Chapter III

REVIEW OF RELATED LITERATURE

3.1 Studies on Computer Assisted Instruction

3.2 Studies on Constructivism

3.3 Studies on Constructivist - Computer Assisted Instruction

3.4 Conclusion

References
REVIEW OF RELATED LITERATURE

Modern technology has undoubtedly brought many benefits to today’s society. We live in an age that is characterised by its immense accumulation of knowledge. At one time, students could learn a small, but fixed body of knowledge. But today, the enormous amount of available information, coupled with the fact that the amount of knowledge in the world continues to double at an increasingly quick rate, requires a transformative approach to education. It is imperative that the student of today learns how to be an information manager, rather than an information regurgitator. Explosion of knowledge has also made it impossible for the teachers to impart the ever increasing learning material within the constraints of time and syllabus. This situation has warranted the need for alternative methods of instruction that would enrich the students in the process of education. This literature review explores the three methods of instruction namely Computer Assisted Instruction, Constructivist Method and Constructivist-Computer Assisted Instruction, with importance given to empirical and qualitative studies. An attempt has been made to review the studies related to the major dimensions of the study in relation to the area under investigation.

In the words of Good, Barr and Scates (1941)¹, “The competent physician must keep abreast of the latest discoveries in the field of medicine. Obviously, the careful student of education, the research worker and investigator should become familiar with location and use of sources of
Literature reviews serve as a handy guide to the particular topic. It also provides a solid background for the investigation.

A careful review of the books, research journals, theses, dissertations and other sources of information on the problem is one of the important steps in any research study.

The literature review has enabled the researcher to delimit and define her problem and has served as the basis for the formulation of objectives and hypotheses. In the present study, the investigator has made a careful review of the contributions related to her area of research from edited books, journal articles, research periodicals, ERIC documents, dissertation abstracts, research papers, conference presentations etc. and an account of it is given below. The various studies reviewed are divided into three sections.

- Studies related to Computer Assisted Instruction
- Studies related to Constructivism
- Studies related to Constructivist Computer Assisted Instruction

3.1 STUDIES RELATED TO COMPUTER ASSISTED INSTRUCTION

The potential benefits of Computer Assisted Instruction (CAI) cannot be underestimated in the contemporary world. There is a plethora of established findings on the instructional value of computer, particularly in advanced countries. A great deal of researches has been conducted on the effects of computer use on student achievement, attitudes, motivation, student age, learning rate, and different student population. These cover a wide range
Review of Related Literature

of topics, from computerized learning activities which supplement conventional instruction, to computer programming, to computerized recordkeeping, to the development of databases, to writing using word processors, and other applications.

The main focus of this review is the most commonly used and most frequently researched kind of educational computer use - computer-assisted instruction (CAI). CAI generally consists of drill and practice, simulations, instructional games, and tutorials; instruction can contain new material, and can be used alone or as an enhancement to traditional instructional methods. There are now several CAI packages on different subjects. It is obvious that the current trend in research all over the world is the use of computer facilities and resources to enhance students’ learning. Here, the investigator tries a quick review of such studies.

The use of computers in the classrooms has boomed in the recent years, fueling a debate over whether or not computer-assisted instruction (CAI) is an effective means of improving student achievement. Many researches (Jeyamani, 1991; Singh et al, 1991; Whipple, 1991; Cotton, 1997; Ryan, 1999; Chang, 2000; Bincy, 2001; Varghese, 2001; Vijayalakshmi, 2001; Basil & Blessing, 2005; Maya, 2005; Gladiz, 2006; Kausar et al., 2008; Gravitt, 2010; Serin, 2010; Yusuf & Afolabi, 2010) have revealed that the use of computers in instruction showed significant increase in the academic achievement of students.
Certain studies (Cannon, 2005; Joseph, 2006; Owusu et al., 2010) which indicated that students who were instructed by the conventional or other approaches performed better on the post-test than those instructed by the CAI.

