Chapter III

REVIEW OF RELATED LITERATURE

3.1 Studies Related to Effect of Modern instructional Strategies

3.2 Studies on Experiential Learning

3.3 Studies on Learning Style

3.4 Studies related to Achievement with respect to learning styles

3.5 Studies on Experiential Learning and Learning Styles on Achievement’
Review of Related Literature

Review of related literature is an important pre-requisite to actual planning and execution of any research work. “The identification of a problem, development of a research design and determination of the size and scope of the problem, depend to a great extent on the care and intensity with which a researcher has examined the literature or other research studies and authoritative writings related to the problem under investigation” (Mouly, 1964).¹

The survey of related studies implies locating, studying, and evaluating reports of relevant researches, study of published articles, going through related portions of encyclopaedias and research abstracts, study of pertinent pages out of comprehensive books on the subject and going through related manuscripts if any (Borg & Gall, 1989).² The research worker needs adequate familiarity with the work, which has already been done in the area of his choice. “In the field of education, as in other fields too the research worker needs to acquire up-to-date information about what has been thought and done in the particular area from which he intends to take up a problem for research” (Sukhia & Melhotra, 1981).³
The purpose of the literature review was to comprehensively investigate ideas, issues, and themes related to the Effectiveness of Kolb’s Experiential Learning on Achievement in Mathematics of Students at Secondary Level. For that the investigator collected as many studies as possible related to different aspects of the problem under investigation. The studies collected are given under the following heads.

3.1 Studies Related to Effect of Modern instructional Strategies
3.2 Studies on Experiential Learning
3.3 Studies on Learning Style
3.4 Studies related to Achievement with respect to Learning Styles
3.5 Studies on Experiential Learning and Learning Styles on Achievement

3.1 Studies Related to Effect of Modern Instructional Strategies

This section includes recent studies related to the application of different strategies regarding teaching in general and teaching of mathematics in particular. The studies on how mathematical interest and attitude towards mathematics are affected by the application of different strategies are also given in this section.

Erdogan & Baren (2009) studied the effect of mathematics teaching provided through drama on the mathematics ability of six-year-old children. The study revealed that teaching of the
mathematical concepts through entertaining activities, in which children want to participate and can be active, will be more appropriate since these concepts are abstract and relatively hard to learn in the pre-school period. Therefore, drama method should be used in teaching mathematical concepts in pre-school education institution.

In meta-analysis of eleven studies, Abraham(2008)\textsuperscript{5} provides evidence of effective ICT supported language learning, particularly related to vocabulary development and the promotion of conversational fluency. Several observers describe the efficacy of wireless SMS text and technologies to support vocabulary development (Chen & Chung, 2008\textsuperscript{6}; Lu, 2008\textsuperscript{7}; Aderinoye, 2008\textsuperscript{8}). De Almeida - Soares (2008)\textsuperscript{9} describes the constructive use of blogs to promote English as a Foreign Language instruction for secondary students.

Hardy(2008)\textsuperscript{10} discusses a middle school project called Technology in Math Education(TIME) in advancing the integration of ICT into the school mathematics curriculum. Franklin & Peng (2008)\textsuperscript{11} offer a case study evaluating the use of iPod Touch device to advance middle school math teaching. Teasdale(2008)\textsuperscript{12} describes a British project that applies ICT to the promotion authentic, outcome-led, problem-based, learner – centered mathematics education. Sindhu (2008)\textsuperscript{13} found that website
learning is more effective than the activity oriented method of teaching Biology at the Higher Secondary level.

Crisen et al. (2008)\textsuperscript{14} found that effective instructional practice developed is a combination of pedagogical skills and ICT knowledge for conceptualizing secondary school mathematics teachers’ classroom practices.

From a review of 99 studies of cooperative group training method, Slavin (1990)\textsuperscript{15} found that cooperative methods were effective in improving students’ achievement. The most effective methods emphasised both group goals and individuals accountability.

Sungur & Tekkaya (2006)\textsuperscript{16} investigated the effectiveness of Problem Based Learning and traditional instructional approaches on various facets of students’ self regulated learning, including motivation and learning strategies. Instruction to the control group with teacher centred, text book oriented traditional instruction and experimental group with Problem Based Learning, in which students worked with ill structured problems. Results revealed that Problem Based Learning students had higher levels of intrinsic goal orientation, task value, use of elaboration learning strategies, critical thinking, meta-cognitive self regulation, effort regulation and peer learning compared with control group students.
Rodríguez (2006) conducted a study on E-learning in Project Management Using Simulation Models: A Case Study. In this study, the possibility of enhancing E-learning systems to achieve deep learning has been studied by replicating an experiment in which students had to learn basic software engineering principles. The result shows that, quantitatively, the latter group achieved a better understanding of the principles; furthermore, qualitatively, they enjoyed the learning experience.

When an experimental group was taught geometry concepts using drama and the control group using the traditional instruction, Kariuki & Humphrey (2006) found significant difference between the academic achievement of experimental and control groups. No difference was found in the interest and attitude toward math between experimental and control groups. Finally, no significant relationship was found between academic achievement and interest and attitude towards math.

The study done by Chung & Tam (2005) examined the effects of different approaches to teaching learners with mild intellectual disabilities to solve mathematical word problems. Students presented with worked example and cognitive strategy instruction solved more problems correctly and generally outperformed students presented with conventional instruction in both immediate and delayed tests.
The purposes of the study by Fuchs et al. (2004)\textsuperscript{20} were to assess the effects of Schema-Based Instruction (SBI) in promoting mathematical problem solving and to investigate schema induction as a mechanism in the development of mathematical problem solving. Students receiving SBI, improved more than the control group on problem-solving measures. SBI group’s schema development exceeded that of the control group.

