CHAPTER III

REVIEW OF RELATED LITERATURE

Studies on Learning Styles
Studies on Mathematics Learning and Learning Style
Studies on Learning Style and Teaching Style
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Review of related literature plays a significant role in any type of research work. It allows the researcher to acquaint oneself with current knowledge in the field in which the research is being done. The availability and utilisation of adequate sources or related information enables the investigator to complete the research fruitfully and thus make unique contribution in the field of education with special focus on the method of instruction, learner variables, etc.

For many years, educators and researchers have debated on the different variables which influenced student achievement. Decades of research in education suggest that students utilise individual learning styles (Felder, 1996). Instruction should therefore be multifaceted to accommodate the variety of learning styles. The literature in support of this assertion is vast and includes textbooks, learning style inventories and resources for classroom implementation (Dunn & Dunn, 1993).

Though research in education and applied psychology has produced a number of insights into how students think and learn, the resulting impact on actual classroom instruction is uneven and unpredictable.

Therefore, an attempt has been made here to review the literature and studies related to the topic “Effectiveness of Co-operative
Learning on Learning Style and Academic Achievement in Mathematics Learning at the Upper Primary Level.”

The studies reviewed are classified into the following sections:

(1) Studies on Learning Styles
(2) Studies on Mathematics Learning and Learning Style
(3) Studies on Learning Style and Teaching Style
(4) Studies on Co-operative Learning
(5) Studies on Co-operative Learning and Mathematics

3.1 STUDIES ON LEARNING STYLES

A considerable literature exists on the application of learning style research to accounting education. Learning style is the composite of characteristic cognitive, affective and other psychological factors that serves as an indicator of how an individual interacts with and responds to the learning environment. The investigator for the purpose of the study has traced many literature and research reports in this area. An effort has been put here to bring some of them which are in close proximity with the present study.

Galbraith and James (1984) are of the opinion that focusing on learning style needs is an essential element to any learning environment.

Allinson and Hayes (1988) point out that an individual’s learning orientation is possibly the most important determinant of that individual’s educational attainment. For this reason, considerable research has been
undertaken in recent years to diagnose learning style preferences (Reynolds, 1997). Identifying the characteristics of individual students is seen as a potential way of improving course design and an individual’s learning outcomes (Butler, 1988).

Freeman and Whitson (1992) had reviewed models of learning style, cognitive style and thinking style and made the following recommendations:

1. Style preferences are not unchangeable
2. Style refers to learner’s action, not ability
3. Learning should be considered broader than cognitive achievement
4. Teachers should adopt a belated approach in influencing student actions.

Dunn R., and Dunn K. (1993) are of the view that learning style is composed of biological and developmental characteristics that make identical instructional environments, methods and resources effective for some learners and ineffective for others. The results of the learning style inventory based on Dunn and Dunn model indicate the individual elements in the five basic stimuli that affect an individual’s ability to master new and difficult academic information and skills. The first stimulus strand focuses on biologically imposed environmental elements preferences for sound, light, etc. The second stimulus strand points out the emotional elements like motivation, responsibility, etc. The third stimulus strand highlights the sociological preferences namely working alone, in pairs, with peers, as part of a team, etc.
The preferences for sociological pattern as opposed to learning in a variety of ways are also a learning style trait. The fifth stimulus strand indicates the physiological characteristics namely the perceptual preferences like auditory, visual, kinesthetic, etc. These preferences either enable or prevent students from achieving easily. The global versus analytic processing style is characteristic in the fifth strand.

No person is affected by all learning style elements. Individual’s vastly different combination of learning style preferences can explain why there is no single instructional method that is effective for all students.

Dunn and Dunn’s (1993) learning style model is based on the theory that most individuals can learn, instructional environments, resources and approaches respond to diverse learning style strengths. In addition to this, teachers can learn to use learning styles as a cornerstone of their instruction and students can learn to capitalise on their learning style strengths when they concentrate on new and difficult information.

Gardner (1993) suggested that there are a number of different intelligences which different learners possess in different amounts. According to him, teaching should be geared to students’ specific intelligence. The students’ learning styles should be first measured and then adopt teaching to the individual preferences of the students.

Race (1994) suggests four primary processes by which one really learns fast – at their own pace, at times and places of their own
choosing, when they are in control of their own learning and often with other people around, especially with fellow learners.

