CHAPTER – 2

REVIEW OF RELATED RESEARCH
A summary of the writings of recognized authorities and of previous research provides evidence that the researcher is familiar with what is already known and what is still unknown and untested. Since effective research is based upon past knowledge this step helps to eliminate the duplication of what has been done and provides useful hypothesis and helpful suggestions for significant investigation. (Best and Kahn, 1986, pp. 39).

According to Best and Kahn (1986), the researcher should note the following elements.

1. Reports of Studies of closely related problems that have been investigated.
2. Design of the study, including procedures employed and data gathering instruments used.
3. Populations that were sampled and sampling methods employed.
4. Variables that were defined.
5. Extraneous variables that could have affected the findings.
6. Faults that could have been avoided
7. Recommendations for further research

For the present study, researcher reviewed the following sources in order to find the relevant studies.
1. 1\textsuperscript{st}, 2\textsuperscript{nd}, 3\textsuperscript{rd}, 4\textsuperscript{th} & 5\textsuperscript{th} Survey of Research in Education edited by M. B. Buch.

2. ERIC-SEARCH database.

The researcher mainly concentrated on the studies that are related to application of methods of teaching Mathematics at middle school and secondary school level i.e. std. V to std. X.

Following table shows the titles of some of the relevant studies and their sources.

### 2.1.0 Related Research in India

#### Table 2.1

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Source</th>
<th>Title of the study</th>
<th>Author</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>2\textsuperscript{nd} Survey of Research in Education edited by M.B. Buch.</td>
<td>Development and try-out of auto-instructional programmes in some units of geometry for class VIII and to study its effectiveness in the context of different variables.</td>
<td>Patel C. B.</td>
<td>1977</td>
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<tr>
<td>2.</td>
<td>2\textsuperscript{nd} Survey of Research in Education, M.B. Buch</td>
<td>To develop A-I Programme in Geometry for Std. IX and to find out their effectiveness in relation to different variables</td>
<td>Patel C.B.</td>
<td>1975</td>
</tr>
<tr>
<td>3.</td>
<td>3\textsuperscript{rd} Survey of Research in Education, M.B. Buch</td>
<td>A comparative study of the effects of modern and traditional Mathematics curricula on Piagetian concrete and formal logical thinking</td>
<td>Bala V</td>
<td>1980</td>
</tr>
<tr>
<td>No.</td>
<td>Survey of Research in Education by M.B. Buch</td>
<td>Title</td>
<td>Author</td>
<td>Year</td>
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<td>5.</td>
<td>A study to examine the effectiveness of methods of teaching Mathematics in developing Mathematical creativity.</td>
<td>Miyan</td>
<td>1982</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>To study effectiveness of different strategies of teaching on achievement in Mathematics in relation to intelligence sex and personality</td>
<td>Chitkara M.</td>
<td>1985</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>A study of effects of expository and guided discovery methods of teaching Mathematics on the achievement of students of different levels of intelligence.</td>
<td>Bhalwankar</td>
<td>1985</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Learning disabilities in the reasoning power of the students in geometry diagnosis and prevention.</td>
<td>Dutta Anima</td>
<td>1990</td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>A study of conceptual maturity of students belonging to age group 11 to 14 in non-metric geometry.</td>
<td>Rawool S.</td>
<td>1988</td>
<td></td>
</tr>
</tbody>
</table>
2.1.1 Critical Review of Related Research in India

Various methods of teaching such as auto-instruction, programmed learning, guided discovery, analysis-synthesis, Ausubel's and Bruner's strategies. Piagetian principles have been tried out by the researchers in teaching Mathematics, at middle school and secondary school level.

Patel A.D. (1977): Studied the effectiveness of auto-instructions (A-I) programmes in some units of geometry for class – VIII. He found auto-instruction material was effective in case of the students with high achievement motivation. It was also not very effective in case of students having poor reading habits. Programmed Learning Material (PLM) was
proved to be superior in case of students with poor study habits and high anxiety when compared to traditional way of teaching.

Patel C. B. (1975): Developed A-I programmes in Geometry for Std. IX and studied their effectiveness in relation with different variables. He found PLM more effective than conventional learning in case of high and low IQ groups.

Average time taken by the group- learning through PLM was less than that of the group learning by traditional method.