Kumar (2004)\textsuperscript{21} conducted a study of the impact of Inductive Thinking Model on the learning of Physical Science at secondary level. The investigator concluded that Inductive Thinking Model of teaching is superior to ordinary classroom practices like verbal illustration and demonstration in the learning of Physical Science.

Jayaraman (2003)\textsuperscript{22} found that high achievement is possible in learning fractions in mathematics at upper primary level due to the application of the activity-centered as experimental approach when compared with the conventional approach.

The study by Cass et al. (2003)\textsuperscript{23} evaluated effects of manipulative instruction on perimeter and area problem-solving performance of high school students with learning disabilities in mathematics. Students rapidly acquired the problem solving skills, maintained these skills over a two-month period, and transferred the skills to a paper-and-pencil problem solving format.
Autry (2002)\textsuperscript{24} conducted a study to examine first-grade student’s achievement in mathematics and attitudes towards mathematics using different instructional approaches. Results indicate that there is no significant difference on achievement tests between the constructivist approach and the direct instruction approach.

Kariuki & Wilson (2002)\textsuperscript{25} examined the effects of motivational teaching strategies and traditional teaching strategies on academic achievement and student attitudes toward mathematics. The results showed a significant difference in teaching strategies on academic achievement and in student attitudes toward mathematics.

Vaughan (2002)\textsuperscript{26} investigated the effects of cooperative learning on achievement in and attitudes towards mathematics among fifth graders of color in a culture different from that of the United States. Result indicated that participants made positive gains in mathematics attitudes and achievement.

The report by Blume et al. (2001)\textsuperscript{27} describes the effect of integrating math and science and employing technology to bridge the gap. Post intervention data indicated strengthened mathematical computation skills, increased problem solving skills, and increased student interest.
Mevarech (1999)\textsuperscript{28} compared the effects of three cooperative-learning environments on Israeli seventh grader’s mathematical problem solving (meta-cognitive training, direct strategy instruction and neither). Pencil-and-paper testing assessed student’s problem-solving abilities. Results indicated that students exposed to meta-cognitive training significantly outperformed their counterparts who received strategy instruction, who in turn significantly outperformed students who received no training.

Shyu (1999)\textsuperscript{29} found that computer-assisted video-based anchored instruction was more important than media attributes in the teaching of problem solving among the Taiwanese elementary students.

An experimental study conducted by Oladunni (1998)\textsuperscript{30} focuses on the effects of the application of two problem-solving techniques– meta-cognitive and heuristic–on the achievement of students in the computation of creative mathematics problems. Results indicate that there was a significant difference in the achievement of experimental and control groups.

Woodward & Baxter (1997)\textsuperscript{31} conducted a year-long study of an innovative approach to mathematics, which emphasized in-depth problem solving and achievement of automaticity through math games, found such methods to be viable for students with average and above average academic abilities, but students with
learning disabilities or at-risk students need much greater assistance if they are to be included in general education classrooms.

Marsh & Cooke (1996)\textsuperscript{32} conducted a study on third graders with a history of low achievement in math. They were first given verbal (abstract) instruction in solving word problems. Students were then introduced to manipulative instruction using Cuisenaire rods to set up word problems. Students exhibited immediate and sustained improvement on subsequent probes administered without manipulative available.

\subsection{3.2 Studies on Experiential Learning}

Since its first statement in 1971 (Kolb, 1971;\textsuperscript{33} Kolb, Rubin, & McIntyre, 1971)\textsuperscript{34}, there have been many studies using Experiential Learning Theory to advance the theory and practice of experiential learning. The July 2005 update of the Experiential Learning Theory bibliography by Kolb (2005)\textsuperscript{35} included 1876 entries. It was 1004 entries in the 1999 bibliography (Kolb, Boyatzis, & Mainemelis, 2001).\textsuperscript{36}

Kolb & Kolb (2010)\textsuperscript{37} proposed an experiential learning framework for understanding how play can potentially create a unique ludic learning space conducive to deep learning. The case study suggests that play in a ludic learning space can promote
deep learning in the intellectual, physical, spiritual, and moral realms.

Learners can chart their path on the learning way by developing their meta-cognitive learning capacities, and educators can pave the way by placing learning about learning on the agenda of their educational programs (Kolb & Kolb, 2009). The meta-cognitive model is used to describe how fundamental concepts of experiential learning theory—a learning self-identity, the learning spiral, learning style, and learning spaces—can guide meta-cognitive monitoring and control of learning. Meta-cognitive strategies to help individuals improve their learning effectiveness are outlined.

Dhilwayo (2008) present a prospective entrepreneurship training model based on experiential learning which will enable the "Production" of small business owners or entrepreneurs which is not being achieved by the current methods, design/approach. It provides a model that integrates experiential learning into entrepreneurship education. It shows that appropriate experiential training can truly be integrated in to entrepreneurship education in Africa as in disciplines such as Engineering or Nursing.

Thomas (2008) considered a facilitator is to act intentionally when they are deliberate about what they are doing and can provide rationales for their action. A review of facilitation
literature and the experiential education literature demonstrates the importance of both intentionality and intuitive process when facilitating. The study confirmed the importance of an emphasis on both intentionality and intuition in the preparation of facilitators for experiential education.

Rone (2008) felt instructional pedagogies in learning contexts from classrooms to board rooms are couched within experiential learning paradigms. The field trip is a teaching pedagogy that dress on experiential learning. The effectiveness of field trip as an instructional pedagogy is assured and best practices for incorporating field trips into instruction are presented.