Scoll (1994) conducted an information analysis of 4 MAT model. 4 MAT is an eight step sequential instructional model based on two theoretical constructs, Kolb’s model of learning style and the concept of brain hemispherity. A review of professional literature on research with 4 MAT model indicates that 4 MAT model is capable of comprehensive use of developing instructional units for discursive as well as non-discursive disciplines, for secondary as well as elementary education.

O’Sullivan et al. (1994) investigated how teachers who are trained to use learning styles and how learning style laboratory tutoring programme can assist at risk incoming high school students. The results showed that six of the treatment groups realised an improvement in grades, but the number of students in the treatment group with failing grades suggested that the treatment was not effective.

Sims and Sims (1995) in the book on “The Importance of Learning Styles: Understanding the Implications for Learning, Course design, and Education” discuss on models of different learning styles, instruments to evaluate learning styles and techniques for assessing individual learning characteristics as well as the future of learning style research and its implications for enhancing learning in higher education institutions.

Dyrud (1997) presents three articles that explore the concept of learning styles and its application in business communication. (1) Learning
styles and teaching styles: Who should adapt to whom? (2) The effect of interactive multimedia on learning styles, and (3) Applying Kolb learning style theory in the communication classroom.

Zhicheng (1997) conducted a study to examine the validity of the learning-thinking style inventory and to investigate the learning and thinking styles of college students’ performance. The study revealed significant main effects for major and academic performance on students’ learning and thinking styles.

Ikegulu (1997) conducted a study on effectiveness of mediated instructional strategies and learning styles in multiculturally linguistic environments. The study discusses the effectiveness of mediated instructional strategies in culturally and linguistic diverse learning environments, focussing on the use of computer mediated instruction and its relationship to various learning styles.

Duff (1998) suggests that learning preferences should be measured as this will provide an opportunity to match an individual’s learning style preferences to learning activity to improve learning outcomes and to modify the preferred learning style of the trainee (Honey and Mumford, 1992).

Lemire (1998) through his research describes the psychometric issues associated with three different learning style models (visual, auditory and kinesthetic) and the instruments designed to assess these models. He also presents some background to the learning styles idea along with suggestions for utilising this information with developmental students.
On the basis of an interview with Rita Dunn about learning styles, Shaughnessy (1998) discusses on the research showing the effectiveness of teaching to students’ learning styles in raising student achievement and how learning style teachers and schools differ from conventional teachers and schools.

Lewandowski and Morehead (1998) argued that combined with the challenge to create interesting and compelling student learning and to cope with the variety of preferred learning styles that affect the way in which students gather and process information, there is a need to find a consistent method that is consistent with the instructor’s preferred learning style.

Champagne (1998) suggests that successful instructors realise that students learn differently.

Research that examined the relationship between learning styles and learning environment has suggested that teachers should adjust and structure the learning environment and their expectations of students around the students' individual learning styles (Gadt-Johnson and Price, 2000; Hickson, Land and Aikman, 1994).

Rourke and Lysynchuck (2000) investigated the influence of learning styles on achievement in hypertext. The learning styles of twenty one female and twenty male students enrolled in a psychology class was assessed using the learning style inventory (Kolb, 1985). The learning style inventory categorises respondents into one of four learning styles based on their abilities in the four stages of the experiential learning cycle. A significant
difference was found between divergers who scored highest and accommodators who scored lowest. The results supported previous research which indicated that benefits of hypertext are differentially distributed across learning styles.

Garcia et al. (2000) examined whether college students’ learning styles and thinking styles were interrelated and if these could predict academic achievement. The study revealed moderate relationship between both types of styles and that students’ academic achievement was related to students’ thinking styles.

Bada and Okan (2000) found that for students to achieve effective learning, teachers must give special consideration to the skills and assumptions of learners and to their individual learning preferences.

Research by Hardigan and Sisco (2001) also supports the idea that students’ preferred learning styles differ.

Ross, Drysdale and Schulz (2001) in a study found that learning styles influence the types of learning experiences that students find effective, comfortable and growth promoting. They also found that the effect of learning style on academic performance was significant in student performance with sequential learners performing significantly better than did random learners in two computer science courses.

Hilberg and Roland (2002) made a report which discusses two prominent definitions of learning styles. They conducted studies to find differences between the learning styles of American Indian/Alaska native
students and students of other cultural group. Research based on a variety of theoretical frameworks suggests that American Indian and Alaska native students show some tendency towards

(a) global or holistic style of organising information
(b) a visual style of mentally representing information in thinking
(c) a preference more reflective style in processing information and
(d) a preference for a collaborative approach to task completion.