Bala V. A. (1980): Carried out a comparative study of the effects of modern and traditional mathematics curricula on Piagetian concrete and formal logical thinking. He found both modern and traditional Mathematics curricula were equal on Piagetian formal operational tasks (Std. VII). He also inferred that acceleration of concrete logical thinking was indicated through modern Mathematics.

Gupta (1979) : Evaluated the effectiveness of narration – explanation and analysis-synthesis methods of teaching geometry in high schools (Std. VIII and IX). He found effectiveness of these methods varying with respect to class, IQ and low or high achievers and also in terms of learning objectives such as knowledge, comprehension, application and skill.

Miyan (1982) : Compared the effectiveness of methods of teaching such as tell and do, guided discovery and pure discovery method on developing mathematical creativity. He found guided discovery method
effective in developing originality as compared to tell and do and pure discovery methods.

Giridhari Lal (1986): Studied the effects of individual and conventional learning and found individual learning more effective in terms of Mathematics education.

Chitkara (1985): Found lecture discussion method better suited for below average ability extroverts and introverts respectively.

Bhalwankar (1985): Found expository methods effective on application objective for high intelligence group and guided discovery more useful for low intelligence group on retention objective.

Several researches developed programmed learning material (PLM) and studied its effectiveness in terms of achievement and psychological correlates. Sharma (81) found PLM effective in case of flexibles whereas rigid were beneficial by conventional learning. Rao (85) found PLM superior in achievement for higher grade, privately managed school students with high general mental ability whereas PLM was inferior to methods involving visual projection, activity and experiments. It was equally good and sometimes superior in different content areas in Mathematics.

As far as conceptual understanding of Mathematics at school level is concerned, researchers have examined Ausubel’s, Bruner’s and mastery learning strategies. Chitriv (83) found Ausubel’s advance organizer and Bruner’s concept attainment model superior to traditional method in
knowledge transfer, heuristic transfer, short term retention and long-term retention of the concept. Advance organizer benefitted categorical style students while the concept attainment model did not have a varying effect on different style performances.

Mastery learning (Yadav, 1984) was found superior to traditional method in respect of Mathematics achievement, attitude towards Mathematics and improving self-concept.

Rawool S. (1988) found that students fail at understanding and application levels.

Pandhari A. S. (1988) studies the effect of language, memory and process on student's learning of Mathematics. All these factors influence the latter and not the students' institution.

Sengupta D. (1989) studies that understanding of axioms in geometry occurs in the course of growth between the ages from 5 years to 7 years and in the order different from that given. Also, different children understand different axioms at different ages.

Sarangpani (1990) has analyzed the primary school curricula from Piagetian perspective and he found overall mismatch. It appears that the curriculum designers have never taken into account the various stages of cognitive development of children. The exercises given to children are mostly drill exercises for computation. There is no scope for freedom to
learn or to learn through the play way method. The present teaching is too abstract, algorithmic and ambitious.

Samuel Francis (1989) found Piaget's main theses that the conceptual process follows stages of development and there are stages of development from perceptual reasoning to concrete-logical reasoning are confirmed under Indian conditions. There is a relationship between the mental ability of children and their ability to understand the concepts of conservation of area, mass and volume.

Lalitha Bai T. K. (1992) identified cognitive factor structures of high achievers (HA), average achievers (AA) and low achievers (LA) for total sample (31) cognitive variables reduce to single factor i.e. numerical ability for HA three factors viz. abstract reasoning, numerical spatial ability and non-verbal reasoning, for AA, a single factor – mental ability. For LA, two factors viz. numerical-perceptual ability and numerical ability.

Sarala S. (1990) analyzed conceptual errors of secondary students in learning selected areas in modern Mathematics. Errors are influenced by sex, locality of the school, socio-economic status etc.

Raman J. (1989) identified errors in calculus under four categories viz. entry behaviors, perceptual, conceptual and computational. Many students committed conceptual errors followed by computational errors.
Bhagwat Sunita (1992) prepared a package of divergent thinking type problems in Mathematics for Std. VIII students. It helped in the development of divergent thinking ability of boys and girls.