Ives-Devey (2008) studied the advantages and challenges of experiential learning in Geography. Geography increasingly relies on training of professional who can apply geographies concepts to solve real-world problems. The planning profession for years has been training professionals to work in the area of community planning. Planning programs typically include experiential learning modules throughout the curriculum.

Domesk (2007) provides a concrete example of how experiential learning approaches can be implemented in order to most effectively meet specific educational goals in international sustainability studies. The study presents a multidimensional
international experiential program. It illustrates how experiential learning offers an educational experience that most effectively; connects the academic with the practice, fosters an effective interdisciplinary curriculum, links students to work experience and job opportunities. The literature on experiential learning urges that experiential learning approaches deserve greater attention in theory and practice.

Steel et al. (2007) explored a reuse of themes and issues stemming from the application of an experiential learning approach to postgraduate journalism education of the University of Sheffield. The development of experiential learning programmes within journalism education provides valuable experiences that stimulate the real world of journalism practice.

Ives & Obenchain (2006) conducted a pre-test- post-test study using measures of Higher Order Thinking Skills (HOTS) and Lower Order Thinking Skills (LOTS) in six 12th grade American Government classrooms taught by three experienced teachers over one semester. One of the three teachers implemented a curriculum in two classes based on Experiential Education (EE) Principles with guidance from investigations. Students in the EE emphasised classes demonstrated greater gains in HOTS than the students in other four classes. There was no difference in the two groups of LOTS. The result suggest that EE instruction in High School
classes can promote HOTS more than traditional instruction does with no sacrifice in LOTS.

Stavenga de Jong, Wieystra, & Hermenussen (2006)\textsuperscript{46} were investigating the relationship between school-based (academic) and work-based (experiential) learning approaches of students in vocational education programs. The study identified two academic learning dimensions (Constructive learning and Reproductive learning) and three experiential learning dimensions (analysis, initiative, immersion).

Breunig (2005)\textsuperscript{47} is of the opinion that the educational theories of experiential learning and critical pedagogy intersect in a number of ways. One of the intended aims of both of these pedagogies is that the purpose of education should be to develop a main society just world. The investigator explores some of the ways for experiential educators and critical pedagogues to begin engaging a more purposeful classroom praxis that acts on the theoretical underpinnings of share pedagogies as one means to work toward their shared vision of a more society just world.

Research involving different methodologies and different educational and workplace populations, has shown that Experiential Learning Theory (ELT) is useful for understanding team learning and performance (Adams, Kayes, & Kolb; 2005).\textsuperscript{48}
Pauleen, Marshall, & Ergort (2004) used ELT to construct and implement web-based team learning assignments in knowledge management. Students worked on projects in virtual teams evaluated that 75% agreed or strongly agreed that experiential learning was a valuable way of experiencing and learning about a variety of communication channels in a team environment and 99% found that experiential learning to be more valuable than simply reading about something.

Lingham (2004) found that the more the team supported the experiential learning cycle through norms that focused their conversation on interpersonal diverging and task oriented converging, the better they performed, the more satisfied they were with their membership on the team, and the more they felt psychologically safe to take risks on the team.

McGlinn (2003) used experiential learning cycle in a teacher education program, emphasizing the reflective component of the cycle to overcome students’ lack of reflection on their teaching. The investigator claims that the experiential learning model is effective in promoting change and development in students’ self-knowledge about their teaching practices by providing time for reflection.

Cleave-Hogg & Morgan (2002) designed an anesthesia simulation based on experiential learning for undergraduate
medical students. The study supports the value of integrating the experiential simulation exercise in the anesthesia undergraduate curriculum.

Hweng & Henson (2002)\textsuperscript{53} conducted a study on a critical review of the literature on Kolb's learning style inventory is a commonly used measure of learning styles on Kolb's experiential learning model. The psychometric soundness of learning style inventory scores has been critiqued historically. This study reviewed the literature learning style inventory and evaluated the psychometric propositions of Kolb's original and received versions of the learning style inventory.

Powell & Wells (2002)\textsuperscript{54} conducted a study on the effectiveness of three experiential teaching approaches on student science learning in fifth grade public school classrooms. In this study the investigator compares the effect of three experiential science lessons in meeting the objectives of the Colorado model contents science standards. It uses Kolb's Experiential learning model as a frame work for understanding the process by which students engage in learning when participating in Experiential learning activities. The study concluded that the model is very effective in environmental Education.
Harrelson & Leaver-Dunn (2002)\textsuperscript{55} suggest that experiential learning requires that teachers assume a facilitator mind set, which might be a difficult mind set for some.

Park & Bang (2002)\textsuperscript{56} studied the performance of 52 Korean industrial work teams using the Belbin team role model, which is conceptually linked to ELT (Jackson, 2002).\textsuperscript{57} They found that teams with roles that matched the particular stage of a team’s work / learning process performed best.

Sprau & Keig (2001)\textsuperscript{58} introduce films in the history survey course based on experiential learning model. They recommend that the experiential learning model can best serve the students’ interests, so that students are guided to acquire higher-order thinking skills to deal with subsequent learning experiences.

Terry (2001)\textsuperscript{59} published an article about experiential learning. The investigator explains the importance of Kolb’s experiential learning model. Translate learning style theory into the university teaching practice, namely Classroom learning, assignment, essay research writing and examinations. The recommendations for practice can be adopted to accommodate the style delineations of other theorist models. It focuses on university classroom group, essay research writing and examination experiences.
Healey & Jenkins (2000) applied the Svinicki and Dixon model to the teaching of geography course. In their view, two central practical applications of the experiential learning theory are relevant to different types of learning environment be it a lecture course or a seminar-based course.