Yunfei and Simpson (2002) conducted a study on “Effects of learning styles and class participation on student enjoyment level in distributed learning environments.” The results highlighted that there is a good relationship between learning style and class participation on student enjoyment level.

Hlawaty (2002) identified and compared the preferred learning style characteristics of German adolescents and analysed the similarities and differences by age, gender and academic achievement within and among groups of students in different educational settings. In this study, 869 German adolescents aged 13, 15 and 17 were administered the German language version of the learning style inventory. Results show that younger adolescents in Germany appear to be more persistent, authority, parent and teacher motivated than older students. While low achievers favoured the presence of an authority figure in the environment, the academically gifted were least parent and teacher motivated. The results of the study highlights the need for administering learning style inventory for VII standard students.
Farker (2003) examined the effects of teaching through traditional versus learning style instructional methods on an urban sample of 105 heterogeneously grouped 7th grade students’ achievement, attitudes, empathic tendencies and the like. The data that was subjected to a statistical analysis supported the implementation of a multisensory rather than traditional approach for teaching lessons. He co-ordinated the effectiveness of learning style methods for increasing achievement and attitude towards learning.

Aruna and Usha (2006) conducted a study on the influence of cognitive style, intelligence and classroom climate on process outcomes in science. The study found that there is significant relationship between cognitive skills and process outcomes in science.

Johnson and Johnson (2006) in their study on learning style and preference for online learning support found that among the four index of learning styles of students (active-reflective, visual-verbal, sequential-global, sensing-intuitive) active learners expressed preference for face to face study groups rather than online study groups and for online quizzes rather than pencil and paper quizzes. Visual learners expressed preference for online quizzes rather than online study groups.

A study was conducted by Malathi and Malini (2006) on the relationship between learning style and achievement among higher secondary students of Chennai. The study revealed that there is high correlation
between learning style and achievement, which implies that higher the achievement better was the learning style among higher secondary students.

Rayneri et al. (2006) in their study examined the learning styles of gifted middle school students, student perceptions of the classroom environment and possible connections between learning style, classroom environment and achievement levels. Eighty gifted students from grades 6, 7 and 8 were administered the Learning Style Inventory (LSI) to identify student learning preferences. The study found that learning styles of gifted students have correlation with achievement in all content areas.

Hawk and Shah (2007) in their study have indicated that students can and should develop their abilities that are not in their natural modes and preference. This is possible only if they are aware that learning style do exist in individuals and that not all individuals learn in the same way.

Schellans et al. (2007) in their study on learning in asynchronous discussion groups, highlight the significant impact on the intensity of interaction of students in a group. The study also projects the impact of student learning style on the achievement of the individual.

A close review of these studies throws light into the fact that learning styles do exist in individuals at varied levels just as how intelligence differs from individual to individual. It has also been observed that learning style of an individual has a direct influence on his academic performance. It is therefore essential that teachers should develop appropriate learning
experience to cater to the learning style of the students and thus empower them.

These studies have enabled the investigator to develop proper understanding about learning patterns of individuals and device appropriate strategies for the study.

### 3.2 STUDIES ON MATHEMATICS LEARNING AND LEARNING STYLE

Attainment of mathematical competencies has become a difficult task for almost all students. It is essential that the ambiguity regarding the acquisition of mathematical competencies should be reduced to a maximum possible extent. A thorough knowledge about the pattern of learning of the learner is essential for the attainment of this task.

The studies reviewed earlier have revealed that learning has direct influence on the academic achievement of an individual. As the present study focuses mainly on mathematics learning, a review of authentic reports on the relationship between mathematics learning and learning style has become essential. A briefing of such studies is given below.

Copenhaver (1979) has conducted a study to examine the differences in cognitive learning styles used by students learning mathematics and English. An attempt was made to determine if students do change their learning styles as they move from one subject area to another.

A research entitled as “Mathematics learning viewed from neurobiological model for intellectual functioning” was conducted by Davidson (1983). The learning of mathematics was addressed in this study with special
focus on defining learning styles in mathematics, classifying individuals according to learning styles, relating achievement to learning styles, associating learning styles with localised hemispheric functioning of the brain, correlating learning styles in mathematics with general learning styles, and tailoring teaching strategies to learning styles. Results confirm that mathematics learning styles more strongly reflect qualitative aspects of performance than straight success or non-success.