**Conclusion**

The examples of studies cited above are closely related to the study of students' cognitive abilities. The researchers aim to probe the construction of thoughts in students' minds with respect to different variables such as intelligence, perception, abstract reasoning power, numerical ability etc. Although not defined exactly as constructivism, these studies deal with the construction of process, flaws in construction of ideas and the resultant errors in the performance. The major difference in the constructivist approach and these studies lies in the basic ideology and the mode of experimentation. In constructivist teaching, teacher sees every step taken by the student in problem solving as the original and direct output of his cognitive construction. His or her performance is not fitted in the frames of mental aptitudes such as numerical ability, abstract reasoning power etc. Rather the teacher probes the thinking pattern of the student in order to find the cause of errors using various strategies as discussed in Chapter 3.

**2.2.0 Related Research Abroad**

Researcher referred to educational encyclopedia, journals and ERIC-SEARC database in order to locate the research work carried out in teaching Mathematics at middle school level in other countries. A very few abstracts were found as far as application of constructivist strategies to
teaching Mathematics at elementary or middle school level is concerned. Most of the research is related to studying the nature of Constructivism and the types of Constructivism.

A few of the noted projects are as follows:

5. Debra Sprague and Dede Christopher, 1999 “Constructivism in the Classroom”.

The Recent Studies – 2004

1. Title: Facilitating development of Constructivist teacher leadership: Transforming teacher understanding of self as inquirer and collaborator.
   Authors:
   Roger B. Peckover, Saint Mary’s University of Minnesota.
   David Bernard, Saint Mary’s University of Minnesota.
   Suzanne Peterson, Saint Mary’s University of Minnesota.
   Louise Covert, Saint Mary’s University of Minnesota.
2. Title: Comparing aspects of Constructivist research methodologies in Mathematics education: Modelling intersubjectivity and tool use.
Author: Jason Silverman – Vanderbilt University

3. Title: Constructivist dilemmas through a cross disciplinary lens.
Author: David Kirshner – Louisiana State University.

4. Title: Instructional design models for Constructivist learning: A theoretical synthesis of essential elements.
Author: Yufeng Qian, Lehigh University.

Theme: Constructivist as a paradigm for teaching and learning.

2.2.1 Critical Review of the related research abroad

As said earlier, most of the research on Constructivism in other countries is related to the study of nature of Constructivism and its epistemological perspective. Susan Hanley in Maryland Collaborative Teacher Preparation programme has presented some strategies of implementing Constructivist format in the classroom. She has given
guidelines for the teachers to adopt Constructivist approach and methodologies for creating a constructivist classroom.

J. G. Bergerom and Herscovics (1983) in their paper “Learning as Constructivist Activity”, say that knowledge is not a transferable commodity and communication not a conveyance. Knowledge and competence are seen as the products of the individual’s conceptual organization of the individual’s experience. According to Bergeron and Herscovics it is more important still, if students are to taste something of the mathematician’s satisfaction in doing mathematics, they cannot be expected to find it in whatever rewards they might be given for their performance but only through becoming aware of the neatness of fit they have achieved in their own conceptual construction. (Internet website on constructivism)

Pasty F. Kanter (1998) suggests various Constructivist activities for helping small children learn Mathematics at home and to make it an enjoyable experience with them (An essay on internet)

Martin Dougiami (1998) in his essay, “A journey into Constructivism”, describe the types of Constructivism such as trivial, radical, social cultural and critical constructivism. He concludes that despite the very fluid nature of Constructivism and its many faces, I now believe that attempting to understand it which simultaneously applying that understanding in a reflective manner promote the development of influential mental constructs that are useful in the pursuit of more effective communication, teaching and learning (an essay on internet).
Sprague and Dede (1999) have made an attempt to clear the teacher's confusion about implementing the Constructivist strategies and maintained the discipline in the classroom in their essay, “Constructivism in the classroom”. (site on internet)

Recent Studies on Constructivism (Year 2004)

1. Title: Facilitating development of Constructivist teacher leadership: Transforming teacher understanding of self as inquirer and collaborator.


Authors:
Roger B. Peckover, Saint Mary's University of Minnesota
David Bernard, Saint Mary's University of Minnesota
Suzanne Peterson, Saint Mary's University of Minnesota
Louise Covert, Saint Mary's University of Minnesota

Abstract: This paper reports longitudinal research from a two year professional development programme designed to support development of teacher leaders through constructivist processes of dialogue and inquiry. Transformations in thinking observed in this study suggest strong promise for constructivist practices to facilitate development of reciprocity in teacher thinking requisite to meeting challenges facing teachers as leaders.

