random sampling selected 735 teachers teaching science at secondary stage. Vijayakumari (2002) selected Ninety six students of standard six from randomly selected government higher primary schools of rural areas. Jones (2002) collected data from 194 students in high school introductory biology and chemistry classes in Gainesville, Florida. Department of Education, university of Louisiana at Monroe (2004)It compared the performance of seventh grade students using an IASC to that of seventh grade students using a traditional science curriculum. Jones (2005) collected data by researcher's direct observations of co-teachers' practice. Data were also collected from interviews and reflective pieces from the co-teacher. Triangulation of data on each teacher's case supported the validity of the findings. Case reports were prepared from this data for each classroom teacher. Cross-case analysis was carried out to search for major theme and findings. Morrison (2005) involved three teachers in various stages of implementation of Inquiry-Based Science Method (IBSM). One participant was a novice in using IBSM,

one participant was in her second year of implementation, and the third participant was experienced with IBSM. The cases were set in a rural high school in three different science classrooms. Dee (2006) conducted the study with four sixth-grade students participating in a four-day residential outdoor education program. It included four participants' two female and two male students.

Reaction scales, Observation scales were used by majority of the researchers for the data collection. Apart from these, Basic science process skills by Padilla Crowin and Twiert, Scientific Attitude Scale, Ravens' Progressive Metrics and achievement test in science was used by Vijayakumari (2002). Classroom Observations, Interviews, field visits, student enactment were the qualitative data collection techniques used by researchers.

Jones (2002) used two treatments in the study: Video-based instruction and hands on activity-based instruction. The treatment group students participated in at least 500 minutes of instructional time divided among five seasons over 10 instructional days. Treatment 'A' was defined as participation in video-based instruction. Treatment 'B' was defined as the participation in four hands on science activities regarding crash related physics concepts. Rosso (2004) described combination of visual skills and reflective thinking as an aesthetic experience, which represents a heterogeneous approach to science, and an effective learning experience. Dewey' concept of experience was used to define the connection between experience and education. If education is experience based then the integrity of a student's experience is vital. Morrison (2005) observed each classroom under investigation was five times. Data was initially organized according to teachers' definitions, beliefs, teachers' barrier to implementation, and teachers' enablers to implementation. Then patterns emerging from each case were compared in a cross-case analysis. Joseph (2006) documented classroom lessons on videotape and an observation scheme was employed. Observations focused on teachers; efforts in building and sustaining lesson coherence. Contextualizing instruction, providing opportunities for student, providing opportunities for student sense marking, supporting student sense-marking, creating a classroom climate for learning, and enacting lessons with congruency to the unit materials. Volsey (2006) examined the ways in which student teachers deliver science activities to elementary students. The data collected for this study included classroom observations and interviews with the student teachers that served as the study's participants. Dee (2006) gave cameras for documenting the most important aspects of

their outdoor education experiences to the participants. The pictures were used to stimulate conversation and encourage reflection during the interview process.

Data analysis techniques included product moment correlation and centroid factor method (Ganapathi, 1993), ANOVA &'t' test (Vijayakumari, 2002) and (Jones, 2002) ANCOVA (Monroe, 2004), triangulation and cross case analysis (Jones, 2005) and video script analysis (Dee, 2006).

Study conducted by Ganapathi (1993) found thirteen factors from out of the twenty areas. For the thirteen factors, the areas of the Para-academic activities were listed in the order of the magnitude of the factor loading. Among these thirteen factors, science project activities factor has the highest percentage (43.12 %) of variance; next in the order, was science club, science scrapbook and school garden. The organization of the above four important activities contribute for the improvement of science teaching at secondary school level, which seem to be reasonably independent. In organizing the above activities teachers may face certain problem like: lack of adequate sets of tools; lack of expert guidance; and over emphasis on the coverage of syllabus.

Study conducted by Vijayakumari (2002) found following results; (a) the teacher initiated explanation, demonstration, directions, questions and pupil initiated talk to teacher and silence were significantly more for the low achievers than of high achievers.(b)there was significant difference between the high achievers and low achievers taught through the CLM with respect to the percentage of time spent on the various regions of the matrix and variation in different interaction ratio.

Jones (2002) found that, combining both the treatment produced significantly higher mean score than either treatment used individually. Participating in video-based instruction initially produced significant changes in students' attitudes but these changes were not maintained after students completed the activity-based instruction. Similar findings were evolved in the study conducted at Monroe. Department of Education, university of Louisiana at Monroe (2004) reported that the ANCOVA results for the ITBS science scores showed that the seventh graders involved in the IS activity-based science program had a significantly higher adjusted posttest mean compare to students in a traditional science programme. Similarly positive results have found with 9^{th} grade students involved in an activity based science programme.