Doris (1992) conducted a study to compare the learning styles of various majors. The results show that students with mathematics major had a different learning style when compared to learning styles of business, science and social science majors.

Thomson and John (1997) in their article “Attending to learning styles in mathematics and science classrooms” discuss on the applications of the Dunn Model to mathematics and science education. The authors are of the view that mathematical problem solving patterns and references can be discussed in light of learning style preferences. Projects such as the Cognitively Guided Instruction (CGI) project at the University of Wisconsin emphasise that teachers create mathematical learning environments that resonant with teacher styles, as well as student needs and differences. Engaging activities linking mathematics with other disciplines using manipulative and creative problem-solving experiences are often welcomed by students with global or non-traditional learning styles. According to the authors, the greatest benefit from attending to learning styles can be an
ongoing consideration and aid in attacking new and difficult situation and the processing of information.

Studies on individual difference in skill acquisition suggest that the fastest learners are those who develop strategies for concept formation (Eyring, Johnson and Francis, 1993). Thus, any model of mathematics learning must include strategy building as a learning style. The most suitable learning model applicable to mathematics is Kolb’s learning model (Jeff, 2002). In the Kolb model, a student’s learning style is determined by two factors – whether the student prefers the concrete to the abstract and whether the student prefers active experimentation to reflective observation. This results in four types of learners:

Concrete, reflective : Those who build on previous experience
Concrete, active : Those who learn by trial and error
Abstract, reflective : Those who learn from detailed explanation
Abstract, active : Those who learn by developing individuals

Although other models apply to mathematics, this evidence suggests that differentiating into learning styles may be more important than the individual style descriptions themselves (Felder, 1996).

The above research works done in the field of mathematics learning and learning style revealed the fact that there is significant relationship between mathematics learning and learning style. Mathematics teachers can utilise such findings in small but significant ways. They can help
students discover, utilise and appreciate their own learning style for better performance in mathematics.

3.3 STUDIES RELATED TO LEARNING STYLE AND TEACHING STYLE

Though Activity Oriented Approach has been adopted after spectacular researches in education, yet there exists some lacuna in the effective transaction of mathematics curriculum, as is revealed from the school records. This drawback may be due to the fact that learning style of students do not match the learning experiences given nor the teaching style of the teacher.

To find out if learning style of students and teaching style of teachers can be matched appropriately, the investigator explored previous studies and articles. The review of those studies and literature which are closely related to the present study are given below.

Martin (1986) suggests that teaching may be enhanced as more insights are gained about how each student responds to the teaching/learning process and how learning style and teaching style are interrelated.

Pettigrew and Buell (1987) conducted a study to examine experienced and preservice teachers’ abilities to diagnose student learning style preferences. The results indicate that a wide variety of learning styles existed among the students and that neither experienced nor preservice teachers could accurately diagnose their students’ learning style.

Information analysis by Ast (1988) generates the fact that the identification of students’ learning styles and the subsequent correlation of
them with teaching styles have important implications for curriculum and instruction. In order to match learning and teaching styles, teachers should be skilled in several styles so as to accommodate individual differences. Students should be provided with a variety of learning settings, resources and instructional methodologies that will ultimately match their self-determined needs and goals. Students taught by their preferred method tend to achieve better, be more interested in the subject matter, like the way the subject is taught and want to learn other subjects in the same way. Differences in learning styles can be accommodated on all occasions, but educators should make every effort to understand these differences and alter instructional style in those areas and at those times that modifications are possible.

Davidson (1990) in the journal “Performance of instruction” presents an article on “Matching learning styles with teaching styles.” He discusses the concept of matching instructional methods to learning styles to improve student performances. Research on learning styles is reviewed and other benefits of investigating learning styles are suggested, including recognising the cognitive and affective diversity among students and encouraging more versatile teaching techniques.

Dunn and Frazier (1990) in their article “Teaching Styles” present an instrument to help identify teachers’ current teaching styles to encourage them to utilise teaching styles responsive to individual student’s learning styles. The inventory assesses instructional planning, teaching
methods, teaching environment (student groupings, room design and learning environment) and evaluation techniques.