Mc Goldrick, Battle; & Gallagher (2000) developed a managerial economic course based on experiential methods applied to one form of service learning, student-based instruction.

Krista (2000) stated in his report that experiential learning style inventory is widely used to understand the stages of learning and the ways people prefer to receive and process new information. The model and self assessment are both based on Kolb's experiential learning theory, emphasis the need for learner involvement in educational activities.

Miettinen (2000) conducted a study about the concept of experiential learning and John Dewey’s theory of Reflective thought and activities. He studied Kolb’s electric method of constructing model of experiential learning. He concludes that Kolb’s notion of immediate concrete experience is epistemologically problematic.

Gopinah & Sawyer (1999) developed a computer-based enterprise simulation based on experiential learning in business course to bridge the gap between knowledge and its application.
and found that the recursive nature of experiential learning promotes strategic decision making and group behavior consistent with long-term strategy.

In Political Science Brock & Cameron (1999) developed instructional sequences for a course based on experiential learning cycle and concluded that there is great merit in following the four-stage learning cycle. They highlighted that David Kolb’s experiential learning model and examines learning preference within the icon of the model. Discusses implications and provides illustrations for each of the model’s 4 stages. 1. Concrete Experience 2. Reflective Observation 3. Abstract Conceptualisation. 4. Active Experimentation.

Travers (1998) investigated the impact of experiential learning methods on students’ self-regulation of their own learning process in mathematics. The purpose of the study was to examine whether the treatment group taught mathematics through an experiential learning method demonstrated a higher level of self-regulation than the control group, which was taught mathematics through a traditional lecture format. The results indicate that the experiential learning group demonstrated a higher level of self-regulation. Students taught experientially were exposed to a variety of situations from which to compare a new experience with previous ones, thus developing the ability to critically evaluate what worked and didn’t work in a given learning situation.
Vince (1998)\textsuperscript{67} explains that experiential learning is important in management education. He considered the propositions of Kolb's learning style model by adding psychodynamic and political as illustrates the complexity of experiential learning when unconscious forces and power aspects.

Luckner & Nadler (1997)\textsuperscript{68} described 12 reasons why experiential learning is effective. The reasons are

i) Equality

ii) Developing relationship quickly

iii) Disequilibrium

iv) Projective technique

v) Decreased time cycle

vi) Meta Learning

vii) Chaos and Crisis in a Safe Environment

viii) Kinaesthetic Imprint

ix) Common language/ company mythology

x) Encourage Risk Taking

xi) Diversity of Strengths

xii) Fun

Berry & Woolfe (1997)\textsuperscript{69} found Kolb's model of experiential learning is effective in examining the issues relating to teaching method and assessment procedure.
Saundess (1997)<sup>70</sup> argues that a basic understanding of experiential learning process and the nature of cases and simulations on experiential activities will help instructors of business communication.

Siegel, Khursheed, & Agarwal (1997)<sup>71</sup> conducted a controlled field experiment to test the effectiveness of video simulation as a way to integrate experiential learning theory in the teaching of auditing in their accounting course. The videotape used in the experiment followed the principles of experiential learning in teaching the fundamental steps in auditing. The results of the experiment indicated significantly higher examination scores for the experimental groups, supporting the value of experiential learning for improving effectiveness in teaching auditing.

Hatcher & Bringle (1997)<sup>72</sup> reported the effectiveness of the learning cycle in designing reflection activities in in-service learning settings.

Gardner & Korth (1997)<sup>73</sup> used ELT to design a course in group dynamics, group development, and group effectiveness. They used the experiential learning cycle to improve transfer of learning. They found experiential learning model enhances the learning process, reinforces the link between theory and practice, and facilitates the transfer of learning to the workplace.
Rasanen (1997)\textsuperscript{74} developed a model of experiential art interpretation in which students reflect and construct aesthetic meaning through an integration of art history, criticism, and aesthetics guided by the experiential learning model. She suggests that experiential art interpretation increases students’ expressive skills and results in products that are meaningful both to their makers and others.

Joining Together: group theory and group skills by Johnson & Johnson (1996)\textsuperscript{75} was one of the first texts to pick up on Kolb and to link experiential learning with the work around groups by Lewin and others.

Stiernborg, Zaldivar, & Santiago (1996)\textsuperscript{76} conducted a pre-test post-test quasi-experimental design study to assess the comparative effectiveness of didactic teaching and experiential learning in a HIV / AIDS training program for nursing students in the Philippines. The study concluded that the experiential learning approach was more effective than the didactic approach for knowledge acquisition.

Munton (1996)\textsuperscript{77} a study on the theories of education and learning argues that continuous training is important for improving the quality of day-care provision. Social learning theory is used to examine Kolb’s experiential learning model is an approach to training day-care providers. The study concluded with
the creation of conditions under which experiential learning can be implemented effectively.

Piette (1995)\textsuperscript{78} analyses paradoxes of management development -trends and tensions. He concluded that the experiential learning model: (1. abstract conceptualisation 2. traditional management education) is influenced in management education.

Fraser (1995)\textsuperscript{79} examined what is lost and gained in the translation of private experience into public sphere.

