CHAPTER 2
THEORETICAL ORIENTATION AND REVIEW OF THE PAST STUDIES

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2.1 INTRODUCTION

In the research study, it is necessary to formulate the theoretical orientation which will provide information and ideas for seeking answers to the topical questions and frame the work and approach. (Mary Wroblewski, 2011) Theoretical orientation helps the researcher to ponder and develop thoughts or theories on what the possible answers could be. These thoughts and theories are then grouped together into themes that frame the subject which is known as a theoretical framework. The main benefit of a theoretical orientation is that it can help a researcher determine problem areas, content considerations, research questions that need to be addressed, and the methodology or way in which the researcher plans to go about finding an answer to the research question. (Michelle McGriff, 2011)

The second chapter is an attempt to make a contribution of thoughts and theories in the field of the effectiveness of Computer Assisted Instruction (CAI) on learning achievement into the theoretical framework of this research. It is needed to state the theoretical concepts or the basic ideas on the Computer Assisted Instruction (CAI) and the work already done in the research studies, to attain an overall relevance and purpose. Theory is used to craft the null hypothesis, which is either proved or disproved by the research itself and the review literature provide readers with a background for understanding current knowledge on a topic and illuminate the significance for the new study.

The researcher has summarized the relevant theory from books and review of the past research which have already done in the area of effectiveness of Computer Assisted Instruction (CAI) on learning achievement and presented in this chapter.

2.2 THEORETICAL ORIENTATION

The theoretical orientation is stated the basic ideas on the topic i.e. definition of effectiveness, definition of Computer Assisted Instruction (CAI), definition of learning achievement, theoretical foundation of CAI, type of CAI, steps of constructing of CAI,
advantage and disadvantage of CAI, effectiveness of CAI in teaching-learning process, and Career and technology subject in Thai basic core curriculum.

2.2.1 Definition of effectiveness

Effectiveness is the capability of producing a desired result. When something is deemed effective, it means it has an intended or expected outcome, or produces a deep, vivid impression. (Dictionary.com, 2011)

The origin of the word “effective” stems from the Latin word effectivus, which means creative, productive or effective. It surfaced in Middle English between 1300-1400 A.D. (Harper, Douglas. 2011)

Efficacy, efficiency, and effectivity are terms that can, in some cases, be interchangeable with the term effective. The word effective is sometimes used in a quantitative way, “being very effective or not very effective”. However, neither effectiveness, nor effectively, inform about the direction (positive or negative) and the comparison to a standard of the given effect. Efficacy, on the other hand, is the extent to which a desired affect is achieved; the ability to produce a desired amount of the desired effect, or the success in achieving a given goal. Contrary to the term efficiency, the focus of efficacy is the achievement as such, not the resources spent in achieving the desired effect. (Pearson Longman, 2011)

Other synonyms for effectiveness include: clout, capability, success, weight, performance. Antonyms for effectiveness include: uselessness, ineffectiveness.

Another source of confusion regarding the term effectiveness is its relationship with the term affectiveness. Due to the similarity in the way these two words are spelled, they are often confused with each other and used incorrectly. The term affectiveness (noun) is derived from the root word affective (adjective) meaning concerned with arousing emotions or affection or relating to moods, attitudes or feelings. In a simple word effective means output and efficiency means outcome. (Collins Reverso, 2011)

The term “effectiveness” can be defined by educators as below:

Fraser (1994) defined effectiveness as a match between stated goals and achievement. In other words, effectiveness can be refers to the quality or the achievement or output of education which must be involved judgements about the goals.
Erlendsson (2002)\(^8\) defines effectiveness as: the extent to which objectives are met (doing the right things).

Wojtczak (2002)\(^9\) defines effectiveness in the context of medial education:
Effectiveness: A measure of the extent to which a specific intervention, procedure, regimen, or service, when deployed in the field in routine circumstances, does what it is intended to do for a specified population.

NSIN (2002)\(^{10}\) defines effectiveness as a long term outcomes of learning which include many of the following:
- More knowledge and greater complexity of understanding
- More positive feelings, emotions and affiliation to learning: success, satisfaction
- Enhanced more skills and action appropriate to goals and context
- Increased engagement and self-direction
- More reflective approach
- More developed vision of future self as a learner
- Greater facility in learning with others
- More sense of participation in a knowledge community

UNESCO (2004)\(^{11}\) defines effectiveness as an output of specific review/analyses that measure (the quality of) the achievement of a specific educational goal or the degree to which education institution can be expected to achieve specific requirements.

Peter F. Drucker. (2006)\(^{12}\) point out that effectiveness in medicine relates to how well a treatment works in practice, as opposed to efficacy, which measures how well it works in clinical trials or laboratory studies whereas in education, effectiveness refers to the learning achievement of a specific educational goals.

Oxford Dictionaries (2007)\(^{13}\) defines the word “effectiveness” as the degree to which something is successful in producing a desired results.
Audioenglish.net Dictionary (2009)\textsuperscript{14} states that effectiveness has two senses:

1. Power to be effective; the quality of being about an effect
2. Capacity to produce strong physiological or chemical effects

Effectiveness is about outcomes, consequences and results. It is almost a synonym for success, for being effective means achieving the outcomes and results. Effectiveness is achieved by determining what the “right” thing which must be done; and then doing it right. The right vision for organization, coupled with focused execution and continuous improvement (i.e. efficiency), results in effectiveness.

Accurate and Reliable Dictionary (2009)\textsuperscript{15} defines effectiveness as the producing or capable of producing an intended result or having a striking effect. Effectiveness means the ability to accomplish a purpose; the power to be effective, the quality of being able to bring about an effect.

Business Dictionary (2009)\textsuperscript{16} mentions that effectiveness is the degree to which objectives are achieved and the extent to which targeted problems are resolved. In contrast to efficiency, effectiveness is determined without reference to costs whereas efficiency means doing the thing right, effectiveness means doing the right thing. Effectiveness is very similar to efficiency, but the measure is related to some enterprise objective rather than the technical quality of output. The indicator of effectiveness is related to customer satisfaction rather than output. Therefore the effectiveness measure of a business process can be indicated by the resources inputs needed to produce a level of an enterprise objective.

Free Online Dictionary (2009)\textsuperscript{17} states that effectiveness is the power to be effective; the quality of being able to bring about an effect. In the other words, it is the capacity to produce strong physiological or chemical effects.

Dean, R. Spitzer (2009)\textsuperscript{18} illustrates that effectiveness as the producing of desired results. Effectiveness has to do with getting the right results; efficiency relates to cost or investment. The effectiveness has to do with the outcomes due to the content of learning.
From the above definition, it can be concluded that effectiveness means the degree to which something is successful in producing a desired results or the objectives are achieved a specific goals. It is the ability to accomplish a purpose, the power to be effective, the quality of being able to bring about the success in achieving a given goal and the capacity of producing a desired outcome.

In the present study, effectiveness refers to the ability of computer assisted instruction (CAI) to accomplish a learning purpose in the career and technology subject (learning substance: electronic, title “Multi-Meter”) for tenth grade students. This includes the power or the degree to which computer assisted instruction (CAI) is successful in producing a desired results and the quality of being able to bring about the highest level of students’ learning achievement in knowledge and understanding, key competencies and desired characteristics.

2.2.2 Definition of computer assisted instruction (CAI)

Current growth in computer technology is advanced quickly which is a catalyst for change in all professions. As a result, bringing the computer to participate in work and it become efficiently than more ever. Academic learning has brought the computer to use in teaching and learning as well. Nowadays, many countries bring computer to use as a medium of instruction in schools and allow students to learn depend on their own ability and speed they need. (Suwanna Sombunsukho et al, 2011) Learning and teaching today is necessary to develop and apply advanced technologies used in conjunction with the teaching and learning in order to optimize the learner. Computer assisted instruction (CAI) has become to be the aid of teaching and learning application. There are numbers of researches about teaching and learning using computer assisted instruction (CAI) which found that achievement of students who is taught through CAI is greater than student who is taught by traditional instruction.

Idea and practice of computer assisted instruction (CAI) is grounded in the twentieth century. Use of computer in education is referred by many names such as: • Computer Assisted Instruction (CAI), Computer Aided Instruction (CAI), Computer Assisted Learning (CAL), Computer Based Learning (CBL), Computer Based Education (CBE), Computer Based Instruction (CBI), Computer Based Learning (CBL), Computer Based
Teaching (CBT), Computer Based Training (CBT), Computer Enriched Instruction (CEI), Computer Managed Instruction (CMI), Web Based Instruction (WBI) and Web Based Training (WBT). (Wiki Educator, 2008)

Computer assisted instruction (CAI) is used through the entire range of education from pre-school to higher education. It has been defined by many educators as presented below:

Computer assisted instruction (CAI) is the use of computer to present drill-and-practice, tutorial, or simulation activities offered either by themselves or as supplements to traditional, teacher directed instruction. CAI can be used either in isolation, bearing the whole responsibility for conveying instruction to students, or in combination with conventional, i.e., face-to-face, teaching methods. Research has shown that the combination of conventional and CAI instruction has been most effective in raising student achievement scores. (Batey, 1986)

Association for Education Communications and Technology (1977) defines computer assisted instruction (CAI) as a method of instruction in which the computer is used to instruct the student and where the computer contains the instruction which is designed to teach, guide, and test the student until a desired level of proficiency is attained.

Computer assisted instruction (CAI) is explained by Frenzel (1980) as the process by which written and visual information is presented in a logical sequence to a student by a computer. The computer serves as an audio-visual device. The students learn by reading the text material presented or by observing the graphic information displayed. The primary advantage of the computer over other audio-visual devices is the automatic interaction and feedback that the computer can provide. Multiple paths through the course material can be taken, depending upon the individual student's progress.

Locatis and Atkinson (1984) state that computer assisted instruction (CAI) is a mode of instruction that involves student interaction with the computer directly. Typically, students access programs presented in segments, with each segment including information and questions or problems for students' response. The correctness of each
response is indicated immediately and remedial or new information is presented. Sometimes students also have the option of requesting help or skipping ahead. Although this tutorial (information-practice-feedback) form of CAI is most typical, there are other forms such as drill and practice exercise, simulations and games.

Munden (1996) mentions that computer assisted instruction (CAI) is an educational medium in which instructional content or activities are delivered by a computer. Students learn by interaction with the computer and appropriate feedback is provided whereas Poole (1995) defines computer assisted instruction (CAI) as a computer-based system designed to help students learn subject matter of all kind.

Douglas, N. Arnold (2000) illustrates that computer assisted instruction (CAI) is an instructional material that assists the teaching and learning process which include guided drill and practice exercises, computer visualization of complex objects and computer facilitated communication between students and teachers. The information in the computer assisted instruction (CAI) can be presented on computer in form of text or multimedia formats, which include photographs, videos, animation, speech and music.

Wiki Educator (2008) defines Computer-assisted instruction (CAI) as a self-learning technique, usually offline/online, involving interaction of the student with programmed instructional materials. It is an interactive instructional technique whereby a computer is used to present the instructional material and monitor the learning that takes place. CAI uses a combination of text, graphics, sound and video in enhancing the learning process. The computer has many purposes in the classroom, and it can be utilized to help a student in all areas of the curriculum. CAI refers to the use of the computer as a tool to facilitate and improve instruction. CAI programmes use tutorials, drill and practice, simulation, and problem solving approaches to present topics, and they test the student's understanding.

Sylvette A. La Touche (2010) describes that computer assisted instruction (CAI) is a teaching process in which a computer is used to enhance the education of an individual. It is software teaches specific skills and knowledge, often narrowed to a
specific content area and grade range. It can also be used to describe internet based instruction through the use of webpages, web bulletin boards, and real audio.

Nasser Saleh (2011) points out that computer assisted instruction (CAI) is an approach to teaching and learning where the computer and computer-based resources such as the internet are used to present, reinforce and assess material to be learned.

Suwanna Sombunsukho, et al (2011) define computer assisted instruction (CAI) as a high technology of instruction which computer is used as a medium of teaching and make learning the correspondence between the students and computer as well as teaching between students and teachers, students and students in regular classrooms. Computer assisted instruction (CAI) have ability to respond with information that student can enter immediately.

Manzer Abbas (2012) described computer assisted instruction as an interactive tutorial technique that uses a computer to gift academic material, track learning, and direct the user to further material that meets the student’s desires. It may be used to explain net primarily based instruction through the employment of web-pages, internet bulletin boards, listservs, newsgroups, video, and graphics.