Research has indicated that students have different learning styles and their academic performance is related to their learning styles and the method of teaching used. If the method of teaching used coheres with their learning style, students tend to do well academically. If the teaching method does not fit their learning styles, students tend not do so well (Higbee, Ginter and Taylor, 1991).

More (1993) has also examined the various learning styles and outlines different steps for identifying and integrating the learning styles to provide students with the most effective educational experience possible. His study is in conformity with the studies conducted by Murphy and Della (1989) on determining the learning style of a child and how to use the information to maximise the child’s potential.

Dunn (1998) in a journal article explores time of day as a learning style variable that affects student achievement. It also includes certain suggestive measures for changing the teaching styles of teachers and administrators such as testing themselves to identify their current teaching styles or providing interested teachers with expert training in learning style approaches.

Crowe (2000) discusses in her research report, how David R. Kolb’s methodology of identifying four types of student learning style can be helpful in teaching introductory economics. In his report, he describes certain
steps of teaching processes for teachers. These steps include identification of preferred learning styles of students, the various learning activities suitable for each learning style and the like.

His findings along with other findings indicate the prominent role of learning style in the field of education.

Honigsfeld and Schiering (2004) in their research report present the findings of a new research project on teacher candidates' learning style preferences and the implications thereof for their teaching styles. Similar studies on this pertinent issue have been conducted by Cornett (1983), Jenkins (1981) and Keefe (1988).

The aforesaid studies on learning styles and teaching styles revealed that teaching style can be conceptualised as a teaching situation that emphasises a certain learning style.

Thus, if teachers are going to make informed decisions about the teaching process, they need to know the learning style of their students. Teachers should make provisions to accommodate various classroom strategies by identifying the learning styles of each of their students, matching teaching style to learning style for all difficult tasks, strengthening weaker learning styles through easier tasks and acquainting students to identify and develop suitable learning style.

The review of the studies in this sphere has helped the investigator to frame appropriate strategies to cater to the learning preferences of the learner.
3.4 STUDIES ON CO-OPERATIVE LEARNING

Many in higher education are translating research in education into models of learning specific to their own disciplines (Felder et al., 2000; Buraik, McNurlen and Harper, 1995). These models in turn are used to reform teaching methods, to reinvent existing courses and the like.

In spite of all the innovations in the field of teaching, some sort of dissatisfaction exists among the stakeholders. Good teaching begins with a genuine concern for students and an enthusiasm for the subject. A suitable learning model catering to the above requirements need to be adopted. It is with this notion that the investigator felt the necessity of reviewing the studies and literature on co-operative learning.

Studies on Group Investigation by Johnson and Johnson (1975) and Jigsaw by Aronson (1978) affirm that we learn by teaching, that is, giving explanations is positively related to achievement. While explaining to someone, the giver must classify, organise, indeed reorganise the material conceptually. Further, if the initial explanation is not understood, reformulation is necessary. All of these, it is claimed, will consolidate or expand the giver's understanding (Webb, 1989).

According to Johnson and Johnson (1986), there is evidence that co-operative teams achieve at higher levels of thought and retain information longer than students who work quietly as individuals. The shared learning gives students an opportunity to engage in discussion, take
responsibility for their own learning and thus become critical thinkers (Toller, Sill, Digby and Russ, 1991).

According to Slavin (1989), for effective collaborative learning, there must be ‘group goals’ and ‘individual accountability’. The study revealed that students who participated in collaboration learning got opportunities to analyse, synthesise and evaluate ideas co-operatively. The informal setting facilitated discussion and interaction. The group interaction helped students to learn from, each other’s scholarship, skills and experiences. The students had to go beyond mere statements of opinion by giving reasons for their judgements and reflecting upon the criteria employed in making these judgements.

Studies (Hertz-Lazorowitz, 1990) reveal that amount of task related group with talk is comparatively less in whole class than in co-operative groups. Similarly, pupil involvement was higher in co-operative groups.

Mattingly et al. (1991) conducted a study on co-operative learning. The study concluded that superior academic achievement may be reached through proper employment of Jigsaw II (a comparative learning model that involves small groups of 5-6 students teaching each other subject matter about which they have become experts with success depending upon student co-operation.

Manjit (1996) in her study “Effectiveness of peer interactive learning in improving scholastic achievement and retention” highlighted that
given an opportunity, the pupils are able to assume responsibility and carry out a task successfully and interact purposefully helping each other to learn and be mature in the learning process. The study established that managing one’s own learning and assuming responsibilities goes a long way in helping students become not only task oriented but also disciplined. The study also established that not only older students are able to manage their tasks by themselves but young learners of pre-adolescent stage can also learn from experience and need not be spoon-fed everywhere.