Studies within the past twenty years have focused on the relationship between CAI and achievement in many different subject areas, such as Maths (Singh et al., 1991; Chang, 2000, Erkfritz, 2009, Kao, 2009; Tucker, 2009), Algebra (Handelsman, 1989; Glickman, 2000; Cannon, 2005; Moosavi, 2009; Gravitt, 2010), Physics (Jeyamani, 1991; Vijayalakshmi, 2001; Kannan, 2007), Chemistry (Bincy, 2001), Biology (Maya, 2005; Gladiz, 2006; Owusu et al., 2010; Yusuf & Afolabi, 2010), English (Varghese, 2001) and reading (Blok et al., 2002; Christine, 2002), Computer Science (Kausar et al., 2008).

The amount of benefit a student receives from CAI appears to be related to the age or level of the student. Several studies found positive effects at the primary school level (Iacovou, 1987; Chang, 2000; Blok et al., 2002; Cannon, 2005; Erkfritz, 2009; Kao, 2009; Tucker, 2009). Many studies have been conducted at the secondary (Varghese, 2001; Vijayalakshmi, 2001; Owusu et al., 2010; Yusuf & Afolabi, 2010) and higher secondary (Handelsman, 1989; Jeyamani, 1991; Bincy, 2001; Gladiz, 2006; Kannan, 2007) levels. Studies by Juchau, 1988; Kessler, 2005; Kausar et al., 2008; Moosavi (2009) found significant effects at the college level.
The motivational benefits of using CAI to attempt improvement of general achievement are discussed here. Advocates of CAI (Miller, 1983; Price, 1989; Roberts and Madhere, 1990; Orabuchi, 1992; Owusu et al, 2010; Philip, Jackson & Dave, 2011) claim that using CAI enhances learning through the overall positive motivational factors associated with technology integration into the curriculum. These CAI supporters indicate that CAI improves achievement through increased motivation. Computer-assisted-instruction increases motivation by providing a context for the learner that is enriching, challenging and stimulates curiosity (Miller, 1983). Activities that are intrinsically motivating also carry other significant advantages such as an overall improvement in interest. Providing students with choice over their own learning provides learner-controlled instruction, which contributes to motivation. Increased motivation in turn increases student learning (Price, 1989; Owusu et al, 2010), success in academic gains in reading and mathematics and an overwhelming positive student attitude towards computer assisted instruction and learning (Roberts and Madhere, 1990; Chen, 2005; Philip, Jackson & Dave, 2011), towards school, towards computer and skills students could do with computers (Orabuchi, 1992). In a meta-analysis of 500 studies, Kulik (1994) found that CAI increased the positive attitudes of students towards learning, which resulted in increased learning. Other researchers note that CAI improves school attendance (Cotton, 1997). Kessler (2005), in his study evaluated the perception of Computer Assisted Language Learning (CALL) within teacher of English to speaker of other languages
masters degree programme and found that they were more confident using technology for instruction than creating technology-based materials.

A trend frequently addressed is the potential for technology to enhance learning rate (Capper & Copple, 1985) and increase the retention of learning (Caple, 1996; Gladiz, 2005). Capper and Copple (1985) concluded that the student scores on delayed tests indicate that the retention of content learned using CAI is superior to retention following traditional instruction alone. The work also led them to the conclusion that CAI users sometimes learn as much as 40 percent faster than those receiving traditional, teacher-directed instruction. Gladiz (2006) also proved that CAI was significantly superior to self learning and lecture method in terms of delayed memory achievement and extent of forgetting scores.

Another trend addressed is the use of technology in decreasing the time it takes for students to learn material and the time for instruction of the curriculum objectives (Reeves, 1998). Najjar’s (1996) literature review indicates a time savings of 36 percent when CAI is used in the classroom. Cotton’s (2001) synthesis of 59 research reports yields mixed results in time savings. Based on the research reviewed, Cotton notes that students learn material in either the same time or less time when CAI is used. One study indicated by Cotton (2001) determined that students learn up to 40% faster when taught using CAI, as CAI increases student time on task.