Juergen Haas (2012) defines computer-assisted instruction (CAI) as the teaching process in which a computer is used to enhance the education of a student. It is a self-learning technique, usually online, involving interaction of the student with programmed instructional materials.

The free dictionary (2012) defines computer assisted instruction (CAI) as a teaching process that uses a computer in the presentation of instructional materials, often in a way that requires the student to interact with it and also called computer-assisted learning.

Miller-Keane Encyclopedia (2012) gives the definition of computer-assisted instruction (CAI) that CAI is the instructional activities that use a computer as the primary vehicle for teaching content or processes rather than one-to-one interaction with a student.
Britannica Encyclopedia (2012) defines computer assisted instruction (CAI) as the instructional material presented by a computer. Since the advent of microcomputers in the 1970s, computer use in schools has become widespread, from primary schools through the university level and in some pre-school programmes. Instructional computers either present information or fill a tutorial role, testing the student for comprehension. By providing one-on-one interaction and producing immediate responses to input answers, computers allow students to demonstrate mastery and learn new material at their own pace.

McGraw-hill Science & technology dictionary (2012) defines Computer Assisted Instruction (CAI) as the use of computers to present drills, practice exercises, and tutorial sequences to the student, and sometimes to engage the student in a dialog about the substance of the instruction. It also known as computer aided instruction and computer assisted learning (CAL).

From the above mentioned it can be concluded that computer assisted instruction (CAI) is an instructional material which is used to present drill-and-practice exercises as well as the tutorial of stimulate activities offered in a logical sequence to students either by themselves or as supplements to traditional instruction in which computer is used. It is the online educational medium or interactive tutorial technique in which instructional contents or activities are delivered by computer in form of text or multimedia formats, photographs, videos, animation, speed and music which aims to enhance educational quality of students. It is a student’s self-learning technique which is learned by reading the teat material presented or by observing the graphic information displayed. Students learn by interaction with the computer and appropriate feedback is provided.

In the present study, computer assisted instruction (CAI) refers to a form of learning that computer is used as a supplement traditional teacher-based learning. Computer assisted instruction (CAI) in career and technology subject (learning substance: electronic title “Multi-Miter) is used as a tool to deliver the information, guide and practice exercises in form of text or multimedia formats, photographs, videos, animation, speed, music and test to the student for a desired level of the learning achievement. Following
the definition of computer assisted instruction (CAI) above, this study aims to find out whether or not CAI can be effectively utilized for effective teaching and learning of 10th grade students’ learning achievement in career and technology subject.

2.2.3 Brief history of computer and computer assisted instruction (CAI) in education

New technologies are integrated into disciplines and more disciplines are being influenced by the new technologies in an integrate way. Most of educators and researchers try to use technologies in various subject matters, and this integration changes in nature, concepts and methods of work in each subject.

Current day, computer and computer assisted instruction (CAI) is used in the school in all round the world. Advancements in technology are inevitably reflected in educational systems. In most of developed countries, education has been penetrated by information technologies (IT) and a large number of teachers devoted to computer assisted instruction (CAI) in their teaching and learning process. (Olga Pili, 2008)

CAI started in the 1950s and early 1960s, mainly in USA. Pioneers such as Stanford University in California and International Business Machines Corporation (IBM) have introduced CAI into selected elementary schools. Initially, CAI programmes were a linear presentation of information with drill and practice sessions. These early CAI systems were limited by the expense and the difficulty of obtaining, maintaining, and using the computers that were available at that time. Programmed Logic for Automatic Teaching Operations (PLATO) system, another early CAI system initiated at the University of Illinois in the early 1960s and developed by Control Data Corporation, was used for higher learning. It consisted of a mainframe computer that supported up to 1000 terminals for use by individual students. By 1985 over 100 PLATO systems were operating in the United States. From 1978 to 1985 users logged 40 million hours on PLATO systems. PLATO also introduced a communication system between students that was a forerunner of modern electronic mail (messages electronically passed from computer to computer). The Time-shared Interactive Computer-Controlled Information Television (TICCIT) system was a CAI project developed by Mitre Corporation and Brigham Young University in Utah. Based on personal computer and television technology, TICCIT was used in the early 1970s to teach freshman-level
mathematics and English courses. With the advent of cheaper and more powerful personal computers in the 1980s, use of CAI increased dramatically. In 1980 only 5 percent of elementary schools and 20 percent of secondary schools in the United States had computers for assisting instruction. Three years later, both numbers had roughly quadrupled, and by the end of the decade nearly all schools in the United States, and in most industrialized countries, were equipped with teaching computers. (Douglas, N. Arnold, 2000)³⁹

A recent development with far ranging implications for CAI is the vast expansion of the Internet, a consortium of interlinked computers. By connecting millions of computers worldwide, these networks enable students to access huge stores of information, which greatly enhances their research capabilities.

2.2.4 Computer Assisted Instruction (CAI) theories

Computer assisted instruction (CAI) theories has been gaining acceptance as on one of technologies used effectively in educational system. It was grounded in all the predominant learning theories of the twentieth century i.e. behaviourist, cognitive and constructivist.

Behavioural theory focuses on objective, observable behaviours. Behavioral theorists concentrate on immediately observable consequences. Behavioral learning theories tend to emphasize changes in observable behavior as indicators of learning. Behavioural theory has roots in the work of Pavlov who presented Classical Conditioning theory as a result of his experiments with the salivation of dogs. Pavlov showed how an animal could be conditioned to salivate (response) at the prompting of an arbitrary stimulus bell paired with presentation of food. Pavlov called this process the "conditioned reflex". (Hergenhahn & Olson, 1997)⁴⁰

Edward Thorndike was another important influence on the behaviourist view. He studied the association learning in animals and human beings. He examined how certain types of stimuli affected learning, with a focus on how students might be promoted to learn new material by repeated association with the material they already knew. He also examined methods of shaping learning behavior through rewards and punishments. (Klein, 1996)⁴¹
Huffman, Vernoy & Vernoy (1995) mention that behaviorist psychologist and founder of operant conditioning B.F. Skinner focused on basic principles of learning. He gathered experimental data to develop his stimulus-response theory. The major principle underlying his learning theory is that behaviors change according to their immediate consequences. Pleasurable consequences strengthen behaviors, while unpleasant consequences weaken them. Skinner modified behavior by altering external conditions, noting the response to those conditions and encouraging or discouraging that response. These three elements of the learning experience are technically called the discrimination stimulus, the response and the reinforcing stimulus.

Cognitive psychology focuses on the mental processing of information. It is concerned with acquisition, storage, retrieval and use of knowledge. Cognitive psychologists study how humans gather, encode and store information from their environment using such mental processes as perception, memory imagery, concept formation problem solving, reasoning, decision making and language (Huffman, Vernoy & Vernoy, 1995). Cognitive theorists view people as active processors of information, who seek out information in an attempt to make sense of the world around them. Therefore, concept of cognitive theorists concerns to how the brain operates, so closely parallels the operation of computers that another label for cognitive theory i.e. information processing theory has emerged. According to this approach, humans gather information from the environment and then process it in a series of stages. A certain type of processing is performed at one level before the information is passed on to another level for a different kind of processing. Thus, cognitive theorists like computer programmers began to think of learning in terms of sensory input, encoding, and retrieval systems (Huffman, Vernoy & Vernoy, 1995).

Constructivists believe that what gets into the mind is not transmitted or poured by some external manipulator but has to be constructed by the individual through knowledge discovery or social interaction. Learning takes place when individuals participate in meaningful activities. They construct both mechanisms for learning and their own unique version of knowledge, colored by background experiences and aptitudes. Constructivist perspective emphasizes the active role of the learner in building understanding and making sense of information (Roblyer & Edwards, 2000; Chen, D., Hsu, J.J.F. and Hung, D., 2000).
Constructive perspectives are based on the ideas of educational philosophers such as John Dewy, Lev Vygotsky, Jerome Bruner, Jean Piaget and Howard Gardner. There are two major strands of constructivist perspective. One strand might be called cognitive constructivism based on the epistemology of Piaget and the other social constructivism based on thoughts of Vygotsky (Roblyer & Edwards, 20004; Maddux, Johnson & Willis, 1997).

Roblyer & Edwards (2000) observed that cognitive constructivism is based on the epistemology of Piaget who studies how knowledge begins and develops in individuals. Two widely recognized features of Piaget’s theories are: Stages of cognition development and Processes of cognitive functioning.

Social constructivism emphasizes the importance of interaction of a child with its environment for his cognitive development. Social constructivist perspective is grounded in the ideas of theorists such as John Dewey and Lev Vygotsky (Roblyer & Edwards, 2000; Maddux, Johnson & Willis, 1997).

Dewey’s Social Constructivism: John Dewey’s idea emphasizes on student centered education, learning by doing and need to center student instruction on relevant, meaningful activities support constructivist models of teaching (Roblyer & Edwards, 2000). Dewey viewed education as a process of social activity. He viewed school as a miniature society where children encounter personal and social problems and their experience lead them to construct and reconstruct their knowledge (Ornstein & Levine, 1995).

2.2.5 Types of computer assisted instruction (CAI)

Computer assisted instruction (CAI) can be presented in form of text or multimedia formats. Each of computer assisted instruction (CAI) format is appropriate under different instructional circumstances and therefore takes a different pedagogical approach. Different types of computer assisted instruction (CAI) are summarized by different educators such as Poole (1995), Cox (1995), Geisert and Futrell (1995), Maddox, C. D., Johnson, D. L. & Willis, J. W. (2001) and Bitter and Pierson (1999) and have presented as follow:

(1) **Software for Drill and Practice:** The type of CAI aims to present drill and practice software for the learner’s memorize information. It does not act as teacher, but as a
kind of automated flash card. The programme presents a question to the learner, the learner responds, and the software then gives feedback as to whether is correct or incorrect. Most drill and practice software will accept two incorrect answers, and then provide the correct answer so that the learner is not a particular item for a long period of time. (Sandra, R. Lugpit, et al, 2011)

It can be said that drill and practice programmes are used to provide the students with repetitive exercise for specific skills that have been taught in the classroom and supplies immediate feedback on the correctness of the response. Used in this manner, CAI functions as a supplement to regular classroom instruction, and may be especially useful when a teacher does not have the time to work individually with each student. Drill and practice on the computer may also motivate students more than traditional workbook exercises. It is not the function of drill and practice software to impart instructional activities; rather, drill programs are useful for sustaining, refining, or perfecting performance in some category of behaviour already leaned by another method. Usually drill and practice is employed to increase the speed or accuracy of student performance of certain task. Software for Drill Practice allows learners to work problems or answer questions and get feedback on correctness. It is an important learning technique for building basic knowledge and basic intellectual skills, such as number manipulation, vocabulary, spelling sentence construction etc. These skills are the foundation for higher level intellectual activity. Good drill and practice software provides the user with an enjoyable opportunity for repetitive interaction and immediate feedback on the accuracy of response. Drill and practice software is typically associated with behaviorism, because students are commonly given 'stimuli' (questions), are required to make responses to the stimuli, and then receive some sort of reinforcement. (Chen, D., Hsu, J.J.F. and Hung, D., 2000; Roblyer & Edwards, 2000; Poole, 1995; Geisert & Furtell, 1995; Maddox, C. D., Johnson, D. L. & Willis, J. W. (2001)

Drill-and-Practice Software assists students in reviewing, rehearsing, reinforcing, and practicing concepts to which they have already been introduced. It does not introduce new concepts Provides immediate and relevant feedback to students. It prevents students from learning something incorrectly. CAI can focus on concepts, problems, etc. that a student needs to work on. It does not force students to go over topics that they already know.
(2) **Tutorials Software:** This type of CAI aims to instruct the learner and intends to introduce new concepts and focuses on the presentation of new material in a format that captures the attention of a student, and keeps him/her focused on the most important aspects of the new topics. This type of software may include some practice or reinforcement, but it is primarily used in a teaching capacity. Constant or periodic interaction with the student may be provided to prevent the student's attention from wandering and to evaluate his/her grasp of the new material. (Sandra, R. Lugpit, et al, 2011)

Tutorials activity includes both the presentation of information and its extension into different forms of work, including drill and practice, games and simulation. (Wiki Educator, 2008) Tutorials CAI provides some information or clarifies certain concepts in addition to providing the student with practice exercises. In this sense, the computer begins to take over actual instructional functions, tailored to the student's individual level of achievement. (Kyaw Soe, et al, 2010) Tutorials act like tutors by providing all the information and instructional activities a learner needs to master a topic. All the conceptual or skill based body of knowledge is presented on screen followed by quiz to assess the user's comprehension of the concept or acquisition of the skill. The software monitors progress on the basis of the results of the quiz taking the user on the new material or back over old material. A good tutorial presentation is enjoyable, thorough, and sensitive to the user capabilities; and provides immediate and appropriate feedback. Interactivity is key to user involvement and perseverance. (Cox 1995; Poole 1995; Roblyer 2000) Tutorial software is more associated with the cognitive learning theory, because new knowledge is presented in a systematic way. It is expected that students learn principles and rules, comprehend them and become able to apply the newly acquired knowledge to new situations. A computer based tutorial programme works with an individual student in a very interactive manner and often provides an ideal learning situation for information transmission. (Chen, D., Hsu, J.J.F. and Hung, D., 2000).