In order to revitalize the engineering education, in 1989 the College of Engineering and Technology at Brigham Young University initiated a faculty training program based on the experiential learning model (Harb et al., 1995).\textsuperscript{80} Several faculty members redesigned their courses to reach the full spectrum of the experiential learning cycle, using a variety of teaching strategies. Also Rogers & Frieberg (1994)\textsuperscript{81} discuss applications of the experiential learning framework to the classroom.

Dyer & Schumann (1993)\textsuperscript{82} developed an experiential learning laboratory classroom in their marketing course and developed the Knowledge / Experience Integration Learning Model in a senior level marketing class. At the completion of the course, students reported an increased level of critical thinking ability and
capacity to apply and connect theoretical knowledge with real-life business application.

Ronald (1993)\textsuperscript{83} conducted a study on the enhancement of learning on public sector in training programmes using Kolb’s experiential learning model. The study suggests that people differ in the way they perceive and process information.

Specht (1991)\textsuperscript{84} examined the effect of an experiential learning method in student learning in an undergraduate accounting course compared with another class conducted using a traditional lecture method. The results revealed that the experiential class demonstrated retention of knowledge over a six-week period, whereas a significant decrease in the scores of the lecture class was observed. The study also concluded that students in the experiential learning classroom may have formed a better understanding of the concepts, thus successfully retaining knowledge better than students in the lecture class.

Mezirow (1991)\textsuperscript{85} develops a comprehensive theory of how adults learn by making meanings of their experiences. He focuses on perspective transformation.

Hartshorn, & Sue (1990)\textsuperscript{86} examine research about the use of manipulatives to teach Mathematics. ‘Manipulatives’ refers to objects that can be touched and moved by students to introduce and reinforce a Mathematical concept. Research suggests that
manipulatives are particularly useful in helping children move from concrete to the abstract level. Building the Bridge between these levels requires careful structuring of manipulatives by the teacher, issues relating to the implementation and success of manipulatives, the period of students exposure and training.

Von Eschenbach, & Raqsdale (1989) investigated the effect of an experiential classroom environment on children's learning through the integration of Mathematics and Social studies. The findings support the contention that children leave better by doing. Children are more attentive to their learning, achieve a deeper insight or meaning of the concepts and are able to apply the information.

Atkinson & Murrel (1988) reports that Kolb's experiential learning theory offers the career counsellor a meta-model with which to structure and ensure a thorough investigation of self and the world of work in a manner provides the client with an optional amount of learning and personal development. Fitzhubbon (1987) stated that Kolb's experiential learning can be adopted and applied to student -teacher supervision.

Svinicki & Dixon (1987) described a comprehensive instructional model to deal with the constraints and challenges that instructors and students encounter in adopting experiential learning as an instructional framework. The instructional design
model incorporates a broad range of classroom activities that lead students through the full cycle of learning. The model has been successfully applied in various academic fields such as geography (Healey and Jenkins, 2000), theatre (Gressler, 2002), and political science (Brock and Cameron, 1999).

Baker, Simon, & Bazeli (1987) contended that teaching is an art requiring the instructor to select from among a wide variety of instructional strategies to teach students with a diversity of learning preferences.

Wilkerson (1986) studied the relationship between preferred learning and clinical achievement of Baccalaureate nursing students. The theoretical framework was based on Kolb’s model of experiential learning with four phases from concrete experience to active experimentation. The study found Kolb’s learning style inventory was effective to assess preference for learning.

Sugarman (1985) promotes the usefulness of the Kolb’s experiential learning model for curriculum planning, implementation, and evaluation in the counseling field. The experiential learning framework helps students expand their repertoire of learning skills through the conceptualization of the total learning process. He stated that experiential learning is helpful for trainees, student counsellors and clients.
Sims & Sauser (1985) proposed the experiential learning model as a theoretical basis to design management curricula intended to develop managerial competencies in business students. They offer seven core principles that need to be in place, if such curricula are to be successfully implemented.

Experiential exercise has proven to be effective in generating considerable student involvement and participation in the learning process, with increased student capacity to retain knowledge for a longer period of time (Umapathy, 1985).

Lipshitz (1983) underscores the complexity of the role of an experiential teacher who needs to have a firm grasp of the relevant conceptual material and also develop sensitivity and skill in managing students’ emotional reactions to the learning process. He designed and implemented an experiential behavior science course in the Israeli Military Academy focused on the development of problem-solving, decision-making, and crisis-management skills in their officers. The aim was to use the experiential learning model to counter the organizational environment of the Israeli Defense Force.

Brookfield (1983) described experiential learning a direct encounter with the phenomena being studied. He used the term in contrasting sense. On the one hand it is used to describe the sort of learning undertaken by students who are given a chance to
acquire and apply knowledge, skills and feelings in an immediate and relevant setting. The record is education that occurs as a direct participation in the events of life.

Certo (1976)\textsuperscript{99} articulated the value of experiential learning as a methodology of education that focuses on the whole person and emphasizes the critical role of the facilitator as an active experiential instructor who blends, with a proper balance, experience, reflection, conceptualization, and action in the classroom activities.

Pace (1977)\textsuperscript{100} emphasised the relevance of experiential pedagogy that gives primary to learners’ experience, action, and opportunity for students to test out newly learned concepts and theories.

Carlsson, Keane, & Martin (1976)\textsuperscript{101} used ELT learning cycle framework to analyse the biweekly reports of research and development project teams in a large consumer product corporation. McMullan & Cahoon (1979)\textsuperscript{102} applied Kolb’s (1971)\textsuperscript{33} experience-based learning evaluation instrument in their organizational behavior course.