Computer-assisted learning can be an efficient teaching-learning procedure for different student population. CAI when used in conjunction
with the trainee support system proved to be more beneficial to underachievers (Rose, 1992) and the performance of low achievers improved when they were instructed by the CAI (Owusu et al., 2010). The potential of computer-assisted instruction in working with individuals who have autism has been a controversial topic for both teachers and parents since its introduction. The impact of computers on the vocabulary acquisition of young children with autism revealed that the children were more attentive; more motivated, and learned more vocabulary in the computer than in the behavioral program which lacked sounds and object movement (Moore et al., 2000). In another study (Christine, 2002), children with reading difficulty read more effectively when they were taught through CAI. Studies conducted in children with Down’s syndrome (Ortega-Tudela & Gomez- Ariza, 2006) and in children with mild intellectual abilities (Cerasale, 2009) revealed a positive effect on the use of computer assisted teaching.

3.2 STUDIES RELATED TO CONSTRUCTIVISM

Constructivism has become an important aspect of educational reform. “Constructivism as a philosophy is not new, but its application to modern education is still in the formative stages” (Ward 2001). Schools that are using constructivist methods have met with some success, but those schools are rare. Constructivism is a theory of learning rather than a theory of teaching; therefore, it does not prescribe a particular set of teaching practices. This means that the teachers can use a number of methods of teaching and assessment that will fit in the rubric of constructivism – even certain, more
didactic practices, such as lecturing, note taking, and textbooks (Colburn, 2000).

There are several studies which show the positive effect of constructivism. The studies by (Lord, 1997; Guthrie et al., 2004; Bijas, 2007; Cook, 2007; Kim, 2009; Julie, 2010; York, 2010) showed significant increase in the achievement of student when they were taught through the constructivist approach.

Kirschner et al. (2006) argue that the constructivist teaching technique ‘learning by doing’ is useful for more knowledgeable learners, and is not useful for novices. Dogru & Kalender (2007) found no significant difference between traditional and constructivist methods. However, in the follow-up assessment fifteen days later, students who learned through constructivist methods showed better retention of knowledge than those who learned through traditional methods.

The effect of constructivism on the age or level of the students is revealed by some studies. At the primary level, Guthrie et al. (2004) compared three instructional methods for third-grade reading: a traditional approach, a strategies instruction only approach, and an approach with strategies instruction and constructivist motivation techniques including student choices, collaboration, and hands-on activities. The constructivist approach, called CORI (Concept-Oriented Reading Instruction), resulted in better student reading comprehension, cognitive strategies, and motivation.
A few studies (Kim, 2005; Bijas, 2007) done at the middle school level also resulted in better student achievement when constructivism was used. Bijas, 2007 suggest that constructivist informed pedagogy provides opportunities for students to construct relevance of the content by relating new learning to student’s personal experiences and prior knowledge.

Gonen et al. (2006) & Cook (2007) concentrated their studies at the high school level. The study by Gonen et al. (2006) provides a comparative effect study of the Computer Assisted Teaching and the 7E model of the Constructivist Learning methods on attitudes and achievements of the students in physics classes. Statistical analysis of achievement tests showed a significant difference between the students’ achievements at the knowledge and comprehension levels of cognitive domain with no difference noted between their achievements at the application level. To determine the effect of the instruction methods on the student’s attitudes towards the physics course, a physics attitude scale was applied to both groups. The results have indicated that the student’s attitudes towards physics learning were not affected by different instruction methods. Cook’s (2007) study revealed that students are more motivated to participate in activities that allow them to work with peers, contribute their own ideas and relate topics of interest to their own realities.

In undergraduate general science education class, Kim (2009) found a positive significant effect of incorporating active learning strategies such as small group learning with authentic tasks, scaffolding and individual
reports, which were employed to enhance students’ learning and critical thinking.