Tutorial software usually assesses the learner's skill, then presents new instruction, gives practice, asks a question and, depending on the learner's response, either remediate by re-teaching, or moves on to the next level. Tutorial software has value to the
learner in that it allows the learner to answer every question, proceed at her/his own pace, and provides privacy of feedback. If the tutorial is branching rather than linear, it is more useful educationally. Linear tutorials allow the learner to take only one path, following it from beginning to end. Branching tutorials, on the other hand, allow the learner to decide which part of the software to use at a particular time. This means that if a student already knows some of the material, s/he can proceed to new, unfamiliar material.

(3) Simulation software: The purpose of simulation software is to provide approximate computer representations of real-world phenomena or situations. It provides learners with an opportunity to work cooperatively, solve problems, and speculate "what if". This type of software is time effective, cost effective, and safer than experiencing the situation first hand. These are condensed learning exercises specifically designed to represent vital real-life activities by providing learners with the essence or essential elements of the real situation without its hazards, cost or time constraints. If a simulation programme is designed correctly, students who use it may have experiences roughly equivalent to what they might encounter in similar real-world situations. For example, they might be able to study causality by investigating alternate chains of events, or to make choices and explore consequences of their decisions. (Sandra, R. Lugpit, et al, 2011)

As the simulation software simulates an environment, thus, it allows learner to change the values of parameters in the system, and provides feedback in the form of graphical or diagrammatic display of how the systems' behavior changes. For example in a simulation based on a model of a pond with three main inhabitants, phytoplankton, herbivore, and fish, the learner may change the number of one or more population and see the effect on the others. Simulations provide a means for learning about an environment that may otherwise not be available to learner to explore, for reasons of safety, time, expanse, or general practicality. A simulation focuses on exploration and discovery learning. It is not an exercise that necessarily has a fixed or correct solution, and the route to the solution may be varied. A computer simulation offers the opportunity for relationships to be explored and exposed by the student’s direct manipulation of the variables in the model-. Although simulation programs are usually constructivist, i.e. they allow students to construct their own knowledge; they can have cognitive orientations also (Cox, 1995).
Alessi & Trollip (1991)\textsuperscript{74} identify two main types of simulations: Those that teach about some thing and those that teach how, to do something. These two main types are further classified into four categories i.e. physical, process, procedural and situational simulations.

Physical simulations: Users manipulate objects or phenomena represented on the screen. For example, students see selections of chemicals with instructions to combine them to see the result or they may see how various electrical circuits operate (Roblyer & Edwards, 2000)\textsuperscript{75}.

Process simulations: These speed up or slow down processes that usually either take so long; or happen so quickly that students could not ordinarily see the events unfold. For example, courseware may show the effects of changes in demographic variables on population growth or the effects of environmental factors on ecosystems. Biological simulations like those on genetics are popular, since they help students experiment with natural laws like the laws of genetics by pairing animals with given characteristics and showing the resulting offspring (Roblyer & Edwards, 2000)\textsuperscript{76}.

Procedural simulations: These activities teach the appropriate sequences of steps to perform certain procedures. They include diagnostic programmes, in which students try to identify the sources of medical or mechanical problems, and flight simulators, in which students simulate piloting an airplane or other vehicle (Roblyer & Edwards, 2000)\textsuperscript{77}.

Situational simulations: These programmes give students hypothetical problem situations and ask them to react. Some simulations allow for various successful strategies such as letting students play the stock market or operate businesses. Others have most desirable and least desirable options such as choices when encountering a potentially volatile classroom situation (Roblyer & Edwards, 2000)\textsuperscript{78}.

Reasons to use simulations are that the real-world phenomenon may operate in a time frame that is too long to investigate in the classroom. The real-world phenomenon may be too expensive to simulate in the classroom. Effective simulations can allow the students to gain important insights from the experiments without the expense of actually conducting
them. The real world phenomenon may occur only at locations that are remote from the classroom. The students may need to be involved in a role-playing environment that would be impossible for them to realize in the real world at their age. Many real-world situations are simply too dangerous to undertake in the classroom.

(4) Instructional games: Instructional games are courseware whose function is to increase motivation by adding game rules to learning activities. Instructional games often creates a contest to achieve the highest score and either beat others or beat the computer. Instructional games can be similar to drill and practice or simulation courseware but their instructional connotation to the student is different due to entertaining and competitive environment. When students know they are going to play a game, they expect a fun and entertaining activity because of the challenge of the competition and the potential for winning (Roblyer & Edwards, 2000)\(^79\).

Cox (1995)\(^80\) mentions that some simulations are designed as games, often including role-playing. In such simulations the program focuses not only on the underlying model but also on the way in which the learner interacts with the model. Learning may be built up by discovery and conjecture; the simulation encourages learning by inquiry and decision making. According to Chen, D., Hsu, J.J.F. and Hung, D. (2000)\(^81\), instructional games are usually associated with behaviorism because of the variety of reinforcement mechanism inherent in game environments in which students are motivated by competition and game rules to strive to reach to the goal.

(5) Problem Solving Software: Problem solving software requires students to apply higher order strategies and synthesize knowledge from multiple curricular areas in order to solve problems Students can test hypotheses, learn from mistakes and refine skills as they gain mastery of problem solving techniques. Software of this type can provide practice in solving problem by modeling general critical thinking steps, by focusing on specific subject-area issues, or by creating an open environment in which students can discover their own strategies. The problem solving software affords the user more freedom than does drill and practice or tutorial software, but does not necessarily present the real world context that characterizes simulation software (Bitter & Pierson, 1999)\(^82\). Problem solving software teaches
directly, through explanation and/or practice, the steps involved in solving problems or help learners acquire problem solving skills by giving them opportunities to solve problems.

Problem solving software is sometimes associated with the cognitivist learning theory because students are explicitly taught specific cognitive strategies. A problem solving software is more sophisticated type of learning than that of drill and practice. The computer presents fairly complex problems in which students can learn and improve their problem solving skills. These types of problems cannot be solved by simple memorization; problem solving programs are designed to promote students’ higher order learning skills such as logic, reasoning pattern recognition and strategies. As they interact with the program, they gradually move from simple trial and error to more logical and systematic thinking processes (Chen, D., Hsu, J.J.F. and Hung, D., 2000); Roblyer & Edwards, 2000).

It can be said that problem solving software is used to aid students in developing high-level problem-solving skills and strategies. In many ways it is like simulation software. Students make decisions by specifying values for variables and then observe the consequences of their decisions. Problem solving software usually requires a great deal of student input and presents the student with a lot of feedback. Some of the skills and strategies that can be fostered by problem solving software include the following: Classifying things, Establishing hierarchies, Identifying trends, Identifying sequences, Breaking a problem into parts Identifying relevant and irrelevant information, Working backwards to justify conclusions, Eliminating personal biases, Making and testing hypotheses, Graphing data and interpreting the graphs, Using arithmetic and mathematics to calculate or estimate values.

(6) Integrated Learning System (ILS): According to Underwood and Brown (1997), ILS are systems across computer networks that provide a comprehensive, multiyear collection of computer-assisted instruction (CAI) delivered primarily through a model of individual assessment and task assignment and which record and report student achievement. A good ILS includes courseware for broad range of learning experienced, including simulations and on-line vehicles for research. The development of ILS is grounded firmly in the behavioral school of learning theory. ILS have largely addressed mathematical and language material where the body of content is arranged hierarchically. Additionally
there are deemed to be identifiably right or wrong answers. The behaviourist approach taken by ILS designer precludes any element of social interaction.

(7) Software for Micro Computer-Based Laboratories: Recognizing the value of micro computer based laboratory (MBL) to research, hardware and software systems have been developed. These systems have enabled the students to automate the process of gathering data from experiments, conducting relevant analysis and producing meaningful reports. Scientific experiments are linked to micro-computers in laboratories to automate the process of recording the results of experiments. Complete data sets can be stored in secondary memory for further analysis. Summary data are produced as text and in a graphed format (Poole 1995). Theoretical underlying purpose for MBL is precision in data collection and analysis and hence in conclusion.

(8) Discovery Learning Software: Discovery Learning Software provides a large database of information specific to a course or content area and challenges the learner to analyze, compare, infer and evaluate based on their explorations of the data. It provides a structured, simulated environment that directs a student’s attention toward a topic of interest. It also provides ways for students to manipulate facets of that environment to discover important concepts. This technique can be used to challenge the participants to create novel ways of addressing various issues based on the information that is provided to them. (Sylvette, A. La Touche, 2010)

(9) Reference Software: Reference software can take the form of any traditional reference works, such as dictionaries, encyclopedias, and thesauri on CD-ROM. Other reference software presents extensive collections of information on a focused topic. Electronic reference works can be utilized just as traditional reference material would be. Depending on the particular learning activity, students might refer to software as needed to answer specific questions. They also might openly explore a multimedia reference without specific goals to guide their learning. The multimedia components of reference software present information in graphic, audio, video or other alternate formats that allow uniquely unlimited access to students who might not be developmentally able to contend with the text version of the information (Bitter & Pierson, 1999).
Dialogue: With this type of CAI use, the student takes an active role in interacting with the computer, giving instructions in the form of a computer language so as to structure the student’s own curriculum. The computer provides information, exercises, and feedback. Dialogue CAI is believed to come closest to actually substituting for regular instruction (Gourgey, Azumi, Madhere, & Walker, 1984).

2.2.6 Characteristics of effective computer assisted instruction (CAI)

Computer assisted instruction (CAI) is utilized in education as an educational medium in which delivers instructional activities in the late 1950s. As the technology has been changed rapidly over the twenty years, computer assisted instruction (CAI) is still utilized in education. Drill-and practice, Tutorial, Games, and Simulation are commonly used CAI applications for increasing of dexterity and fluency in a skill. In these programmes student is allowed several tries before the computer presents the correct answer.

Muhammad Khalid Mahmood (2004) has summarized the some effective characteristics of computer assisted instruction (CAI) as follow:

1. Flexibility: The effective CAI should be flexibility. Flexibility means access to teaching materials at a wide range of time or locations. Computers offer great flexibility in the type of resources available to a student as well as increasing flexibility of access to information. Greater flexibility in education is one strategy for dealing with increased number and diversity of students. Computer programmes can allow the user to choose from a variety of instructional treatments. A student who does not learn with a particular approach can be presented with material using an entirely different and unique approach. Instructional programs may use a variety of prompts and cues to produce correct student responses. (Sloane et al. 1989; Maier et al. 1995)

2. Self-Pacing: Self-pacing lets students precede at a pace appropriate for their individual learning levels. Students using self-pacing can control the time allowed to solve problem as well as the rate of presentation they can spend several weeks with remedial material or skip entire lesson. When they feel ready to be tested on the specific material, they can choose the testing cycle. Self-pacing can help to individualize instruction for those students who have used the program before or have prior knowledge of the subject. Self-pacing can be combined with self-placement testing, which directs the student to an
appropriate beginning point and to an optimal instruction rate.

(3) Remediation Options: The CAI should be vary instructional treatments and adapt to individual differences after analyzing student responses. Records of the student's past performance determine the sequence of instruction. In one type of remedial program, the instructor uses computer program to diagnose the student's learning capabilities, achievement level, and cognitive style. On the basis of the diagnosis, the instructor chooses material that is geared to the student. Computer assisted instruction programs may easily provide remedial treatments by employing branching strategy and/or through incorporating hyperlinks to present text, graphics or any type of material for remediation.

(4) Graphics and Sound: CAI should present effective graphic. Graphic representation plays an important role in instruction. In addition to pictures, computer graphics also include the use of screen formatting features such as arrows, boxes and illustrations to emphasize the concept. This nonverbal mode of instruction helps to build comprehension in areas that are difficult to teach by other instructional techniques. Sound in a program can prompt, focus, or reinforce students and thus enhance instruction. At a more sophisticated level, some CAI programmes include speech synthesizers that produce words or sentences. Synthesizes are especially applicable with software for the very young or handicapped users. Computer graphics and sound infuse movement, excitement and animation into a programme.