Studies conducted by Oliver, Omari and Harrington (1998) noted that peer support and co-operation were crucial in learning processes.

Ledlow (1999) in her article on jigsaw opined that teaching each other helps students to understand the material in a way that is far deeper than when they listen to the teacher or when they simply discuss it.

Liaw and Huang (2000) are of the view that instructional interactivity occurs when students engage in discussion or activities with their instructor on topics related to content. Interactivity among students has been shown to enhance learning (Gilbert and Moore, 1998; Jones and Scully, 1998). Further peer-to-peer interactions can reduce teacher workload while improving student learning (Rada, 1998). Research in this area has also determined that feedback students receive from their fellow classmates can be just as effective and productive as teacher-student feedback (Rada, 1998 and Warren, 1999).
Interactive transaction typically involves dynamic, mutual give and take between the instructional system and the learners, including the exchange of relevant information (Merrill and Jones, 1990). Through instructional design, students can interact with course content by discussing, debating and collaborating on learning tasks (Dede, 1996 and Harasim, 1993) advocate that collaborative learning increases student motivation and facilitates higher order learning.

In-Sook (2000) and Yaverbaum & Ocker (1998) in their study noted that comfort level with group members may influence learning outcomes.

Lou et al. (2000) and Blatchford et al. (2001) in their article discuss the importance of within class groupings. The way students are grouped probably has an influence on reference processes in the class and their motivation and learning achievement are probably affected by those of their fellow students they compare themselves with. These articles discuss the effects of heterogeneous and homogeneous grouping and how they affect achievement.

Research on socio-economic status and peer-acceptance in traditional classroom settings has shown that peer-relationships among elementary school aged children and early adolescents are associated with academic performance (Austin & Draper, 1984; Li, 1985 and Wentzel & Asher, 1995). Studies also indicate that children who were not accepted by their classmates are at risk for dropping out of schools (Coie, Dodge &
Kupersmidt, 1990). It also reveals that feelings of isolation by students may deter learning.

The study throws light into the influence of interpersonal relationship on academic performance of an individual.

Emmer (2002) conducted a study on a co-operative learning in elementary classrooms. In this study, 18 elementary school teachers who used co-operative learning was observed and interviewed on multiple occasions. The purpose of the study was to learn more about the components of co-operative learning lessons. It was found that more successful lessons were characterised by some forms of individual and group accountability, teacher monitoring of groups and feedback to students.

The study conducted by Brown (2004) touched upon the child's viewpoint in group learning. It reveals that the students found added benefit of working in groups.

The articles of Felder et al. (2004) and Haller et al. (2000) discuss on the effectiveness of co-operative learning groups. The articles also support the idea that through proper teacher facilitation and formation of co-operative groups, students were able to learn effectively and with higher level of understanding. The same idea was conveyed by Lou et al. (2000) which is discussed earlier.

Agrawal and Chawla (2005) conducted a study on the influence of co-operative learning on academic achievement among 5th graders. It was found that co-operative learning environment provided students with
opportunities to analyse, synthesise and evaluate ideas co-operatively. The informal setting facilitated discussion and interaction. The group interaction helped students to learn from each other’s scholarship skills and experiences.

Veenman et al. (2005) conducted a study on the effects of co-operative learning program on the elaboration of students during help seeking and help giving. The participants were teachers from seven primary schools and 24 dyads from sixth-grade students. It was found that dyads with experience in co-operative learning achieved more than dyads without such experience.

The above studies on co-operative learning reflect that co-operative learning has been a very useful teaching method. Researches done in this area prove that co-operative learning enhances academic achievement, self-confidence and self-esteem of a learner and also his ability to use his social skills. Studies on co-operative learning reveals that one learns better when he explains the matter to others. The above fact has inspired the investigator to use the jigsaw technique of co-operative learning for the study.

3.5 STUDIES ON CO-OPERATIVE LEARNING AND MATHEMATICS

In recent years, mathematics teaching has been confronted by demands for higher standards and better pupil achievement in several parts of the world. Researchers have suggested a shift from teacher-oriented instruction towards more active participatory learning methods as one way to improve the quality of learning process. Because of the different learning
styles of students, faculty are encouraged to use different teaching techniques in their classrooms.