Constructivist approach has been incorporated in the learning of different subject areas as in Biology (Lord, 1997), Physics (Gonen et al., 2006), Chemistry (Yulirahmawati, 2008), Reading (Guthrie et al., 2004), Social Studies (Bijas, 2007; Science (Cook, 2007; Dogru & Kalender, 2007; Martin, 2010), English (Laine, 2009), Writing (Julie, 2010), Maths (Quigley, 2010), Nursing (York, 2010).

The small number of studies that exists have found mixed and contradictory results about who gets constructivist teaching. A study by Smerdon, Burkam, and Lee (1999) sheds light on who is more likely to receive constructivist teaching rather than didactic teaching. Their study is based on a sample of over 3,600 high school science students taken from the National Educational Longitudinal Study (NELS: 88). They found that “didactic instruction is more common among higher socioeconomic status and female students; constructivist instruction is practiced more often among students of lower ability. Constructivist teaching is also more common in both higher-level science courses and lower-level courses. The students of average social and academic status appear to be the forgotten majority with respect to constructivist instruction”. Some studies have also created a picture of who gets constructivist teaching. One of the most important factors in determining whether or not students will receive constructivist instruction is
the teacher’s perception of his or her students’ abilities. In general, traditional techniques are used in lower level courses (Talbert and McGlaughlin, 1993).

The tendency is for teachers to emphasize higher-order thinking skills in higher-level classes, which have college-bound students. Furthermore, Newmann and associates (1996) found an even distribution of authentic instruction related to race, gender, and socioeconomic status, but students with greater ability tended to be exposed to more constructivist teaching and learning.

There are many important factors that will determine whether or not constructivist teaching and learning can become more widespread. These factors include: teacher preparation, professional development, government requirements, teacher attitudes, community and parental attitudes, and administrative support.

Ward (2001) argues that “the central figure responsible for producing change is the teacher”. For the teacher, the evolution of teaching and learning towards constructivism has to begin at the beginning: teacher education and preparation. As Windschitl (2002) says, “One of the most powerful determinants of whether constructivist approaches flourish or flounder in classrooms is the degree to which individual teachers understand the concept of constructivism”. Teachers must learn about the underlying theory in order to know what types of activities are appropriate for the given learning goals. In the absence of some other model, teachers tend to teach the way they were taught, and most teachers were taught using
traditional, didactic method (Windschitl, 2002). Even pre-service student teachers at colleges of education being taught about constructivism are being taught these theories and ideas through teacher-centered, traditional methods (Smerdon, Burkam, and Lee, 1999). Changes in the methods of teaching towards constructivism and student understanding need to start at the beginning.

Teachers need the continuing support of professional development. Too often, professional development time is not used to improve the skill sets and understandings of teachers. Teachers, more than anything, will need time, resources, and training to design the activities and assessments that will lead their students toward understanding (Ward, 2001).

Cochran-Smith & Lytle (1999) emphasised the importance of teachers having ‘inquiry as stance’. They used the metaphor to capture ‘the ways we stand, the ways we see and the lenses we see through’. They stressed that *inquiry as stance* is a construct for understanding teacher learning in communities, which relies on a richer conception of knowledge, practice and learning than that allowed by traditional conceptions. Edwards-Groves (1999) concluded that teachers need to teach students more about the learning process and enable students to get to know themselves as learners. MacNaughton & Williams (2004) has revealed the complexity of the teacher’s role as a reflective practitioner. The teacher has to be a *manager* of multiple processes of reflection: their own and the individual processes of
the many students they teach. They have to be able to cope with their own emotional responses to new ways of working and also those of their students.

The student-teacher relationship also becomes more complex in a constructivist classroom. As Darling-Hammond (1996) claims it, in classrooms where changes from traditional to constructivist methods of instruction are taking place, the relationship between teacher and student is more interactive, complex and unpredictable. Jett (2009) indicated that those teachers who had a more student focused or constructivist approach to science teaching were more likely to effectively use a wider variety of formative assessment strategies in their instruction.