(5) Distance learning: One of the most useful of computer assisted instruction (CAI) is its adaptability for distance learning. Before the dominance of microcomputers, distance learning was mostly accomplished through the mail system supplemented by telephone contact. On the contrary, CAI provides regular and timely interaction with the instructor and current feedback. Students can repeat tutorials as often as needed and work at their own pace. CAI also can be used with greater numbers of students than a traditional classroom would hold. CAI and web-based instruction have opened avenues of access to individuals with disabilities that were not possible before. (Smrutisikha, 2012)

(6) Student's individual needs: CAI should adapt to the student's individual needs. It acquires information about the student's current knowledge of a subject and his/her goals in learning the subject and then creates a user profile based on this knowledge. It can then adjust itself to the individual student. It is unique in that students and/or instructors can
communicate with each other anywhere in the world within seconds via the Internet. Feedback from the instructor can be obtained immediately. (Smrutisikha, 2012)

2.2.7 Benefit of computer assisted instruction (CAI)

CAI brings with it several potential benefits as a teaching and learning medium. These include self-paced learning, self-directed learning, the exercising of various senses and the ability to represent content in a variety of media. With self-paced learning, learners can move as slowly or as quickly as they like through a programme. If they want to repeat some task or review some material again, they can do so as many times as they choose. The programme will not tire or complain about repetitions. Learners can skip over a topic if information is already known, making the learning process more efficient. With self-directed learning, learners can decide what they want to learn and in what order.

Meskill and Mossop (1997) report that computers encourage learning as they provide a stimulating environment and promote enthusiasm. Computers may help the reticent student who is afraid to make mistakes in a classroom situation (Chun, 1994).

CAI brings several possible advantages as teaching and learning tool. The main strength of the computer as a learning medium is its ability to rapid process information. This makes it possible for the computer to accept and act upon a variety of different kinds of response from the learner and to provide information in textual, graphical, and animated form (Rushby, 1989). According to Kaput (1992), there are three advantages of usage of technology in teaching and learning; interactivity, connectivity and controlling of learning environments. Furthermore, computer suggests opportunities for learner-control, improved enthusiasm, associations to the real world, and enhance student achievement as measured in variety of ways.

Ertmer (1999) stated that “CAI benefits most students when compared with traditional instruction because it increases student interest, reduces anxiety, provides more time on task, and provides instant feedback for the student”. Besides, CAI could also benefits students with the following: self-sufficient learning, independent learning, the exercising of various senses and the ability to represent content in a variety of media. In computer assisted environment students can fix their pace of learning. That is to say, with self-paced learning,
learners can progress as slowly or as quickly as they like through a program. In addition to this, if students want to replicate some task or review some material again, they can do so as many times as they wish. The programme will not tire out or complain about repetitions as sometimes teachers do. Also, students can leave out a topic if content is already known or understood, making the learning process more efficient.

CAI provides a self-directed learning to students, and allows learners to become empowered to take increasingly more responsibility to choose, control, and evaluate their own learning activities which can be pursued at any time, in any place, through any means, at any age. Simply put, learners can decide what they want to learn and in what order.

According to Fletcher (1990) \(^{100}\), “people remember 20% of what they hear, 40% of what they see and hear and 75% of what they see, hear and do”. Therefore, the more senses are used through which we obtain information, the easier to keep in mind. The fact that the computer can exercise various senses and present information in a variety of media can enhance the learning process. As a result, students can retain knowledge.

Further, CAI is visually attractive, when it presents concepts using demonstrations that are made attractive by animation, color, and sound. Besides this, computer assisted instruction captures and holds the students’ attention by providing opportunities for competition where the opponent is the student’s previous performance (Mahmood, 2006) \(^{101}\). CAI also eliminates the misconceptions by providing immediate feedback, since immediate feedback prevents learning concepts incorrectly.

As Cotton (2001) \(^{102}\) indicated teachers can benefit from CAI since it can be programmed with concept, level and ability specificity; that is, the students are not challenged outside his or her demonstrated ability range, nor are they allowed moving to a higher level until they have mastered the level on which they are working.

There is ample evidence that computer assisted instruction (CAI) is more effective than the traditional methods of instruction. The advantages of CAI as identified through the findings of research studies areas below:

1. CAI can be used to increase high achievement levels for students of different ages and abilities. (Braun 1990) \(^{103}\) Computer Assisted Instruction (CAI) is among the range
of strategies being used to improve student achievement in school subjects, including reading. Programmes for CAI have come a very long way since they were first developed over two decades ago. These programmes tutor and drill students, diagnose problems, keep records of student progress, and present material in print and other manifestations.

(2) Since the students learn at their own pace and convenience; opportunities to work with vastly superior materials and more sophisticated problems; personalized tutoring; automatic measurement of progress; and others. (Muhammad, K. M., 2004) Teachers as well are expected to gain from CAI, as they experience less drudgery and repetition, greater ease in updating instructional materials, more accurate appraisal and documentation of student progress, and more time to work directly with students (Kulik, Bangert, & Williams, 1983). With increasing advances in computer technology, computer assisted instruction (CAI) is now seen by many as a method of providing relevant instruction for large numbers of students.

(3) Learning from computers encompasses approaches to CAI in which the computer is used as a means for transmitting specific subject matter, such as reading. The flow of information is basically from the computer to the student, with the computer presenting learning material or activities for student responses. The computer retains records of the student’s progress through the course of study. (Goldberg and Sherwood, 1983).

(4) In addition to the rise in achievement levels, it was found from many researches that CAI enhances learning rate. Student learning rate is faster with CAI than with conventional instruction. (Capper and Copple, 1985)

(5) Computers are used not only as a means of helping schools analyze data, computers have become a pervasive tool toward optimizing student learning. For example, students are regularly using the internet to gather and assimilate information for use in research assignments. They are preparing "electronic" presentations using computer presentation programs and LCD projectors. They are using word processing programs to create various other reports. Students are even using spreadsheets to increase their experiences with mathematical concepts. In addition, many schools have incorporated interactive computer-assisted-instruction into their program to provide students opportunities to master specific educational objectives or standards. (Capper and Copple, 1985)
(6) CAI helps to increase student cognitive processes and motivation: Computer programmers have been able to create computer assisted instruction programmes that have served to increase student learning by affecting cognitive processes and increasing motivation. Current research shows the mechanisms by which computer programs facilitate this learning: (1) personalizing information, (2) animating objects on the screen, (3) providing practice activities that incorporate challenges and curiosity, (4) providing a fantasy context and (5) providing a learner with choice over his/her own learning.

(7) Computer assisted instruction (CAI) programmes are interactive and can illustrate a concept through attractive animation, sound, and demonstration: CAI allows students to progress at their own pace and work individually or problem solve in a group. It provides immediate feedback, letting students know whether their answer is correct. If the answer is not correct, the programme shows students how to correctly answer the question. CAI offers different types of activity and a change of pace from teacher led or group instruction.

(8) Computer assisted instruction (CAI) improves instruction for students with disabilities: This is because students receive immediate feedback and do not continue to practice the wrong skills. CAI captures the students’ attention because the programs are interactive and engage the students’ spirit of competitiveness to increase their scores. Also, computer assisted instruction (CAI) moves at the students’ pace and usually does not move ahead until they have mastered the skill. Programmes provide differentiated lessons to challenge students who are at risk, average, or gifted.

(9) Computer assisted instruction (CAI) provides one-to-one interaction with a student, as well as an instantaneous response to the answers elicited, and allow students to proceed at their own pace. CAI is particularly useful in subjects that require drill, freeing teacher time from some classroom tasks so that a teacher can devote more time to individual students. A CAI programmes can be used diagnostically, and, once a student’s problem has been identified, it can then focus on the problem area. Because of the privacy and individual attention afforded by a computer, some students are relieved of the embarrassment of giving an incorrect answer publicly or of going more slowly through lessons than other classmates.

(10) Computer assisted instruction (CAI) helps teachers to success in teaching learning process: CAI instruction offers mastery learning materials, individualized
programmed instruction that guarantees students' success in mastering knowledge. When the teachers use computer assisted instruction properly it has many advantages. Such as;

CAI offers lots of educational materials; also it provides drills to improve the student's knowledge and game based drills to increase learning enjoyment. Furthermore it enables to assess students' progress and capabilities with tests. CAI is more effective at practicing part. As it provides lots of question types so students can find the opportunity of seeing lots of question types. Also CAI, especially tutorial programmes give person to study individually and learn by him or herself. Students can solve a lot of problems or can do a lot of exercises with the help of CAI. Students received immediate feedback, so they can deal with misunderstandings easily. It also gains them a lot of time. Moreover, students enjoy their job, and learn more effectively.

(11) Computer assisted instruction (CAI) provides a World-Wide learning environment with access to worldwide knowledge webs so this extends and enriches students' learning experience.

(12) Computer assisted instruction (CAI) is Learner-Centered and interactive. The focus is the learner rather than the teacher as in Constructivistic Approach. CAI Instruction is Individualized Instruction. The students will have a virtual Personal Tutor helping he/she masters the information. Taking the course on computer increases the learner's computer skills. By doing so, the students will be able to critically analyze information, solve problems and communicate with others.

(13) Computers become widespread with progressive technology: Students use computers commonly and they interest in technology. Using computers for a lesson is very effective to motivate them. Moreover, it can be find lot of sources from internet and apply them to students. Especially in practicing students see evaluation of their performance and give feedback to students. When the answer is false programme gives some clues to find the correct answers. In this way they analyze the clues and solve problems according to these clues. That improves information analyzing of students.

(14) CAI help to increase students' attention: There are lots of CAI materials and different activities. Students can reach these activities which may be funny for students. CAI can increase the students' attention to the subject and so students study their own time and they can study outside the class.
(15) CAI impacts and improves students overall level of mastery. In this process its’ receiving immediate feedback on students performance is very important. Students have too much chance to practice their learning, after practicing they can see their level of knowledge and they can see how much they know about the subject, in which areas they have trouble. So they should want help in the areas they are lack of. By the help of CAI teachers can assess students’ performance and lessons efficiency easily.

(16) CAI has the capacity to initiate flexible interactions with the student which is not possible in the teaching machines. The computer is able to record and store all the responses of the students. It can use the information in deciding what information to give the student next. It can branch not just in terms of one answer but also in terms of a whole series of previous answers. It can also record the time taken to answer a question and the degree of correctness of the student’s response. It uses information in planning to determine which branch to take.

(17) CAI helps to determine subsequent activities in the learning situations. The large amount of information stored in the computer is made available to the learner more rapidly than any other medium. The dynamic interaction between the student and instructional programme is not possible to be secured by other medium. It can completely individualize materials. It can dramatically increase student’s access to information. It often engage the interest of students, motivating them to learn and increasing independence and personal responsibility for education. (Sandra, R. Luqpit, 2011)

From above mentioned, the advantage of CAI can be summarized as follow:

• One-to-one interaction and allow student to work privately. Student can solve the problems on their own because it is the individualized learning, individual attention and individualize instruction
  • Great motivator and sustaining motivation
  • Never get tired, frustrate or angry
  • Never forget to correct or praise
  • Freedom to experiment with different options
  • Instantaneous response/ immediate feedback to the answers elicited
  • Self pacing- allow students to proceed at their own pace
• Helps teacher to devote more time to individual students
• Privacy helps the shy and slow learner to learns
• Give immediately feedback
• Learn more and more rapidly
• Multimedia helps to understand difficult concepts through multi sensory
• Reaching learners even outside classrooms
• Using learning time efficiently
• Student can learn with enjoyment, fun and entertainment
• Increased peer interaction due to a collaborative rather than competitive
learning environment
  • Self directed learning, elimination of space, time and geographical constraints –
students can decide when, where, and what to learn
  • Increased interaction with more accessible teachers with decreased feedback
turn-around time
  • Increased quality of learning with deeper critical reflection and systematic
scaffolding of ideas taking place
  • Increased access to databases and other resources not normally available
distance learners (Berge, 1995b; Hiltz, 1994).

2.2.8 Limitation of computer assisted instruction (CAI)

There are some limitations of computer assisted instruction (CAI). These issues
include: finance, lack of hardware and software, lack of teacher preparation and
competency, limited number of educational software, and the lack of curriculum integration.
One of the important concerns of the implementation of CAI is how to finance it. Hardware
and software are expensive entries for most of the poor schools. Other barrier to effective
use of CAI is the curriculum integration. Curriculum integration is the use of computers to
support and enhance learning and teaching.