### 3.3 Studies on Learning Styles

The Learning Style Inventory (LSI) has been used widely in computer and information science, particularly to study end user software use and end user training (Bostrom, Olfman, & Sein,
It has been used to examine the relationship between learning style and problem solving and decision making, on-line search behavior, and performance in computer training and computer assisted instruction.

Many of the studies in psychology were on LSI psychometrics. The first version of the LSI was released in 1976 and received wide support for its strong face validity and independence of the two dimensions of the learning process (Marshall & Meritt, 1985; Katz, 1986).

Yenilmer (2007) studied the relationship among the learning styles, Math anxieties and math attitudes of the secondary school teacher training students. The results show that math anxiety and math attitude are efficient in predicting preferred learning styles of secondary school students in learning Mathematics.

Kayes (2005) in his study explores the internal validity and reliability of Kolb’s revised Learning Style Inventory (LSI-2A and LSI-3). This study largely supports prior research supporting the internal reliability of scales. Principal Component Analysis provides evidence for a 2 factor structure as hypothesized by Kolb.

Sandmire & Boyce (2004) investigated the performance of two-person collaborative problem-solving teams in an allied health education-anatomy, physiology, and pathology course. They compared a group of higher abstract/high concrete student pairs
with a group of abstract pairs and a group of concrete pairs. The abstract/concrete pairs performed significantly better on a simulated clinical case than the abstract pairs, indicating the value of integrating the abstract and concrete dialectics of the learning cycle.

Sloan et al. (2004) conducted a study on learning styles of elementary pre-service teachers. This study was investigated the learning style preference of 72 elementary pre-service teachers who were near the end of their third year of collegiate study. A learning style inventory, the style Analysis survey, was administered to determine learning style preferences. The categories assessed were (a) using physical senses, (b) dealing with people, (c) handling possibilities, (d) approaching tasks, and (e) dealing with ideas. Over all the subjects possessed some common characteristics. They showed an inclination toward being usual learners who were extroverted, closing-oriented, and global learners.

Ishiyama & Hartlaub (2003) conducted a comparative study of student learning styles in two different political science curricular models at two universities. The result indicated that while there was no statistically significant relationship between student learning styles in underclass students, there was a significant difference in mean scores among upper-class students between the two universities.
Berry (2003)\textsuperscript{112} suggests that if African American student receive Mathematics instruction recommended by certain standards, such instruction will complement their cultural styles and learning preferences.

Halstead & Martin (2002)\textsuperscript{113} found that engineering student teams that were formed randomly to include all learning styles performed better than self-esteem teams.

There is considerable variation in inquiry norms and knowledge structures within some fields. Professions such as management (Loo, 2002a\textsuperscript{114} & 2002b\textsuperscript{115}; Brown and Burke, 1987)\textsuperscript{116} and medicine (Sadler et.al., 1978\textsuperscript{117}; Plovnick, 1975)\textsuperscript{118} are multi-disciplinary including specialties that emphasize different learning styles. Social sciences can vary greatly in their basic inquiry paradigms.

Sharp (2001)\textsuperscript{119} showed that classroom experience of students can improve teamwork skills with theory by recognizing and capitalizing their strengths, respecting all styles, sending messages in various ways, and analysing style differences to resolve conflict and communicate effectively with team members.

In the study of a 6-week teambuilding program, Hall (1996)\textsuperscript{120} reported difficulty with self-selected teams that tended to group on the basis of friendship.
Kayes (2001)\textsuperscript{121} found that teams made up of members whose learning styles were balanced among the four learning modes performed at a higher level on a critical thinking task than teams whose members had specialised learning styles. Researches by Hardigan & Sisco (2001)\textsuperscript{122} supported the idea that students preferred learning style differ. Sandmire, Vroman, & Sanders (2000)\textsuperscript{123} investigating pairs formed on the action /reflection dialectic showed no significant performance differences.

Research that examined the relationship between learning style 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 & Price, 2000;\textsuperscript{124} Hickson, Land & Aikman, 1994)\textsuperscript{125}

The majority of studies in medicine focus on learning style analysis in many medical education specialties. Curry (1999)\textsuperscript{126} has done a number of studies comparing different measures of learning styles. Other research has examined learning style and student performance on examination and the relationship between learning style and medical specialty career choice.

Reese (1998)\textsuperscript{127} developed a program using learning style interventions to improve student learning at the University of Denver Law School.
Nulty & Barrett (1996)\textsuperscript{128} caution that the learning style grouping should not be taken as absolute representation of a particular student population, because different teaching strategies and discourse modes may be adopted which are not traditional to that discipline. Their study also suggests that learning styles are related to the stage the students have reached in their studies.

Researchers and educators contend that understanding of the distribution of learning styles in one’s discipline and subspecialty is crucial for the improvement of the quality of instructional strategies that respond to the individual need of the learner, as well as the optimal level of competency and performance requirement of each profession (Baker, Simon, & Bazeli, 1986;\textsuperscript{129} Bostrom, Olfman, & Sein, 1990;\textsuperscript{103} Drew & Ottewill, 1998;\textsuperscript{130} Fox and Ronkowski, 1997;\textsuperscript{131} Kreber, 2001;\textsuperscript{132} Laschinger, 1986;\textsuperscript{133} McMurray, 1998;\textsuperscript{134} Rosenthal, 1999;\textsuperscript{135} Sandmire, Vroman, & Sanders, 2000;\textsuperscript{123} Sims, 1983).\textsuperscript{136}

In the first experimental study of the effect of learning styles on team performance, Wolfe (1997)\textsuperscript{137} examined how homogeneous three-person teams of accommodators, divergers, assimilators, or convergers performed on a complex computer business simulation compared with heterogeneous teams. The four groups of heterogeneous teams had similar performance results.
There are studies suggest that educators need to adopt their teaching styles and instructional methods to facilitate the learning process by offering a variety of learning opportunities appropriate to different student learning styles and to different subject matters (Baker, Simon, & Bazeli, 1986; Buch & Bartley, 2002; Cartney, 2000).