Beyond the need for changing teacher education and professional development, there are obstacles to the widespread adoption of constructivist teaching and learning. One of the problems with the current reform movement is the standardization of teaching and learning to which it leads. The standardized tests used to measure the progress of schools and students against each other differ greatly from the authentic assessment strategies used by constructivists and emphasize basic skills and information recall rather than deeper understanding and critical-thinking skills (Talbert and McGlaughlin, 1993). This phenomenon often leads teachers to abandon their constructivist strategies and, instead, teach to the test (Rowan, 1990).

Furthermore, standardization of curricula and assessments is in sharp contrast to the how Dewey and the constructivists see the curriculum. Dewey believed that education should focus on the student and be connected
to their lives beyond school (Wiske, 1998). Different students will have different views of the world, and these diverse views and understandings may not match the views and understandings of students in other places - or even in the same classroom.

Another source of resistance to constructivism is parents and students who are concerned about scores on standardized tests, especially for those students trying for entrance into college (Smerdon, Burkam, and Lee, 1999; Windschitl, 2002). This pushes teachers toward traditional, didactic instruction. Furthermore, parents, most of whom were taught in traditional ways, find the constructivist classroom “dangerously experimental and are skeptical about the use of such pedagogy with their children” (Windschitl, 2002).

3.3 STUDIES RELATED TO CONSTRUCTIVIST-CAI

To understand learning within a constructivist framework, as a contextual activity, the whole learning environment must be examined. However, the wide diversity of constructivist views make the task very complex and beyond the scope of this research. These views commonly emphasize the role of the teacher, the role of the student, and the cultural embeddedness of learning (Duffy & Cunningham, 1996; Simons, 1993). Using these commonalities as guidelines, this review outlines the relationship of constructivism with technology by looking at (a) technology as a cognitive tool, (b) constructive view of the thinking process, and (c) the role of the teacher in technology enhanced environments.
A number of research studies (Jonassen, 1994; Duffy & Cunningham, 1996; Kafai et al., 1997; Swain & Pearson, 2001; Pear & Crone-Todd, 2001; Meli, 2009; Chiu, 2010; Kennedy, 2010; Shen & Liu, 2010; Shyr, 2010) have been done on technology as cognitive tools.

Cognitive tools refer to technologies, tangible or intangible, that enhance the cognitive powers of human beings during thinking, problem solving, and learning. Cognitive tools do not preclude the use of computers to increase productivity for learning. According to Swain and Pearson (2001), teachers and students must be educated to use the computer as a productivity tool, as well as a tool for learning, research, networking, collaboration, telecommunications, and problem-solving. Meli (2009) examined the impact of multimedia as a delivery tool for enhancing vocabulary in second language classrooms.

The traditional view of instructional technologies of instruction, summarized by Jonassen (1994), as conveyors of information and communicators of knowledge is supplanted with active role the learner plays in learning with technology. Technologies, primarily computers, help build knowledge bases, which will “engage the learners more and result in more meaningful and transferable knowledge… Learners function as designers using the technology as tools for analyzing the world, accessing information, interpreting and organizing their personal knowledge, and representing what they know to others”. Technological tools such as spreadsheets, databases, expert systems, video conferencing and others can be used by students to
analyze subject matter, develop representative mental models, and then transcribe them into knowledge bases.

According to Duffy & Cunningham (1996), the central assumption of constructivism is that learning is mediated by tools and signs. “Culture creates the tool, but the tool changes the culture. Participants in the culture appropriate these tools from their culture to meet their goals, and thereby transform their participation in the culture”. The computer is a form of mediational means that has aspects of both tool and sign. The role of computer in education has been largely viewed as an instructional tool and for providing a richer and more exciting learning environment (Taylor, 1980). By focusing on the learner, the role of technology can support new understandings and capabilities, thus, offering a cognitive tool to support cognitive and metacognitive processes. Educational philosophy of social constructivism maintains that human learning occurs primarily through a socially interactive process. The multimedia software Logo proved to be a good context for students to learn through collaboration and project management. The interaction between team members, the flow of ideas and loud thinking encouraged the children to experiment and find alternative ways for designing and solving problems (Kafai and her colleagues, 1997). The computer-mediated teaching system, called computer-aided personalized system of instruction (CAPSI) developed by Pear & Crone - Todd (2001) which is consistent with social constructivism, revealed that students in a
CAPSI-taught course receive and give a large amount of substantive feedback.