Sandra, R. Lugpit (2011) points out the limitation of using computer assisted
instruction (CAI) as follow:

(1) It difficult to develop or find out the CAI software. The courseware can be
bought as a fully developed package from a software company, but the programme provided
this way may not suit the particular needs of the individual class or curriculum. A courseware
template may be purchased, which provides a general format for tests and drill instruction,
with the individual particulars to be inserted by the individual school system or teacher. The
disadvantage to this system is that instruction tends to be boring and repetitive, with tests
and questions following the same pattern for every course. Software can be developed in-
house, that is, a school, course, or teacher could provide the courseware exactly tailored to
its own needs, but this is expensive, time-consuming, and may require more programming
expertise than is available.

(2) The computerized instruction cannot extend the lesson beyond the limits of the
programming.

(3) Poorly designed CAI systems can dehumanize or regiment the educational
experiences and thereby diminish student’s interest and motivation. All individualized
instruction and CAI instruct the students in such a way, that all will achieve the same level of
competency. Other disadvantages of CAI stem from the difficulty and expense of
implementing and maintaining the necessary computer systems.

2.2.9 Effectiveness of computer assisted instruction (CAI) on students’ achievement

The widespread usage of computer assisted instruction (CAI) in classroom as
teaching aids has increasingly popular during the last twenty years. A lot of research has
been conducted on the effects of CAI use on student achievement, attitude, and other
variables. There is a large enough data to show the usefulness of effectiveness of CAI that
capable to improve the students’ achievement. Different forms of CAI as supplement to
traditional method of instruction have proved their effectiveness to augment student
achievement. Poole (1995)\textsuperscript{113} asserts that CAI is a tool in the hands of both the student and
the teacher. The effectiveness of that tool depends entirely on the knowledge and skills that
the students and teacher bring to the learning process.

Hasselbring (1984)\textsuperscript{114} found from the results of research studies and meta-
analyses on the effects of computer assisted instruction (CAI) on student achievement. It
was further found that the results favour the use of computer assisted instruction (CAI) over
traditional instruction. CAI with drill and practice were significantly more effective in
promoting increased student achievement among high achievers and low achievers and in both elementary and secondary graders.

Mevarech and Rich (1985) conducted a three-year study on the effects of CAI on third, fourth, and fifth grade Israeli students. The study divided participants into two groups; one group receiving traditional instruction supplemented by CAI and the other receiving traditional instruction only. Results which compared the type of instruction to grade level and gender on the Israeli Ministry of Education's Arithmetic Achievement Test, showed that at all three grade levels, the learning achievement scores of students who are taught by CAI was significantly higher than students who received traditional instruction only.

In Cotton's study (1991), it was found that the use of computer assisted instruction, as a supplement to traditional, teacher-directed instruction, produces higher achievement compared to those to traditional instruction. Moreover, results were also valid for students of different ages and learning abilities in different subject matters.

Randel, Morris, Wetzel, & Whithill (1992) examined 68 studies to test the difference between CAI games/simulation and traditional instruction in student performance. Results revealed that, in seven out of eight studies, use of CAI games/simulation lessons is superior to traditional instruction for improving student's achievement.

Hall, T.E., Hughes, C.A. & Filbert, M. (2000) studied on Computer Assisted Instruction in reading for students with learning disabilities: A Research Synthesis and found that CAI can serve as a powerful tool for reading teachers, but it is only suitable as one part of an effective reading curriculum. CAI should be used to supplement, not replace, traditional reading instruction. The studies examined in this analysis point to several elements of a successful CAI programme. Teachers who use CAI often implement it as an addition to their regular reading programme, meaning that students using CAI are receiving additional instruction and practice in reading. This extra reading time alone may account for some of the improvements shown by children who use CAI. CAI programmes designed using research-based teaching strategies were found to be highly effective. CAI programmes that provided students with both elaborate feedback on their responses and opportunities to correct mistakes and rehearse the correct response were found to be more effective than those not
providing elaborate feedback and rehearsal. Most of CAI programmes in reading for this study employ drill and practice procedures, followed by strategy instruction, then simulation. The area of reading intervention focus was evenly split between word recognition and reading comprehension, followed by language/vocabulary, then pre-reading skills instruction.

Bayrakter (2000)\textsuperscript{119} conducted a study employing meta-analytic research approach and found that CAI was most effective in science subject (physics) and had little effect on science subject (chemistry and biology) achievement. Simulations and tutorial programmes had significant effect on student achievement in science subject but drill and practice was not found effective. Another finding from the study was that experimenter developed software was more effective than commercial and that CAI was found more effective when duration of treatment was shorter than four weeks. Review of the literature reveals that simulations are the most effective type of CAI in the subject area of science. Microcomputer based laboratories (MBL) are also found to be effective for better learning of sciences concepts. Effectiveness of any computer assisted instruction programme depends upon: Quality of instructional software and Quality and functioning of hardware.

Muhammad Khalid Mahmood (2004)\textsuperscript{120} compares the students' achievement on general science subject using the traditional method and CAI found that students like the CAI programme and benefited from it. They found it better mode of instruction than the traditional method.

Ghulam Murtaza (2006)\textsuperscript{121} studied on effect of Computer Assisted Instruction (CAI) on the secondary school students' achievement in Science subject. CAI was use as a tool to facilitate and improve instruction. CAI programmes use tutorials, drill and practice, simulation, and problem solving. This study was designed, to see the effect of computer-assisted instruction as a supplementing strategy on the academic achievement of secondary school students in the subject of science. It was found that the students with high achievement level were taught through computer-assisted instruction. The computer-assisted instruction was found equally effective for both male and female students.
Mohammad, R. I. and Hadi, D. (2011) studied the effect of CAI on science achievement of higher primary students CAI software package and found that CAI has effect on academic achievement in science subject of students in experimental group and scores of students in experimental group were higher than the students who were teaching by traditional method in control group. The results of the study also revealed that there is no significant difference between boys and girls in academic achievement scores in science of experimental group after implement the CAI software package teaching method and both of two groups have been got higher scores in science subject.

Mwei, K. Phillip, et al. (2011) studied the effect of Computer Assisted Instruction on student’s attitudes and achievement in Matrices and Transformations in Secondary Schools and found that there was a significant difference in the Mathematics achievement and attitude of students. The results of the study indicated higher achievement and positive attitudes with CAI treatment groups. Making connections between the goals of Mathematics education and CAI offers a valuable means for improving mathematical knowledge and skills and hence performance in Mathematics. This indicates the need for teachers to provide opportunities for all students to engage in CAI groups in Mathematics.

Anna, T.L. (2011) conducts a meta-analysis of the studies exploring the effectiveness of CAI on career and technology subject found that computer assisted instruction (CAI) has an overall positive effect on learning achievement of career and technology subject of secondary school students. The most effective CAI mode appears to be "drill and practice" with the use of combinations of modes being equally effective. CAI appears to be the most effective when it is used to supplement regular instruction.

Adeyemi B. A. (2012) investigated the effect of Computer Assisted Instruction (CAI) on junior secondary school students’ achievement in social studies and found that there is significant main effect of academic ability on students’ achievement in social studies. The high academic ability students were significantly better than the low ability students in their achievement in social studies.
The effects of CAI on students’ achievement are not only on various subjects. Some researchers show influence of CAI on other benefits. Capper and Copple (1985)\textsuperscript{126} found that CAI students have more of an internal locus of control/sense of self-efficacy than conventionally instructed students. They also state that students’ attendance improved in computer assisted instruction classes as compared with the classes which lecture method was employed. CAI students (experimental group) had higher rates of time-on-task than traditionally instructed students (control group).

Bandura (1993)\textsuperscript{127} found that self-esteem and its traits has an important role in successfulness and dropping out of each student. Some traits of self-esteem such as belonging and acceptance is essential to persons mental health and identified that self-efficacy which is one of traits of self-esteem has effect on enhancing the motivation and performance of each person. The results of his study which gained by applying the CAI in teaching science subject to the students shown that CAI teaching method has effect on self-esteem of students and the results confirmed that self-esteem of students has increased after treatment and when students (boys and girls) are in this kind of educational environment, they will enhance their self-esteem sense.

2.2.10 Definition of achievement and learning achievement

Achievement is about moving toward goal and fulfilling one target at a time. The primary goal of education is the students’ learning achievement. Kurt Lewin (2011)\textsuperscript{128} American Heritage Dictionary (2009)\textsuperscript{129} defines “achievement” as the act of accomplishing or finishing, something accomplished successfully, especially by means of exertion, skill, practice, or perseverance, successful completion; accomplishment. According to Thinkexist.com (2011)\textsuperscript{130}, “achievement” can be defines as: (a) the act of achieving or performing; an obtaining by exertion; successful performance; accomplishment; as, the achievement of his object, (b) a great or heroic deed; something accomplished by valor, boldness, or praiseworthy exertion; a feat, and (c) an escutcheon or ensign armorial; now generally applied to the funeral shield commonly called hatchment.

Jones (1996)\textsuperscript{131} and Piccoli, G., Ahmad, R. and Ives, B. (2001)\textsuperscript{132} define similar definition of learning achievement. Learning achievement according to their views means the
accomplishment of changes in knowledge, skills and attitude of the learners after the completion of teaching. Learning achievement will be affected by learning styles, course design, teaching and other factors.

Loo, R. (1999)\textsuperscript{133} mentioned that learning achievement is affected by learning styles, course design, teaching and other factors. As far as the evaluation of learning achievement is concerned, whether the learning achievement is good or not good, it can be determined from students’ school grades, the ability to obtain professional certificates, and performance in various internal - external examinations i.e. achievement test, performance test and attitude or desirable performance test.

Lantai Tanah (2006)\textsuperscript{134} defines learning achievement as the success of learners which are able to master the materials of the learning objectives. The learning achievement will be different depend up on what the kinds of motivation of the learner has. Deferent motivation will also make different of the learning achievement of learners. In other way, learning achievement can be identified as the education theory. Learning achievement can be depended into the learner within his motivation, in education or learning system, learning achievement has to be measured. Curriculum or syllabus in learning shows the general achievement called competent ion standard. It shows minimum target of learner which is explained by affective, cognitive, and psychomotor standard. Those standards are appropriate with the educational theory used by the nation. In conclusion, learning achievement is target measured by competences of the learner in learning which are shown by score as a sign and score is not a final expectation. Therefore, learning achievement can be defined as excellence in learning process or all academic disciplines, in class as well as extracurricular activities. It includes excellence in behaviour, confidence, communication skills, punctuality, assertiveness, arts, culture, and the like.

Bill Hunt (2011)\textsuperscript{135} defines learning achievement into three aspects:

1. Essential Life Skills: Students demonstrate the aptitude, attitude, and skills to lead responsible, fulfilling, and respectful lives.

2. Academics: Students obtain, understand, analyze, communicate, and apply knowledge and skills to achieve success in school and life.
(3) Responsibility to the Community: Students understand and model the important attributes that people must have to contribute to an effective and productive community and the common good of all.

Learning goals should be based on achievement, integrity, and maturity.

- **Achievement** concerns to the committing to education includes differentiating and tailoring instruction to meet diverse student needs and the applying academic skills outside the classroom translates to learning as a lifelong process.

- **Integrity** concerns to being ethical which is a core component of decision making that positively impacts the classroom, school, and community. The concepts of honesty, trustworthiness, and respect are essential elements of the learning community.

- **Maturity** concerns to the respecting oneself and others as diverse members of society lead to greater appreciation for the contributions of others.

Jessia, H. V. and Jenny, L. W. (2012)\(^{136}\) states that learning achievement refers to the effective learning which is being able to apply knowledge learned to more than one facet of the daily life; and the ability to internalize information and apply it in future situations.

Rachelle, N. W., Kimber, M. S., and Bonnie, A. W. (2012)\(^{137}\) explain that learning achievement is the effective learning which is done in an authentic way to connect to students' prior knowledge and future usage. It takes place when students involved and actively engaged in the learning process. The material taught should be applicable to age and level. Multiple teaching styles and appropriate medias should be used to reach all students.

Thain, G. S. (2012)\(^{138}\) illustrates that learning achievement incorporates Bloom's Taxonomy. When a student is able to remember, understand, and apply information then they are exhibiting affective learning. Being able to then analyze, evaluate, and create new things based on what was learned would demonstrate an even higher level of learning achievement.

Danielle Stolworthy (2012)\(^{139}\) mentions that learning achievement refers to the learning that is self-motivated through the learner's ability to connect what is learned to life personal experiences.
In the present study, “learning achievement” can be defined as the real accomplishments in the students’ learning process i.e. knowledge and understanding, key competencies and desired characteristics which derived from the computer assisted instruction (CAI) that can be measured by achievement test, performance test and desired performance test.