The study conducted by Jones (2005) found various hurdles teachers' encounter, examples of adaptations observed in the teachers' cases and the supportive interactions with their co-teachers while implementing the inquiry based kits. Rosso

(2004) at the end of the analysis in aggregate measured a strong perceptual experience, a moderate intellectual experience, a minimal emotional experience, and an insufficient communication experience. Individual analysis showed that ten of the thirteen participants had an aesthetics experience through their participation in the questioning project. The Questioning Project, to a modest extent, improved observational skills, promoted intellectual growth, and provided a unique creative experience. Study conducted by Morrison (2005) found various patterns amongst the cases. Patterns shared between cases were; (a) Participants related the IBSM with hands on learning activities,(b) Participant saw students as the center of learning process, (c) Participants had positive constructivist learning practices that were strengthened after implementation of inquiry based teaching, (d) Facilitators of successful implementation of IBSM were positive students' motivation, students' relation to knowledge, and a positive experience for lower level students, (e) Barriers to successful implementation of IBSM were teachers not having complete control of the classroom, upper level students having difficulty with inquiry, time and curriculum being a factor, and teachers feeling unprepared to teach the methodology. Above mentioned studies were showing a positive correlation among the training given to the students and various attributes. Studies conducted on inquiry based teaching and approaches have shown positive results in favor of using inquiry approach to teach science.

Findings of the study by Joseph (2006) confirmed that learning was enhanced when teachers guided students in accomplishing inquiry tasks and in making sense of their inquiry experiences. Simply telling students science ideas appeared less effective for helping students learn. Dee (2006) found that participants interpreted their outdoor education program as a positive experience. Classes that were challenging and gave independence form adults were perceived as most important by study participants. Friends were considered an important part of the outdoor education program by all of the participants, but the natural world became more important as the week progressed. All four participants reported being more comfortable in the outdoors as the conclusion of the program, but their actions indicated otherwise. Joseph (2006) suggested that inquiry experiences rules for differentiating key science idea appeared less effective for helping students learn. Inquiry teachers may need to use explicitness during guidance about how to engage in tasks, to support the learning of students who have limited prior content knowledge and inquiry experience.

2.3.2 Observations and Implications:

Having realized the importance of introducing new methods of teaching science at pre service teacher education level it is equally important to study the studies being conducted which have already incorporated various methods in instructional set up. Total ten studies were reviewed in this section. Activity based word has been perceived by various researcher differently. Parallel words used for similar studies were hands on learning, activity based learning, field learning, active learning, group learning, project based learning though each of these words have a definite meaning, researches' have taken liberty to operationalize these words as per their convenience. Studies presented in this section mainly based on the active involvement of the learner in given task and studying either its effect on certain variables or focused on studying process of involvement during the given task. The unique feature of the studies mentioned here are the methodologies adopted which are mostly processes oriented. Sample size for the studies was also less compare to the common trend of minimum of thirty five students. Four studies were the individual case studies out often studies reviewed.

A group of studies were experimental in nature and having a group pre test -post test - design. Five studies were on activity based teaching and four were on inquiry based teaching and Vijayakumari (2002) focused on methods of teaching science. The study supported importance of field work as an important activity for science students and another study laid importance to the story telling activity as important activity. Teacher enactment of demonstration has been studied in one study. Studies having focus on inquiry based curriculum, inquiry based science method highlighted importance of inquiry approach to teach science. Activity based instruction has shown higher impact compare to video viewing activity. Ganapathi (1993) identified para academic activities in the order of most liked by student teachers.

Review of related literature presented above clearly suggest that science can be taught through activity based approach and various possible activities are field trips, outdoor activities, hands on learning, storytelling, demonstrations, video viewing.

It can be implied from the above,

- ❑ Activities cause better learning in student , interest is developed
- ❑ More delayed memory loss of the content can be ensured when content is learnt by activities.

- Training of science teachers have scope to incorporate the innovative approaches in India.
- The strategies mentioned in section 2.1.1 such as Lecture + discussion, Lecture + discussion + practical, Lecture + discussion + practical + A.V. Aids, Team teaching, Inquiry technique, Pupils activities, Teacher's demonstration, Discussion sessions, Audio visual presentation, Historical back ground about scientists, Programmed learning material, Criterion test and feedback ,Exercises and assignments, Scientific inventions, Guided discovery, Biographical accounts, Summaries, Glossary, Exercises and assignments, Criterion test and Feedback can be equally important for training would be science teachers at pre service level.

2.4 Implications of the related literature on the present study

From the review of the studies under the different sections in this chapter, it can be observed that a total of forty one studies were reviewed. In the initial stage researcher has reviewed sixty studies out which forty studies which were most befitting to the present investigation and presented in details. There were thirteen studies related to science teaching at secondary level, seventeen studies were related to teacher education level out of which seven studies have focused on effect of training on in-service teachers and ten studies on pre-service teacher education level on would be teachers of science at secondary level and ten studies have focused on activity based teaching or effect of innovative approaches to teach science at various level.