Lemire (1998) through his research describes the psychometric issues associated with three different learning style models (Visual, Auditory and Kinaesthetic) and the instruments designed to assess their models. He also presents some background to the learning styles idea along with suggestions for utilising the information with developments.

In their study of learning style differences among pediatric residents and faculty, Kosower & Berman (1996) found that most residents preferred accommodating or diverging styles (81%), most faculties preferred either converging or assimilating learning strategies (73%). Similar results were found in a longitudinal study comparing undergraduate nursing students’ learning styles and faculty learning styles. Nursing students preferred concrete thinking (59%) over abstract thinking (41%), while their faculty preferred abstract thinking (82%) over concrete thinking (18%) (Kalsbeek, 1989).
Sims & 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.

Sadler, Plovnick, & Snope (1978) report some of the difficulties of teaching in an environment in which the learning style of the faculty and the students differ. Their study suggests that faced with such a situation, instructors may be required to use instructional methods valuable to the students but not necessarily appearing or intellectually rewarding to the instructors themselves.


3.4 Studies related to Achievement with respect to Learning Styles

Indu & Ignatious (2008) conducted a study on the perceptual learning styles of High school students. The study revealed that effective learning depends on the learning style of the learner. It also showed that a majority of students preferred the
visual learning style. Government school students preferred the visual and the auditory learning styles compared to their counterparts in private, government aided and corporation schools.

Orhun (2007)\textsuperscript{146} conducted a study on an investigation into the Mathematics Achievement and Attitude towards Mathematics with respect to Learning Styles according to gender. This study aimed to investigate whether there is relationship between gender and Learning Styles, Mathematical Achievement and attitude towards mathematics. The results of this study suggested that their differences among learning modes preferred by female and male students. Mathematics Achievement and attitude towards mathematics were not, themselves dependent on gender. It was also noticed that while female students most preferred the convergent Learning Styles, male students most preferred the Assimilator Learning Styles. No students were observed to prefer the Accommodator Learning Styles in both groups.

Hawk & Shah (2007)\textsuperscript{147} in their study have indicated that students can and should develop their abilities that are not in their natural modes and preferences. This is possible only if they are aware that learning style does exist in individuals and that not all individuals learn in the same way. Thomas (2007)\textsuperscript{148} found that cooperative learning enhances the achievement of students grouped according to their learning styles.
Aruna & Usha (2006)\textsuperscript{149} 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.

Malathi & Malini (2006)\textsuperscript{150} conducted a study 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 scores the better was the learning style among higher secondary students.

Rayneri et al. (2006)\textsuperscript{151} in their study examined the learning style of gifted middle school students, student perceptions of 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 style of gifted students has correction with achievement in all contest areas.

Farkas (2003)\textsuperscript{152} examined the effects of teaching through traditional versus learning style instructional methods on an urban sample of 105 heterogeneously grouped 7\textsuperscript{th} grade students achievements, 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.

A number of studies have examined the relationship between learning style, assessment method, and academic performance. While some studies show relationship between grades and the converging learning style (Rutz, 2003; Boyatzis & Mainemelis, 2000), other studies indicate that these learning style differences in student performance may be a function of the assessment technique used.

There is a good relationship between learning style and class participation on student enjoyment level. (Du & Simpson; 2002)

Kinsley (2002) conducted a study on the effectiveness of four stage model of Mathematical learning. He discusses about the instructional implication of this model. He conducted that the model is very effective than traditional method.

Krista (2000) started in his report on experimental learning style inventory widely used to understand the stages of living and the ways people prefer to receive and process new information. The model and self assessment are both based on Kolb’s experiential learning theory, emphasis the need for learner involvement is educational activities.
Rourke & Lysynchuck (2000) investigated the influence of learning style on achievement in hypertext. The learning style 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 style based on their abilities in the four stage of experiential learning style. A significant difference was found between divergers who scored highest and accommodators who record lowest. The results supported previous research which indicated that benefits of hypertext are differentially distributed across learning style.

Ross, Drysdale & Schultz (2000) 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 preference with sequential learners performing significantly better than the random learners in two-computer-science courses.

Bada & 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.

There has been considerable interest in the study of instructional practices for mathematics teaching in Asia. Recent
assessments have indicated that students in several Asian countries such as Japan, Honkong, Korea and Singapore, have indicated to score above international averages (Kelly, Mullis, & Martin, 2000).\textsuperscript{161} In order to explore possible explanations for these achievement differences, an international study has been conducted to examine cultural factors, such as mathematics curriculum and content, student characteristics and learning styles, and instructional strategies (International Commission on Mathematical Instruction, 2000).\textsuperscript{162}

Oughton & Reed (2000)\textsuperscript{163} measured the relationship between graduate students’ learning styles and performance outcome in a hypermedia environment in which students were required to structurally map out their acquired knowledge and grasp the interrelationships among various ideas and concepts. The result showed that Assimilating and Diverging learners were the most productive on their concept maps.

Lynch et al. (1998)\textsuperscript{164} explores the relationship between learning style and three different academic performance measures in a medical school. The study indicated that Converging and Assimilating learners scored significantly higher on the multiple-choice performance measures, while no learning style difference was found on the Computer-based simulation. It also concluded that the results support the Kolb(1984)\textsuperscript{165} and Newland & Woelfl (1992)\textsuperscript{166}.
assertions that Converging and assimilating learners may have a performance advantage on objective, single best answer, multiple-choice examination.