2.2.11 Definition of effectiveness of Computer Assisted Instruction (CAI) on learning achievement

Effectiveness of computer assisted instruction (CAI) on the learning achievement refers to the ability of computer assisted instruction (CAI) to accomplish a learning purpose in the career and technology subject for 10\textsuperscript{th} grade students. The learning achievement scores was obtained from the learning achievement test on career and technology subject (learning substance: electronic title “Multi-Meter” of 10\textsuperscript{th} grade students, before and after instructed by computer assisted instruction (CAI). This includes the power or the degree to be effective and the quality of being able to bring about the highest level of students’ learning achievement in knowledge and understanding, key competencies and desired characteristics. The computer assisted instruction (CAI) in the present study is a form of learning that utilizes computers, and is typically intended as a way to supplement traditional teacher-based learning. The researcher attempts to present the effectiveness of computer assisted instruction (CAI) as a teaching tool, especially as it impacts on the learning achievement. The study aims to find out whether or not CAI can be effectively utilized for teaching and the 10\textsuperscript{th} grade students’ learning achievement in career and technology subject.

2.2.12 Basic Education Core Curriculum 2008

The Basic Education Core Curriculum 2008 (Ministry of Education, 2008)\textsuperscript{140} has formulated for providing local communities and schools with the framework and orientation of preparing school curriculums. Teaching-learning activities organized for all Thai children and youths at basic education level are aimed at enhancing learners’ quality regarding essential knowledge and skills required for their lives in an ever-changing society. They will be empowered to seek further knowledge for continuous lifelong self-development.
The learning standards and indicators prescribed in Basic Education Core Curriculum 2008 aims to enable agencies concerned at all levels to clearly visualize expected learning outcomes throughout the entire course of study. It provides relevant local schools with confidence in their collaborative efforts to prepare school curriculums of higher quality and harmony.

**Vision:** The Basic Education Core Curriculum is aimed at enhancing capacity of all learners, who constitute the major force of the country, so as to attain a balanced development in all respects - physical strength, knowledge and morality. They will fully realise their commitment and responsibilities as Thai citizens and members of the world community. Adhering to a democratic form of government under a constitutional monarchy, they will be endowed with basic knowledge and essential skills and favourable attitude towards further education, livelihood and lifelong learning. The learner-centred approach is therefore strongly advocated, based on the conviction that all are capable of learning and developing themselves to their highest potentiality.

**Principles:** The principles underlying the Basic Education Core Curriculum are as follow.

1. The ultimate aim is attainment of national unity; learning standards and goals are therefore set with a view to enabling the children and youths to acquire knowledge, skills, attitude and morality to serve as a foundation for Thai-ness and universal values.

2. The curriculum facilitates education for all, who have equal access to education of high quality.

3. The curriculum facilitates decentralisation of authority by allowing society to participate in educational provision, which suits prevailing situations and serves local needs.

4. Structure of the curriculum enjoys flexibility regarding learning contents, time allotment and learning management.

5. The learner-centred approach is strongly advocated.

6. The curriculum is intended for education of all types - formal, non-formal and informal, covering all target groups and facilitating transfer of learning outcomes and experiences.
Aims: The Basic Education Core Curriculum is aimed at the full development of learners in all respects - morality, wisdom, happiness, and potentiality for further education and livelihood. The following goals have consequently been set for achievement upon completing basic education:

1. Morality, ethics, desired values, self-esteem, self-discipline, observance of Buddhist teachings or those of one’s faith, and applying principles of Sufficiency Economy Philosophy;
2. Knowledge and skills for communication, thinking, problem-solving, technological know-how, and life skills;
3. Good physical and mental health, hygiene, and preference for physical exercise;
4. Patriotism, awareness of responsibilities and commitment as Thai citizens and members of the world community, and adherence to a democratic way of life and form of government under a constitutional monarchy; and
5. Awareness of the need to preserve all aspects of Thai culture and Thai wisdom, protection and conservation of the environment, and public-mindedness with dedication to public service for peaceful and harmonious coexistence.

Key competencies: The Basic Education Core Curriculum is aimed at inculcating learners with the following five key competencies:

1. Communication Capacity: This refers to the capacity to receive and transmit information; linguistic ability and skills in expressing one’s thoughts, knowledge and understanding, feelings and opinions for exchanging information and experience, which will be beneficial to oneself and society; negotiation for solving or reducing problems and conflicts; ability to distinguish and choose whether to receive or avoid information through proper reasoning and sound judgement; and ability to choose efficient methods of communication, bearing in mind possible negative effects on oneself and society.

2. Thinking Capacity: This refers to the capacity for analytical, synthetic, constructive, critical and systematic thinking, leading to bodies of knowledge creation or information for judicious decision-making regarding oneself and society.
3. Problem-Solving Capacity: This refers to the capacity to properly eliminate problems and obstacles, based on sound reasoning, moral principles and accurate information; appreciation of relationships and changes in various social situations; ability to seek and apply knowledge to prevent and solve problems; and ability for judicious decision-making, bearing in mind possible negative effects on oneself, society and the environment.

4. Capacity for Applying Life Skills: This refers to the capacity for applying various processes in daily life; self-learning; continuous learning; working; and social harmony through strengthening of happy interpersonal relationships; elimination of problems and conflicts through proper means; ability for self-adjustment to keep pace with social and environmental changes; and capacity for avoiding undesirable behaviour with adverse effects on oneself and others.

5. Capacity for Technological Application: This refers to the ability to choose and apply different technologies; skills in application of technological processes for development of oneself and society in regard to learning, communication, working, and problem-solving through constructive, proper, appropriate and ethical means.

Desired characteristics: The Basic Education Core Curriculum focuses on learners’ development for attainment of the following desired characteristics, which enable learners to enjoy their lives as Thai citizens and global citizens:

1. Love of nation, religion and the monarchy
2. Honesty and integrity
3. Self-discipline
4. Avidity for learning
5. Applying principles of Sufficiency Economy Philosophy in one’s way of life
6. Dedication and commitment to work
7. Cherishing Thai nationalism
8. Public-mindedness

Learning Areas: Observance of the principles of development of the brain and multiple intelligence is required to achieve learners’ balanced development. The Basic
Education Core Curriculum has therefore prescribed the following eight learning subject areas:

1. Thai Language: (knowledge, skills and culture in language application for communication; delight in and appreciation of Thai wisdom; and pride in the national language)

2. Mathematics: (application of knowledge, skills and scientific process for problem-solving, way of life and further education; reasonableness; favourable attitudes toward mathematics development of systematic and constructive thinking)

3. Science: (application of knowledge and scientific process for study and search for knowledge and systematic problem-solving; logical, analytical and constructive thinking; and scientific-mindedness.

4. Social Studies, Religion and Culture: (peaceful coexistence in Thai society and the world community; good citizenship; faith in religious teachings; appreciation of resources and the environment; and patriotism and pride in Thai nationalism)

5. Health and Physical Education: (knowledge and understanding, key competencies and favourable attitude towards strengthening one’s own health and that of others; prevention and proper treatment of various things affecting one’s health; and life skills)

6. Art: (knowledge and skills for initiation; inspiration and imagination in creating works of art; aesthetics and art appreciation)

7. Career and Technology: (knowledge and understanding, key competencies desired characteristics and attitude towards work; management; way of life, livelihood and application of technology)

8. Foreign Languages: (knowledge and understanding, skills, attitude and culture in foreign language application for communication, seeking further knowledge and livelihood)

For each learning subject area, the learning standards serve as the goals in developing learners’ quality. These standards prescribe what the learners should know and should be able to perform. They also indicate moral and ethical values as well as desired characteristics upon completing education at basic level. Besides, the learning standards serve as essential mechanisms in advancing the whole education system, as they inform us
of the contents and teaching and evaluation methods. They also serve as instruments for quality assurance and are adopted for both internal quality assurance and external evaluation, practiced at both educational service area and national levels. Monitoring for internal quality assurance is essential, as it indicates the extent of success in achieving the quality as prescribed in the pertinent standards.

The learning area of career and technology contributes to the development of learners in acquiring knowledge and understanding the basic skills essential to their lives. Learners will be alert to the changes and able to apply the knowledge about living, career and technology into their work with creativity and competitiveness in Thai society and the world community. Learners will be able to see the prospects for their future careers, love working and have a favourable attitude towards work, as well as lead a happy life in the society, based on the principles of sufficiency.

The learning area of career and technology is aimed at learners' holistic development with a view to enabling them to acquire the knowledge, the capacity and the essential skills required for work. Learners will thus efficiently see the prospects of their future careers and further education.

**Learning standards of career and technology subject**

There are 4 learning standards in career and technology subject:

**Standard 1: Living and Family:** Understanding of the concept of the work; possessing creativity and skills in various respect-work processes, management, problem-solving, teamwork and investigation for seeking knowledge, morality, diligence, and awareness of the need to economize on the consumption of energy, resources and the environment for living and for family.

**Standard 2: Design and Technology:** Understanding of the technology and technological processes; designing and making objects, utensils or the methodologies through the creative technological processes; selective utilization of the technologies beneficial to one's life, society and the environment; participation in sustainable technological management.

**Standard 3: Information and Communication Technology (ICT):** Understanding, appreciation and efficient, effective and ethical application of information technology in
searching for data, communicating, problem-solving, working and livelihood. Use the computers to facilitate creation of work or projects with the awareness and the responsibility.

Standard 4: Career: understanding and acquiring the necessary skills and experiences; proper perception of future career; the technological application for career development; possessing morality and favourable attitude towards careers.

In the present study, Standard 2: Design and Technology and Standard 3: Information and Communication Technology (ICT) are selected to use for the instruction.

Learning substance include in career and technology subject:

1. Life and Family: This includes the work in daily life; ability to help themselves, their families and society under the guidance of the principles of sufficiency economy; intent not to destroy the environment; emphasis on the actual practice until the attainment of the confidence and the pride in their accomplishments in order to discover their own capacities, aptitudes and interests.

2. Design and Technology: This includes the creative development of human capacities by applying the knowledge with technological processes to create objects, utensils and methodologies, or to increase efficiency in life.

3. Information and Communication Technology (ICT): This includes the process of information technologies; communication; the search for data; application of data and information; solution of problems or creation of work; values and effects of ICT.

4. Career: This includes the skills essential to learners’ career recognition of the importance of morality, ethics and favourable attitude towards careers; ability to use technologies appropriately; appreciation of values of honest careers; and ability to see the prospects for future careers.

Indicators: Indicators specify what learners should know and be able to perform as well as their characteristics for each grade level. Indicators reflect the learning standards. Being specific and concrete, they can be utilized for prescribing contents, determining learning units and organizing teaching-learning activities. They serve as essential criteria for evaluation in order to verify the learners’ quality.
Learners’ quality of career and technology subject

The learners’ quality refers to the following abilities:

1. Ability to understand the methods of working for their livelihoods; establish achievements through creative thinking; be skilful in team working, management, problem-solving and seeking knowledge; work morally and have an awareness of cost-effective and sustainable use of energy and resources.

2. Ability to understand the relationship between technology and other disciplines; analyze technological systems; have creativity in problem-solving or responding to the needs; make and develop objects and utensils through safe technological processes by using software to design or present the accomplishments; analyze and choose to apply the technologies appropriate to daily life, society and the environment, and manage the technologies through the clean technologies methods.

3. Ability to understand the components of the information systems, the components and the principles of functioning of computers, systems of data communication for computer networks, the characteristics of computers and connecting accessories, and be skilful in using computers to solve problems; write programming languages; develop computer programs; use hardware and software; communicate and search for data on the Internet; use computers to process data to serve as information for decision-making; use ICT to present achievements and use computers to create work or projects.

4. Ability to understand the guidelines for entering the employment, the choices and the application of technologies appropriate to the careers; have experiences in the careers they have aptitudes and interests, and have the desired characteristics for the careers.

In the present study, the computer assisted instruction (CAI) was use as the teaching aid or instruction material which includes guided, drill and practice exercises, computer visualization of complex objects and computer facilitated communication between students and teachers to assists the teaching and learning process in career and technology subject (learning substance: electronic title “Multi-Meter”). The details of using CAI in this study are as follow:
2.3 REVIEW OF THE PAST STUDIES

2.3.1 Definition of review of the past studies

The review of the past studies is a link between the research proposed and the past researches. It tells the researcher about various aspects that have been already established or conducted and concluded by other authors. It gives a chance for readers to appreciate the evidence that has already been collected by previous research. The review of relate literature is needed for the research work and hardly any research project which is totally unrelated with research that has already taken place. The review of literature is very important aspect of any research both for the work planning as well as to show its relevance and significance.