2. Title: Comparing aspects of Constructivist research methodologies in Mathematics education: Modelling intersubjectivity and tool use.

Abstract: Making sense of the relationship between the radical Constructivist and social Constructivist philosophy and its implications on research methodology is the gist of this paper. The goal of this paper is to explicate differences and similarities between the radical Constructivist view and the emergent perspective, which is a branch of social Constructivism. These people show that the boundaries between the two are fuzzy – it seems, at times, that the two philosophies have as many similarities as differences. This discussion will serve to further the issue of how, rather than the work, in these two major camps of mathematics education research building only within themselves, researchers can utilize research done in both the camps to mutually constrain and reinforce each other while furthering the development of a research base in Mathematics education.

3. Title: Constructivist dilemmas through a cross disciplinary lens.


Author: David Kirshner, Louisiana State University.

Abstract: Integrative theories like situated cognition theory and social Constructivism have come to be emblematic of the pedagogical reform movement. However, their appealing inclusiveness is offset by a lack of accessible foundations that could make such theories effective in supporting reform. Cross disciplinarity is a new approach to the relating psychological theory to pedagogical practice by framing discrete pedagogical methods towards diverse metaforce of learning as habituation.
construction and enculturation. Here the author illustrates using von Glaserfeld's radical Constructivism that the narrow, unifocal theories that support cross-disciplinarity are themselves subject to pressures that lead to opaqueness and obscurity.

4. Title: Instructional design models for Constructivist learning: A theoretical synthesis of essential elements.
   Author: Yufeng Qian, Lehigh University.

   Abstract: In order to identify essential elements in designing Constructivist learning, this paper reviews five Constructivist instructional design models (Hannafin, Land and Oliver, 1999; Jonassen, 1999; Nelson, 1999; Savery and Duffie, 1996; Schank, Berman and Macpherson, 1999.) As a result of this study, a comprehensive conceptual framework of those key-elements that are essential to designing Constructivist learning is generated.

   Theme: Constructivist as a paradigm for teaching and learning.
   Agenda:
   - What is Constructivism?
   - How does this theory differ from traditional ideas about teaching and learning?
   - What does Constructivism have to do with my classroom?
   - Expert interview
What is the history of Constructivism and how has it changed over time?
- What are some critical perspectives?
- What are the benefits of Constructivism?

Constructivist teachers encourage students to constantly assess how the activity is helping them gain understanding. By questioning themselves and their strategies, students in the Constructivist classroom ideally become expert learners. This gives them ever-broadening tools to keep learning. With a well-planned classroom environment, the students learn HOW TO LEARN.

When they continuously reflect on their experiences, students find their idea gaining in complexity and power, and they develop increasingly strong abilities to integrate new information. One of the teachers' main roles becomes to encourage this learning and reflection process. e.g. groups of students in Science class are discussing a problem in Physics. Though the teacher knows the answer, to the problem, she focuses on helping students restate their questions in useful ways. She prompts each student to reflect on and examined his or her current knowledge. When one of the students comes up with the relevant concept the teacher seizes upon it, and indicates to the group that this might be a fruitful avenue for them to explore. They design and perform relevant experiments. Afterwards, the students and teacher talk about what they have learnt and how their observations and experiments helped (or did not help) them to better understand the concept.
Conclusion

After taking an exhaustive review of related research on Constructivism in India well as abroad the researcher came to conclusion that still the work is to be done from a scratch in this particular subject, in India. Highly celebrated theories of learning such as Piaget’s cognitive development theory, Ausubel’s advance organizer, programmed learning, mastery learning etc. have been tried out by the researchers in order to test their effectiveness under the influence of different variables. However, Constructivism is relatively new trend in the educational practice and it has not been yet implemented by educators in India. Some of the schools in USA claim to be purely Constructivist in their teaching methodology. In India, there is a lack of pioneer work in Constructivism. Hence, as a first step towards the establishment of Constructivist practice in schools, the researches planned to test the effectiveness of Constructivist approach to teaching Mathematics at middle school level.

Rationale for choosing this topic for the present study has been explained in detail in Chapter – 1.
REFERENCES

8. Educational Resources Information Centre (ERIC), USA and Psychological on line database assessed through DIALOG Service from Knight – Ridder Information Inc. 2000.