Science instruction focused on complex topics can succeed by combining visualizations with generative activities to encourage knowledge integration was revealed by Chiu (2010). Kennedy’s (2010) study on the effectiveness of using blogs, wikis and e-portfolios in college composition classes showed that there is an improvement in the composition of their academic prose across the duration of the course.

A web-based learning environment was designed by Shen & Liu (2010) and he further examined the effect of the web-based training and found that the students in experimental group made significantly greater gains compared to control group in self-plan. Shyr (2010) demonstrated RECOLAB’s effectiveness in helping students to understand the concepts and master the technologies for the web-based mechatronics monitoring and control learning system.

Some researchers like Jonassen, 1994; Black & Mc Clintock, 1995; Kafai et al, 1997; Swain & Pearson, 2001; Funkhouser, 2003; Saritas, 2006; Khan, 2009; Park, 2009; Joe et al., 2010; Williamson, 2010; Wu et al., 2010 have made studies related to constructivist view of ‘thinking’.

Jonassen (1994) states that cognitive tools, along with constructivist learning environments guide and activate cognitive learning strategies and critical thinking. Cognitive tools help in knowledge construction and not knowledge reproduction. The knowledge constructed by
The importance of interpretation as being central to cognition and learning is stressed by Black and McClintock (1995). Their design of Study Supported Environments (SSEs) based on constructivist design principles called Interpretation Construction Design (ICON) focused mainly on the interpretive construction of authentic artifacts in the context of rich background materials, and spanning across different fields of study. Their study showed that in addition to learning specific content, students were able to acquire generalisable interpretation and argumentation skills.

Metacognition, or the self-monitoring and self-control of the learning process were emphasized by Kafai et al. (1997). New knowledge which is composed is added to previous representations, modifying them in the process. This usually requires external scaffolding in the form of people, books, or technologies such as computers. Swain & Pearson (2001) demonstrates that the process of thinking in constructivist paradigms requires higher-order skills, delving deeper and harder into content and context. Saritas (2006) developed a conceptual framework based on constructivist learning principles to examine whether knowledge construction was promoted through computer conferencing in two graduate level bioethics courses. Knowledge
construction through computer conferencing was examined from three main constructivist principles namely active participation, peer to peer interaction and cognitive conflict resolution. Results of the study suggest computer conferencing system by itself does not guarantee knowledge construction but provides insight into the nature of knowledge construction.

The effects of computer software on mathematics achievement and attitudes toward mathematics of secondary school students (Funkhouser, 2003) demonstrated significantly better performance on a standardized test of geometry concepts than the control group at the 0.05 level of significance. Results of assessments of student attitudes toward mathematics were mixed. Khan’s (2009) study revealed that a meaningful curriculum, empowered educators and integration of technology for teaching and learning motivated students to succeed. Grade 7 teacher’s constructivist instructional practices in a technology rich mathematics classroom through a lens of cultural-historical activity theory (CHAT) was studied by Park (2009) which indicated that it was the changed nature of the class activity system due to the introduction of ICTs that called for systemic adjustments of classroom practices as a whole.

Jou et al (2010) combines the main advantages of CBR (Case Based Reasoning) and TRIZ (Russian acronym for Theory of Solving Inventive Problem) to transfer physics to industrial technology. Based on this synergy, interactive web-based environments were developed. The evaluation was conducted in a “Special Project Design” course requiring students to design a robot that could carry out several functions. With
project-based learning approaches, planning activities and investigations play a critical role in the project process. Through the web-based environments, students can explore the essence of basic physics, design technologies, and the integration of mechatronics. Further, web-based reasoning and meaningful learning modules are developed to scaffold creative design and to enhance student participation, motivation, and learning effectiveness. Findings showed that inquiry modules were able to facilitate investigation and planning activities in product design stages. The responses obtained were very encouraging. Students in the course were appreciative of these on-going changes and indicated that these were indeed helping them to develop their engineering thinking and design skills, increasing their motivation to study.