2.3.2 Importance of review of the past studies

The effective literature review helps the researcher to understand the existing body of knowledge including where excess research exists. It provides a solid theoretical foundation for the proposed study. The effective literature review also help to substantiate the presence of the research problem, justify the proposed study as one that contributes something new to the body of knowledge, and frame the valid research methodologies, approach, goals, and research questions for the proposed study. (Leedy and Ormrod, 2005)\textsuperscript{141}

Kumar, V. (2009)\textsuperscript{142} states that a large part of review of literature actually needs to be done even before the research project is formalized. This is essential to make sure that the researches are not repeating the work that someone has already done earlier. Sometimes, if the research has already been undertaken earlier, then it provides an option of modifying the
work by adding a new perspective or altering some of the methods of research to obtain a perspective that will be different from earlier works and thus more valuable. Occasionally, the work may be exact repetition of the work done earlier, but with a different set of data or sources of facts, and purpose of the research may just be seen if the results are similar to earlier works.

A good researcher usually goes through a lot more literature than is actually incorporated in the paper. This is because different literature may have differing relevance for the current project and all of it may not worth reporting in the end, but in the initial phase, when the researcher is looking for all aspects of an issue that could be relevant one would like to extensively explore the literature and see if any relevant findings are already available. Some of the literature reviewed is directly relevant and hence used as a preface to explain the background of work. Then other reports may be relevant from the point of view of the project as they provide some clues to the puzzle by suggesting a hypothesis, which may be the subject matter of your research project.

The review of the related literature is necessary to show the available evidence to solve the problem adequately and thus the risk of duplication can also be avoided. It provides ideas, theories, explanations or hypotheses valuable in formulating the problem. It also suggests methods of research appropriate to the problem, to locate comparative data useful in the interpretation of results and to contribute to the general scholarship of the researcher. Review of literature is also important to highlight difference in opinions, contradictory findings or evidence, and the different explanations given for their conclusions and differences by different authors. Thus review of literature is a very important part of one's research.

2.3.3 Past studies related to the effectiveness of computer assisted instruction (CAI) on learning achievement

This chapter presents 11 past researches related to the effectiveness of computer assisted instruction on learning achievement which was already done in Thailand and in different countries as follow:

Objective of the study: The major objectives of the study were:

1. To find out the relative effects of computer-assisted instruction as supplementing strategy on the academic achievement in science;
2. To explore the difference between treatment effects on the students of high and low intelligence;
3. To investigate the difference between treatment effects on male and female students.

Research design: This study was designed, to see the effect of computer-assisted instruction as a supplementing strategy on the academic achievement of secondary school students in the subject of science. The experimental research was adopted for this study. To achieve the objectives of the study, following null hypotheses were tested:

1. There is no significant difference between the mean scores of the students taught science with CAI as supplementing strategy and without CAI;
2. There is no significant difference between the mean scores of the high achievers and low achievers of experimental and control groups;
3. There is no significant difference between the mean scores of male and female students of experimental and control groups.

Tool used in the study: The study was based on 'Operant Conditioning' theory of B. F. Skinner. There were two different treatment patterns applied during the experiment. Both the groups were taught through routine method by the same teacher. The computer-assisted instruction was used as additional strategy for the experimental group. During the experiment period, the experimental group received the treatment of independent variable, i.e. computer-assisted instruction whereby the experimental group was exposed to certain web-cites consisting of drill and practice, tutorials, simulations and animation. In the meanwhile he control group was kept busy in other activities such as guided practice and independent practice. This was adopted to control the variable of time and to realize the primary objective of the study. The experiment continued for six weeks. In order to find out treatment effects, a teacher-made post-test was administered to the experimental as well as control group.
immediately after the treatment (teaching) was over. The purpose of this test was to measure the achievement of the students constituting the sample of the study. Final data were collected from 40 students, 20 from each group.

**Sample of the study**: Secondary school students studying science subjects constituted the population of the study. The students of 9th class of The City School, H-8, Islamabad were selected as sample of the study. Only students studying biology as elective subject were included in the sample. Sample students were assigned to two group i.e. experimental group and control group. Both the groups were equated on the basis of their achievement scores in previous semester in the subject of biology. Each group comprised 20 students.

**Technique of analysis of data**: The achievement scores of the sample were obtained as a result of the post-test. After obtaining the scores, the lists were prepared for each group and the means, standard deviations, differences between means were computed. Significance of difference between the mean scores of both the groups on the variable of previous achievement was tested at .05 levels by applying t-test. To see the treatment effects for male and female students as well as high and low levels of achievement of both the groups, the factorial design (2 X 2 analysis of variance) was applied. For this purpose the students of both groups were divided into two halves, namely, high achievers (above the mean score) and low achievers (below the mean score) on the basis of scores on previous achievement test.

**Major findings**: The results of the analysis of data revealed that the students taught through computer assisted instruction (CAI) as supplementary strategy performed significantly better. The students with high achievement level showed better results than those with low achievement level when taught through computer-assisted instruction. The computer assisted instruction was found equally effective for both male and female students.

**STUDY 2**: A Comparison of Traditional Method and Computer Assisted Instruction on Students Achievement in General Science. (Muhammad Khalid Mahmood, 2004)

**Objective of the study**: The purpose of this study was to examine the effect of computer assisted instruction on student achievement in general science as compared to traditional method of instruction.
Research design: The experimental research was designed, to see the effect of computer assisted instruction students’ achievement of secondary school students in the subject of science. Study was conducted using posttest only control group design with matched groups on intellectual capacity. Students of the experimental group received computer assisted instruction, for a period of nine weeks in the computer laboratory of the school and the control group studied general science in their class as traditional method.

Tool used in the study: Computer assisted instruction program for the experiment was developed by the researcher using interactive tutorial mode of presentation, covering four chapters from the textbook of general science for secondary classes. Each tutorial comprises a text segment in Urdu followed by multiple choice questions and immediate feedback. Hyperlinks are added to the program for explanation of the text.

Post-test was an achievement test comprising one hundred multiple-choice items, measuring knowledge, comprehension and application components of achievement in three types of the selected content area i.e. biology, chemistry and physics. To evaluate the CAI program in terms of student’s opinion an opinionnaire was administered to the experimental group students.

Sample of the study: An experiment was conducted with 9th class students of session 2001-2003 studying general science at Government Central Model High School No.21, Lahore.

Technique of analysis of data: Eleven null hypotheses were tested by analyzing the data on achievement test. Paired t-test was applied to determine the significance of difference between the mean achievement scores of the experimental and the control groups. Analysis of variance (ANOVA) was applied to explore the difference among the mean achievement scores by the three intellectual capacity sub group of the experimental group. Contract analysis was also run to find out the sub group significantly different on achievement.

Major findings: The results of the study revealed that the experimental group out performed the control group in all achievement areas i.e. overall, by levels of cognitive domain and by type of content. Achievement scores by the intellectual capacity grade. Students like the CAI program and benefited from it. They found it better mode of instruction than the traditional method. Efforts are being made on the part of the government to expand
computer facilities in schools. Expansion in computer literacy, a computer education and computer facilities warrants the need of CAI.


Objective of the study: The purposes of this research were:

1. To demonstrate the education advantage of Computer Assisted Instruction (CAI) on the introductory statistics subject for graduate students
2. To test the difference between the learning achievement scores of two groups of students i.e., participants in an introductory statistics course that integrated CAI and the learning outcomes of participants in a Lecture-only.

Research design: Quasi-experimental design was used in this research. A quasi-experimental design compared learning outcomes of participants in an introductory statistics course that integrated CAI and the learning outcomes of participants in a Lecture-only introductory statistics course. Both courses had several features in common. All were taught by the same instructor and had the same objectives, content, and homework assignments. The instructor was an experienced professor who has been teaching the three credit hours introductory statistics courses since. Different editions of the same textbook (Gravetter and Wallnau, 2000) have been used in this class for more than eight years. The instructor worked with two doctoral level assistants across seven different offerings of the course that were trained to teach the CAI portion. With the exception of the two graduate assistants, the CAI components were identical from quarter to quarter. Course content included descriptive statistics, frequency distribution, central tendency and variability, hypothesis testing, t tests, correlation, regression and nonparametric statistics (chi-square).

Tool used in the study: Computer Assisted Instruction (CAI) on the introductory statistics subject for graduate students was integrated in experimental group of students.

Students in all courses took the same multiple-choice Midterm and Final exams. Both exams consisted of 62 multiple-choice questions. Of the 62 questions of the Midterm and Final examinations, 50 items tested generalized learning (Hannafin and Carney, 1991; Worthington et al., 1996), however, 12 items (those questions reflecting in the CAI session) tested domain-specific learning (Worthington et al., 1996). While Midterm examination was
administered after the 7th week of the course (middle of the quarter) to each session. Final examination was administered to each section at the end of the quarter, (15th week). Generalized learning items included definitions, interpretations and discriminate of terms and concepts, calculations of statistics, and interpretations of results.

Students in the Lecture-plus-CAI section attended 40-minute class each week and completed systematically computerized exercises and tutorials. After learning concept and theory in Lecture-only part of the course, students who choose Lecture-plus-CAI section came to the computer lab and lab instructors show them how to make practice on real data set. For example, students learn and understand theoretical base of the measure of central tendency and what it means in the Lecture-only class. And then in Lab, students learn how to run measure of central tendency, get computer outputs, analyze and interpret them appropriately. Software used to provide these exercises was a data analysis package, SPSS (Statistical Package for Social Sciences).

Sample of the study: Sample was graduate level students during all six quarters of the last two academic years at a Carnegie Research University. In the first meeting of the course, a survey included five questions distributed to the participants. Questions in the survey were: Gender, age, academic major, degree pursued and number of statistics courses taken. During the first meeting of the lecture portion of the course, the professor explained that a one credit hour lab was scheduled and recommended. The students were then registered for the introduction statistics course without Computer-assisted learning (Lecture - only; n = 140) or with Computer assisted instruction (CAI) (Lecture-plus-CAI; n = 65).

Technique of analysis of data: The statistical methods used in data analysis were t - test (independent type), correlation, regression and non-parametric statistics (Chi-square).

Major findings: The results of this study demonstrated that participants in Lecture-plus-CAI section obtained higher averages on midterm and final exams than participants in the Lecture-only sections and these higher averages likely were because of their better performance on concepts and practices that were taught in both regular lecture and CAI course. In addition, when the topics of the introductory statistics course moved from
descriptive statistics to inferential statistics, the learning gap between Lecture-only and Lecture-plus-CAI is increased. Findings suggest participants' learning capacity of the introductory statistics could be improved successfully when CAI used as a supplement to regular lecture in teaching introductory statistics course.

It could be concluded that the traditional methods of teaching introductory statistics are generally viewed as being ineffective because they fail to establish a clear link between statistics and its uses in the real world. To be more effective, using computers with software programs in the introductory statistics course would be one of the important ways to improve student knowledge about statistics and its usefulness in real life. It is a fact that emphasis on real-world applications with the computers is becoming more prevalent in introduction statistics courses at many colleges and universities, including this course.

**STUDY 4 : Effect of Computer Assisted Instruction on Achievement in Teaching of Social Studies Lesson in Primary Education.** *(Alpay Aksin (2006)*

**Objective of the study :** The purpose of this study was to investigate the effect of computer assisted instruction on 7th grade students’ achievement in social studies. The essential question investigated is that "Is there any significant difference between traditional classroom and computer assisted instruction classroom with respect to achievement?"

**Research design:** The quasi-experimental research was designed, to see the effect of computer assisted instruction students' achievement of secondary school students in the social subject. The experimental and control groups, some variables such as students' genders, numbers, their average degrees while passing the 6th classes, their average marks in social studies lesson at the end of the educational year of the 6th classes and the results of the pre-tests were taken into consideration. Computer assisted instruction is applied to the experimental group, traditional instruction which is teacher-centered and lecturing method is given to the control group.

**Tool used in the study :** Computer assisted instruction programme for the experiment which was developed by the researcher using interactive tutorial mode of presentation of social studies for 6th classes students was the tool of the study.
Sample of the study This study based on experimental method was carried out in Yavuz Selim Primary School and Dr. Sedat-Dr. Melahat Baran Primary School during the 2004-2005 academic year in Sungurlu, Çorum.