A review of studies which highlight the influence of co-operative learning on mathematics learning has been done by the investigator for the study. Given below are such studies.

According to McKeen and Davidson (1975), small group learning allows for student pacing, since each group moves at its own pace. Students pursue the solution to a mathematical problem until each member is satisfied with the solution. In a group that functions well, the pace is quite comfortable for all the members. The student who is ready to go ahead is not just waiting for others to ‘catch up’; he is, instead, reinforcing his own mastery by helping other group members to learn the material. It was found that students working in small groups can solve more difficult problems than students working in an individual instruction system. This is because group can afford both emotional support and free exchange of ideas when attacking a challenging problem. Instead of working in isolation, students can learn by interacting in a friendly atmosphere with a small number of peers.

Wiig and Semel (1984) described mathematics as ‘conceptually dense’ which means that the students must understand the language and symbols of mathematics because contextual clues, like those found in reading, are lacking in mathematics. For example, math vocabulary like greater than, smaller than, denominator, equivalent and mathematical symbols (like =, < or >) must be understood to work problems as there are no
contextual clues to aid understanding. In a co-operative learning activity, vocabulary and symbolic understanding can be facilitated with peer interaction and modelling.

Davidson (1985) reviewed more than 70 studies in mathematics comparing student achievement in co-operative learning versus whole class traditional instruction. In more than 40 percent of the studies, students in the small-group approaches significantly outscored the control students on individual mathematical performance measures.

Treisman (1986) found that African American students at the University of California, Berkeley who worked co-operatively in enrichment sessions outside the class received calculus course grade over one letter grade higher than comparable, African American students who did not use the enrichment programme.

Rivera (1996) conducted a study on the influence of co-operative learning on students with learning disabilities. The study found that co-operative learning is an effective instructional arrangement for teaching mathematics to students both with and without learning disabilities. Coupled with direct instruction, co-operative learning holds great promise as a supplement to textbook instruction by providing students with learning disabilities, opportunities to practice math skills and concepts, reason and problem solve with peers, use mathematical language to discuss concepts and make connections to other skills and disciplines.
Magel (1998) adopted co-operative learning in a large introductory statistics class at North Dakota University. The researcher found that co-operative learning techniques can be effectively used even in a large class. It was also found that majority of students enjoyed doing co-operative learning activities. The findings of Dietz (1993) also support this. Random method of assigning students to teams might not always give the best team formation. This was another major finding of the study.

Berry et al. (2002) conducted a study on co-operative learning and mathematics. The major objective of the study focused on small group learning in mathematics as a method of raising the quality of teaching and learning and as a consequence pupil achievement in schools worldwide. They opined that particularly in mathematics, co-operative work can be used in conjunction with practising skills, doing investigations, collecting data, discussing concepts and principles or solving mathematical problems.

Sahlberg and Berry (2002) in their article “One and one is sometimes three in small group mathematics learning” analyse the development of mathematics teaching by asking whether small group learning is an effective arrangement in teaching school mathematics. The article concludes by revealing that working in pairs is a particularly effective form of learning mathematics and they also feel that small groups are beneficial for developing mathematical problem-solving skills.

Berry and Nyman (2002) discuss on small group assessment methods in mathematics. They are of the opinion that assessment of
students’ attainment in courses is often driven by the method of instruction when mathematics is taught in the traditional style of lectures on theory co-ordinated with homework on standard problems; the testing is often oriented to reproducing the skills demonstrated by the instructor. They have discussed about the team-oriented formal testing method in a collaborative learning atmosphere.

3.6 CONCLUSION

Studies so far analysed indicate that among the various learning techniques, the most suitable technique in a mathematics classroom setting is the co-operative learning technique. Moreover, earlier studies reveal that students have different learning styles and their academic performance is related to their learning style and the method of teaching used.

The aforesaid studies reveal that co-operative learning technique is an effective technique that can be adopted successfully among students with varied learning styles.

Although effect of co-operative learning and learning style have been studied in extraordinary number of field experiments of high methodological quality, studies on co-operative learning with due emphasis to learning styles of children need further investigation.

The research reviews on learning style, co-operative learning and mathematics learning have paved way for the study on “Effectiveness of Co-operative Learning on Learning Style and Academic Achievement in Mathematics Learners at the Upper Primary Level.”