A methodology to determine the relative importance and presence of constructivist elements in online learning classes was developed by Williamson (2010). A case study method was used to assess the effectiveness of four key constructivist elements: knowledge construction, collaborative learning, authentic learning and self-regulation in an online masters level public health course. The first three elements were found to positively contribute to student learning in the online environment. A technology-based modelling tool (Air Pollution Modelling Tool, APoMT) that supports students to engage in scientific modelling was designed by Wu et al (2010) based on theories and guidelines of scaffolding. APoMT decomposes a modelling process into manageable tasks, supports an increasingly sophisticated modelling process by integrating multiple variables
into students’ models, provides multiple representations to help students visualize data and relationships, and embeds expert guidance to help learners apply science content to modelling. An implementation study shows that combining APoMT with well-designed learning lessons could effectively support students’ development of conceptual understandings and modelling abilities.

The role of the teacher in technology enhanced environments was studied by Richard, 1998; Jonassen, 1999; Rakes et al., 1999; Kim & Sharp, 2000; Walker, 2000; Witfelt, 2000 and Wu, 2010.

Within a constructivist classroom, the teacher engenders social and intellectual climates, where collaborative and cooperative learning methods are supported (Richards, 1998). Jonassen (1999) stresses that technology-enhanced classrooms tap constructivist strategies, arranging problem-based projects where students actively construct knowledge, linking new knowledge with the previous knowledge. The increasing skill levels of teachers with regard to computers and providing additional opportunities for teachers to integrate technology into lessons may encourage the use of constructivist behaviours according to Rakes et al. (1999)

An exposure to constructivist teaching methods and simultaneous multimedia learning experiences influenced the planning of constructivist behaviours and infusion of technology (Kim and Sharp, 2000). Walker (2000) states that the role and responsibilities of the teacher in the open or the global classroom, as an agent, has to
constantly update information and technology for making learning authentic and relevant. In a constructivist framework, as Witfelt (2000) observed, the teacher assumes the role of the facilitator, providing an environment for spontaneous research, understanding the social and collaborative nature of learning, helping children construct knowledge and initiate problem-based, project-oriented work. The study by Wu (2010) indicated that students who received continuous computer based procedural and early teacher based metacognitive scaffolding performed statistically better at learning scientific inquiry skills than the other treatment groups.

3.4 CONCLUSION

An attempt was made by the investigator to review the studies relating to the major areas under investigation. The review revealed that all the three methods selected are highly effective methods of teaching. The review of literature does more than just describe and report the literature; it synthesises diverse sources, explains findings, and integrates them into a series of recommendations for the design of instructional activities based on the three methods of instruction - Computer Assisted Instruction, Constructivist Method and Constructivist-Computer Assisted Instruction, taken up in the study. The review of studies was helpful in developing the objectives, designing suitable experimental design, selecting and developing suitable tools and also in the analysis and interpretation of data. The literature review was also helpful in conceptualising the research problem clearly and precisely and thus providing a theoretical background for the study.
The best-supported finding in the research literature related to CAI is that the use of CAI as a supplement to traditional, teacher-directed instruction produces achievement effects superior to those obtained with traditional instruction alone. Generally speaking, this finding holds true for students of different ages and abilities and for learning in different curricular areas. Some studies have been reported which compared the effects of CAI alone with those produced by conventional instruction alone. Here, results are too mixed. Some have found CAI superior, some have found conventional instruction superior, and still others have found no difference between them.