Holley & Jenkins (1993)\textsuperscript{167} examined the impact of learning style on four different accounting exam question formats: multiple-choice theory (MCT), multiple-choice quantitative (MCQ), open-ended theory (OET), and open-ended quantitative (OEQ). The result indicated that there was a significant performance difference by learning style for all but the multiple-choice quantitative format. It also concluded that students with different learning styles perform differently depending on the examination format, and that performance cannot be generalised for similar subjects if the testing format varies.

A research entitled as Mathematics learning viewed from neurobiological model for intellectual functioning was conducted by Davidson (1983).\textsuperscript{168} The learning of Mathematics was addressed in this study with special focus as 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 in their straight success or non-success.

Scott (1994) conducted in 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.

Felder & Solomon’s Inventory of learning styles (1992) organises information handling domains into four categories: Processing (Active or reflective) perception (Sensing or intuitive), input (visual or verbal) and understanding (Sequential or global). Student’s learning styles are known to effect their performance at University (Marriott and Marriott 2003, Sangester, 1996).

According to Honey & Mumford (1992), a student’s learning style reflects his or her preference for the four stages of the adult learning cycle: The activist stage, the reflector stage, the theorist stage, and the pragmatist stage.

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.

Grwronski (1971) studied the existence of inductive and deductive learning styles and their effect on Mathematics achievement. No significant difference in achievement was found between students identified as having inductive or deductive learning styles on programs developed inductively or deductively.

3.5 Studies on Experiential Learning and Learning Styles on Achievement

The primary purpose of the Learning Style Inventory (LSI) and Experiential Learning Theory (ELT) is to increase individuals’ understanding of the process of learning from experience and their unique individual approach to learning. There have been many studies that have used ELT and the LSI to improve the learning process in education.

There are studies reported to cover a broad range of applications using ELT and the LSI. Some educators have used an experimental design to compare the effectiveness of an experiential learning method with a more traditional course format, whereas others have developed and implemented assessment methods for teacher-student interaction. While instructional strategies and methods were designed to fit the academic requirements of a specific field, many of the experiential activities reported in the studies can be broadly applied to different fields with adequate modifications.
Valiente (2008)\textsuperscript{176} observed that learning in groups and using experiential approach may have completely different meanings and expectation in various cultures. It seems apparent that different cultures may face difficulties in following the established phases of an active learning cycle or taking part in experiential learning events that do not coincide with their vision of the world and their economic and professional realities.

Warwick (2008)\textsuperscript{177} used Kolb’s Experiential learning model to teach mathematics in the UK General certificate of Secondary Education for which final examinations are taken at the age of 16. When students attend his first year mathematics module generally find that there are a significant number of students for whom the study of mathematics may have been an unpleasant experience in the past.

Knisley (2002)\textsuperscript{178} developed a model of mathematical learning from an exploration of educational research and personal observations. The study Uses Kolb’s model of experiential learning to characterise four mathematical learning styles: 1) allegorizers 2) integrators 3) analyzers and 4) Synthesizers. There styles viewed as corresponding to four stages of mathematical learning.

Gardner & Korth (1999)\textsuperscript{179} used ELT, learning styles, and the learning cycle to develop a course for human resource development graduate students that focused on learning to work in teams. They
found strong relationships between learning styles and preference for learning methods – assimilators preferred lectures, reading, writing, and individual work, while accommodators and often divergers and convergers preferred partner and group work.

McMurray (1998) organized his English-as-a-foreign-language classroom using ELT principles. Classroom observations supported the idea that students benefited from the team role assignment and from accounting for learning style in the course design.

There have been two comprehensive reviews of the ELT/LSI literature, one qualitative and one quantitative. In 1990, Hickcox extensively reviewed the theoretical origins of ELT and qualitatively analysed 81 studies in Accounting, Business education, Medical profession, Post-secondary education and Teacher education. She concluded that 61.7% of the studies supported ELT, 16.1% showed mixed support and 22.2% did not support ELT. In 1994, Illiff (1994) conducted a meta-analysis of 101 qualitative studies culled from 275 dissertations and 624 articles that were qualitative, theoretical and quantitative studies of ELT/LSI. He found that 49 studies showed strong support for the LSI, 40 showed mixed support and 12 showed no support.

ELT posits that effective learners are able to flex their learning styles according to the demands of different learning tasks. To the
extent that the individual learning preferences are respected and recognized, it is also important for the students to be exposed to diverse learning situations where their abilities and competencies can be stretched beyond the comfort of their preferred learning modes. Several studies suggest that in fact students shift their learning strategies to match the learning demands of a particular discipline (Cornett, 1983; Entwistle, 1981; Kolb, 1984; Ornstein, 1977). Some studies suggest that the identification of learning strategies best suited for different learning styles may increase the learning effectiveness of each individual student and conversely, increase students' adaptive flexibility to alter their learning styles to respond to the learning demand of a specific environment (Brenenstuhl & Catanello, 1979; Curry, 1999; Fritzsche, 1977; Lynch et al. 1998).

**Conclusion**

The review of related literature enabled the investigator to have an extensive information on modern instructional strategies in general and experiential learning strategy in particular. It helped the investigator to know the application of Kolb’s experiential learning and learning style in various disciplines and its effect on achievement. It capacitated the investigator to frame the objectives for the study.
References


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Review of Related Literature