There were large number of studies which were conducted in the area of development of programme and strategies to teach various subjects at secondary level between 1980s and 1990s. Strategies and programmes were based on programme learning material to be used by students and found to be effective in comparison to the lecture method. After 190s a change in trend has been observed towards integration of ICT and most studies in this field were on development of Computer Assisted Instruction, Computer Assisted Learning Material and its effect on students. However these studies were restricted to the development of programmes on subjects of school level. Quantitative experimental studies were most commonly observed except few surveys conducted to study the status of science teaching or science education at school level. After 1990s a trend is towards integrating various models, approaches in science teaching and focus is shifted on studying their effect on students understanding rather than studying achievement as indicator of change. Various studies to study their

understanding and process skills, learning style have been taken up by researchers Rathod (2007) and Goswami (1999). These studies were experimental in nature and conducted in India but the studies reviewed from abroad have a shift from effect or effectiveness to study the implementation of the programme and even process of acquiring the skills, learning concepts and developing interest and factors which can accelerate the learning in science. Use of constructivist approach and methodologies has emerged as a recent trend followed by the researcher having case studies and in-depth studies having qualitative research designs.

Studies conducted by Ravindranath (1982), Vardhini (1983), Shah (1986) suggested for integration of various instructional strategies at school level. They have suggested preparing the teachers for these strategies so as to expose teachers for the same. Mehna (1986) found that liking for science teachers and knowledge of science is of the most crucial factors affecting student's achievement in science. According to Cook (2007) cooperative learning strategy is most effective strategy compare to the CAI and Lecture method. He further suggested that activities which provided learners chance to interact with peer members were the most enjoyable and preferred activity by them.

The studies conducted on status of teaching science Suthar(1998) and Umashree (1999) indicated that use of various strategies had positive effect on student achievement and multimedia instructional strategies and cooperative learning are effective than lecture. In spite of these findings, lecture continues to be the most commonly used method even by science teachers at secondary level.

The studies reviewed have clearly indicated that studies pertaining to the preparation of teachers for inclusion of various methods of learning science in their classrooms have a wider scope. Raijiwala (1975) found that training and feedback provided to the teachers of experimental group affects pupils' classroom trust effectively. Shaikh (1999) endorsed that there is a positive significant relation between teachers' professional training and teachers' competencies.

Studies reviewed related to teacher education has indicated that teacher training institutions are not equip with the required facilities. There exists wide gap between curricular changes expected at school level by the teachers and the way teachers are being prepared at teacher education institutions. Desai (1989) expressed a sorry state of science education. George (2007) pointed out general poor awareness of student teachers about the significance and use of multi-sensory equipments and projection

devices, E-learning and web based technology and the theoretical bases of modern instructional strategies. The studies reviewed do not show much encouraging picture however few studies conducted on curriculum transaction at B.Ed. level and new methodologies incorporated to teach science method student-teachers provided optimism of improvement.

With respect to the science method teaching inquiry approach, project based learning , computer assisted instructions are the commonly used methods whereas, experiential learning, hands on learning, cooperative learning package observed as emerging methods of teaching at teacher education level in India. Teacher education institutions are striving to keep pace with the rapid changes at school level by innovative programmes and practices. Study conducted on four year integrated programme by Goswami (2000) indicated that the participatory teacher education programme was effective that the tradition teacher education programme in terms of development of personality and self confidence and self concepts of student teachers. Heather (2006) suggested the indictors of an effective programme out of which well planned field experiences, continuous evaluation of the teachers and blend of theory and practices are considered relatively more contributory in the success of teacher preparation programme.

It has been observed from the review of experimental studies conducted at teacher education level that even thought developed programmes shown positive result they could not be institutionally practiced or would be teachers could not practice it in the classrooms. This could be because of lack of practicability in the developed programmes or lack of facilities which were required for its execution. These programmes were developed having control over the variables and hence could not be translated at field level dew to altogether different situation. It demands for the study which can be taken up in the natural setting and studying its effect on student.

Department of Education Monroe (2004) conducted a study on the students of grade VII focusing on integrated activity based science curriculum and studied its effect throughout the year without having control group. The whole syllabus has been converted into activity based learning and exposure is provided to the students. Continuous feed was collected through feedback sheet. This was than extended for grade IX students and with modifications it was implemented in the state which has shown significantly higher positive result.

Supporting to activity based teaching Rathod (2007) found that the sixty one percent of the learners are kinesthetic learners who learn through active involvement in various activities. Ganapathi (1993) identified that various activities of science such as science club, science scrap book making, school garden maintenance, science museum which can improve science instruction and liked by the students. Most liked activity was the science project making activity. Jones (2002) used hands on activities for physics concepts which resulted in significantly high mean score of the learners.

The studies conducted on activity based teaching have shown positive impact on students' attitude and interest which indirectly influence on achievement of students also however studies were on students at school level. Similar short of study can be taken for preparing teachers on Activity based science teaching. Researchers who have worked on development of programmes either studied effectiveness or studied impact on students at school level. Few studies were purely qualitative which described the context without scope of its replication. A study having blend of both quantitative and qualitative methods can be taken up to study the process of its implementation as well as effect at the end of the implementation.

In a nutshell, the study having activity based teaching for preparing student teachers for teaching science at secondary level through the course teaching of science, can be taken up in a natural setting without having any experimental control wherein process as well as effect can be studied throughout the year.