Few researchers have also found that CAI enhances the learning rate. Student learning rate is faster with CAI than with conventional instruction. In researches on retention of learning, the student scores on delayed tests indicate that the retention of content learned using CAI is superior to retention following traditional instruction alone. Many researchers have come to the conclusion that the use of CAI leads to more positive student attitudes than the use of conventional instruction.

Comparisons made between lower-achieving and higher-achieving students show that CAI is more effective with lower-achieving students than with higher-achieving ones. A few researchers undertook to compare the effectiveness of CAI in different curricular areas. Their findings indicate that CAI activities are effective in the areas of Science, Physics, Chemistry, Biology, Mathematics, Reading and English. Researches conducted on underachievers, learning disabled, autistic children and children
having Down’s Syndrome indicate that their achievement levels are greater with CAI than with conventional instruction alone.

Research literature has shown constructivism to be very successful in many environments, yet a failure in others. While much controversy surrounds the constructivist approach to education, most of them are able to be refuted by researchers in their specific environments. The ultimate answer lies within the teaching environment. The failure of an approach stems from lack of readiness on the teacher and the institution. Another consideration is the learning style of individual students. While some students might not be as successful being taught from a constructivist approach, many others might have success. Teachers need to be able to teach with a variety of methods and tailor education to meet individual needs in order to become successful. Studies revealed that constructivist approach resulted in better student performance or superior achievement than the traditional, teacher-directed instruction. This finding is acceptable for students of different ages and for learning in different curricular areas.

Several studies report that the constructivist teaching technique ‘learning by doing’ is useful for more knowledgeable learners, and is not useful for novices. Constructivist approach has been incorporated effectively in the learning of different subjects such as Biology, Physics, Chemistry, Reading, Social Studies, Science, English, Writing, Maths and Nursing.
Some studies have created a picture of who gets constructivist teaching. One of the most important factors in determining whether or not students will receive constructivist instruction is the teacher’s perception of the students’ abilities. Though there are many factors such as teacher preparation, professional development, government requirements, teacher attitudes, community and parental attitudes, administrative support, etc. which determine whether or not constructivist teaching and learning can become more widespread, the central figure responsible for producing change is the teacher. The student-teacher relationship also becomes more complex in a constructivist classroom.

Studies reveal that an important problem with the current reform movement is the standardization of teaching and learning. Also, the standardization of curricula and assessments is in sharp contrast to the how the constructivists see the curriculum. Another source of resistance to constructivism is parents and students who are concerned about scores on standardized tests. There are also studies which point out that parents, who were taught in traditional ways, find the constructivist classroom dangerously experimental.

Constructivism, as a theory, will be forced into play by emerging technologies because it is impossible for a teacher to use didactic methodology in a technology-rich classroom. There is a strong link between the effective use of modern technology and the theory of constructivism. This link is so strong that it will cause a fundamental shift away from didactic
techniques to a unifying constructivist framework. In a technology rich environment, the educational focus is on learning and instruction goals instead of the technology itself, because technology are merely tools or vehicles for delivering instruction.

Technology makes possible the instant exchange of information between classroom as well as individual students; it allows instant access to databases and online information services, and provides multimedia resources such as interactive audio and video. Technology also allows to present educational materials across media formats like: print, software like power-point, still and motion video, animations, computer graphics.

From the literature review, the investigator concluded that many studies have been done in Computer assisted Instruction and some in Constructivism in India and abroad, but not many are done related to Constructivist- Computer assisted Instruction in India. Many of the studies attempted to compare Computer -Assisted Instruction with Constructivist Model. Some studies revealed a comparison of either of the two methods or a combination of the two with conventional methods. Hence, the study undertaken by the investigator is a fresh attempt as it is a comparative study of the effectiveness of Computer Assisted Instruction (CAI), Constructivist Model (CM) and Constructivist-Computer Assisted Instruction (CCAI) in learning Molecular Genetics at the Higher Secondary School Level.
REFERENCES


assessment in education and training. (pp. 9-33) Hillsdale, NJ: Lawrence Erlbaum.