Technique of analysis of data: The data collected is obtained from 15 knowledge, 15 comprehension, 10 application, totally 40 questions from a multiple choice-test. Mean (\( \bar{X} \)), Standard deviation (S.D.), and t-test were used to analyze the data.

Major findings: The results of the study reveled that the experimental group is more successful with respect to the levels knowledge, comprehension, and application. At the end of the study, it is determined that computer assisted instruction in teaching social studies is more effective for acquiring knowledge, comprehension and application level behaviours than traditional instruction.

STUDY 5: The effects of Computer Assisted Instruction on the Achievement, Attitude and Retention of 4th Grade Mathematics Course (Olga Pilli, 2008)

Objective of the study: The purpose of this study was to examine the effects of the computer software Frizbi Mathematics 4 on 4th grade student’s mathematics achievement, retention, attitudes toward mathematics and attitude toward computer assisted learning and to compare the learning achievement scores of two groups of students i.e. experimental and control group).

Research design: The quasi-experimental research was designed, to see the effect of Computer software Frizbi Mathematics 4 on 4th grade students. Computer software was applied to the experimental group and lecturing method was given to the control group. The study was conducted in spring semester of 2006-2007 academic year and included three units, Multiplication of Natural Numbers, Division of Natural Numbers, and Fractions.

Tool used in the study: The instruments of the study were Computer software Frizbi Mathematics 4 on 4th grade students. Learning achievement test was used for data collection. Scores on achievement tests were collected three times; at the beginning of the study, immediately after the intervention, and 4 months later. Mathematics attitude scale and computer assisted learning attitude scale were administrated only two times; at the beginning of the study and immediately after the completion of the study.
Sample of the study: Two groups (experimental and control) of primary school students from “Sht. Osman Ahmet” primary school in Gazimagusa, North Cyprus were used in this study. Control group was taught using a lecture-based traditional instruction and experimental group was taught using educational software, namely Frizbi Mathematics 4. The control group consisted of 26 students whereas the experimental group consisted of 29 students. The groups were compared on achievement of mathematics, retention, and attitude toward mathematics and computer assisted learning.

Technique of analysis of data: An Analysis of Variance (ANOVA) was used to find out the effect of the effect of Frizbi Mathematics 4 on 4th grade students’ achievement.

Major findings: The results of the study revealed that the student of experimental group obtained more successful than the students in control group.

1. There were statistically significant differences between the students’ achievement mean scores of experimental and control group. This difference is in favour of the students in the experimental group.

2. A series of ANOVAs for repeated measures revealed significant difference between the groups on the attitude scales in favour of experimental group. However, statistically significant differences in favour of treatment group, on the retention tests was attained on the multiplication and division units but not on fractions. The evidence indicates that Frizbi Mathematics 4 for learning and teaching mathematics at 4th grade level is an effective tool.


Objective of the study: The study investigated the effect of computer assisted instruction on the performance of secondary school students in biology. Specifically, the study examined:

(1) The difference in performance in biology, if any, of secondary school students exposed to individualized computer assisted instruction, cooperative computer assisted instruction, and those exposed to conventional instruction.
(2) The influence of students’ gender on their performance in biology, when they are exposed to individualized computer assisted instruction, or cooperative computer assisted instruction.

**Research design:** This study was a quasi-experimental type, of the pre-test, post-test, non-equivalents, non-randomized, control group design. The design is a 3x2 factorial design. This paradigm represents three levels of treatment: the individualized Computer Assisted Instruction (experimental group 1), Cooperative Computer Assisted Instruction (experimental group 2) and the Conventional Instruction (control group); and two levels of gender (Male and female).

**Tool used in the study:** The instruments for this research were the treatment instrument “Computer Assisted Instructional Package (CAIP)” and the test instrument, “Biology Performance Test (BIOPET)”. The treatment instrument, Computer Assisted Instructional Package (CAIP) on Biology, was a self-instructional, interactive package that lasted for 2½ hour for an average student. It contained five lessons structured into modules. The topics covered in the package are food chain, food web, energy flow, nutrient, movement, and pyramid of numbers, all from the ecology aspect of the Nigerian senior secondary biology curriculum. It was developed by the researchers, with the assistance of a professional programme developer using Dream weaver and flash that is, written in Hypertext Markup Language (HTML) with illustrations converted to Graphic Interchange Format (GIF). Intrinsic programming sequence in which single alternative frame exist to reinforce concepts that appear difficult to some students was adopted. At a consistent portion of each frame, navigation buttons were included.

In the development of the package four methodological phases were strictly followed: analysis, design, implementation and validation. In analysis stage, students’ cognitive skills to be improved were considered as a baseline for the development of components of the software, and evaluation instruments were also analyzed and developed at this stage. At the design stage, storyboards, scripts, frameworks and other aspects of the software were defined. At the implementation stage, the software development was based on user-centered design, where the opinion, interests, needs, emotions, thoughts, and so on of users became key factors in the software’s
development. Validation involved the evaluation by biology experts for the appearance, operation and logic of hyperlink, spelling, grammar, readability, and clarity from the viewpoint of persons unfamiliar with the content.

In addition, end users’ usability evaluation was done through a pilot study on a sample, similar to the final sample used in the study. The results obtained in the usability experience were used for improvement of the package.

The test instrument, Biology Performance Test (BIOPET), was a 30 item multiple-choice objective test with five options each which were drawn from the past West African Examination Council (WAEC) Senior Secondary Certificate Examination biology paper II questions. The test content was based on a table of specification covering the six levels of cognitive domain of learning.

Sample of the study The target population of this research was the first year senior secondary biology students in Oyo town and Ibadan city, Nigeria. The nature of the study, however, required that the research sample was purposively selected. This is because a research on CAI must necessarily be conducted in schools where computers are available for students’ use and where the students are computer literate. This was why the NESTO College, Oyo, and Ise Oluwa Montessori Secondary School, Ibadan were purposely sampled for the study. These two schools were selected as the experimental groups. A third school, St. Francis Catholic College, Oyo was also sampled as the control group, as the school is believed to be more or less equivalent in standard to the schools used for the experimental group.

The sample for Experimental Group 1 is made up of 40 students. This comprises of 20 males and 20 females.

The Experimental Group II also has 40 students made up of 19 males and 21 females, while the control group was made up of 19 males and 21 female students.

Technique of analysis of data: All the groups (experimental and control groups) were subjected to the Biology Performance Test (BIOPET) as pre-test. Then, the students in the first experimental (individualized) group were exposed to CAIP which had been installed on desktop computers using a web browser (Explorer or Firefox), while the second experimental group were exposed to the same content with four students working on a desktop computers. Other applications such as Internet access, CAI packages, games, and
so on were disabled or removed. The students in the experimental groups were introduced to the CAI format under teacher’s supervision long enough for them to be familiar with the navigation buttons and use the package independently. In addition, they were encouraged to take enough notes that could be useful for them in the post test.

The control group students were exposed to the conventional teaching method on the same content used for experimental groups. They were taught using conventional classroom format. The classroom contained a chalkboard, overhead projector, and charts which were used for the instruction. The treatment for all the groups lasted for five weeks. After the treatment the three groups were exposed to the BIOPET which had been rearranged as post test.

The scores of students in the three groups were analyzed using ANCOVA. The analysis was done using the three research hypotheses stated for the study.

**Major findings**: The results of the study are as follow:

(1) There was no significant difference in the performance of students in biology when they are exposed to (i) Individualized Computer Assisted Instruction (ICAI), (ii) Cooperative Computer Assisted Instruction (CCAI), and (iii) Conventional Instruction (CI).

(2) There is no significant difference between the performance of male and female students in biology when they are exposed to individualized computer assisted instruction (ICAI). Analysis of covariance (ANCOVA) was used to find out the effect of the main treatment (ICAI) on the performance of the male and female student.

(3) There is no significant difference between the performances of male and female students in biology when they are taught using Cooperative Computer Assisted Instruction (CCAI). Analysis of Covariance (ANCOVA) was used to find out the effect of CCAI (the main treatment) on the performance of female and female students.


**Objective of the study**: The purpose of this study was to compare the effectiveness computer assisted instruction (CAI) and traditional classroom lecture (TCL) on occupational theory.
Research design: The quasi-experimental (randomized two-group pretest/posttest) was designed, to see the effectiveness of Computer Assisted Instruction (CAI) on students in Master of Occupational Therapy programme. Computer assisted instruction (CAI) was applied to the experimental group and traditional classroom lecture method was given to the control group.

During a class session two weeks prior to the training, the class instructor briefly described the study to participants and invited them to participate. Thirty volunteers completed the pretest and posttest. The day of training, participants took the pretest; then they were randomly assigned to the computer-assisted instruction group or the traditional classroom lecture group.

The traditional classroom lecture group stayed in the classroom with the above identified professor for training. The computer assisted instruction (CAI) group was directed to a computer lab. Participants in the computer-assisted instruction group received a CD-ROM. They were briefly instructed about the process of completing the computer-assisted instruction training. Further instructions to navigate the CD-ROM were included in the presentation. Participants worked individually. The researcher was available through the session to resolve technical difficulties. After finishing the training, the posttest for the traditional classroom lecture group was a paper and pencil test, while the computer-assisted instruction group took the same test on the computer. In addition, the computer-assisted instruction group took a paper and pencil survey to explore their attitude toward computers. Training was completed within the maximum 90-minutes scheduled class time.

Tool used in the study: The instruments of the study were the Computer Assisted Instruction (CAI) and the traditional method for students in Master of Occupational Therapy programme. The experiment involved a group of 16 occupational therapy students. The material was a tutorial created to introduce students to the occupational adaptation theory. The content was based on previous publication of the occupational adaptation therapy. The content of the computer assisted instruction (CAI) material introduced students to the basic concepts of the occupational adaptation therapy. The computer assisted instruction (CAI) material was a power-point presentation that incorporated graphics and animation, which presented some interaction with the material. The computer assisted instruction (CAI) model started with a brief on how to navigate the CD-ROM. Then it was organized into two sections.
Section 1 presented the objectives of the presentation and how the occupational adaptation therapy differs from other occupational therapies. Section 2 showed the history of occupational adaptation therapy, an overview of the theory, and an explanation of the occupational adaptation process, which included examples. Finally, it presented the references, credits, and a link to the online posttest.

According to the testing instrument, the knowledge was measured by 22 items multiple choices. The test was used as pretest and posttest with items presented in different order. Content validity analysis was examined using three content experts. Reliability of the test items was examined using KR-20 as an indicator of internal consistency. Coefficients above 0.70 are considered adequate. Results indicated a reliability coefficient of 0.73.

Sample of the study The experimental research conducted on the sample of 30 first year students in Master of Occupational Therapy programme located in the Southwestern United States. Participants were randomly assigned to a CAI group or a TCL group. There were 33 students enrolled in the class, but only 30 attended class the day of the study. For the randomization, each participant received a number. Student with even numbers were assigned to the CAI group and student with odd numbers to the TCL group. Numbers were assigned for the 33 participants, since three participants did not attended; two odd numbers and one even number were unassigned causing unequal group numbers. Therefore, sixteen students were assigned to the CAI, and fourteen to the TCL group.

Technique of analysis of data: To examine the effectiveness of teaching methods, a 2 (teaching method) x 2 (time) repeated measures analysis of variance (ANOVA) was performed. An alpha level of .05 was used to determine statistical significance. All participants were female, with a mean age of 25.8 years (SD +8.2). Mean age for traditional classroom lecture was 24.8 (SD +6.9), while the mean age for computer-assisted instruction participants was 26.4 (SD +9.2). Three percent of the participants rated themselves as novice concerning computer skills, 67% average computer skills, and 30% excellent computer skills. In general, participants in the training groups reported their computers skills as average. The two-way mixed model ANOVA indicated that there was no statistical significant difference between the two instructional groups at pretest, F (1, 28) = .001, p < .05. There was a statistically significant difference between pre and post tests in both groups, F (1, 28) = 19.3, p < .05 and a statistically significant interaction in the posttest between groups,
F (2,28) = 5.05, p < 05. Since the interaction is significant, it was inappropriate to examine the main effects independently.

**Major findings**: The results of the study showed the significant differences between the two groups in cognitive gains (p < 05.), with the CAI group demonstrating more cognitive gain than the TCL group. Additionally, the CAI group spent 46% less time than the TCL group to cover material. The results of this study suggested that occupational therapy learners could independently learn theory using computer-assisted instruction materials. Although the computer assisted instruction (CAI) group started with lower pretest scores, this group scored higher than the traditional classroom lecture group in posttest.

All participants in this study increased their knowledge of the occupational adaptation theory; however, participants in the computer assisted instruction (CAI) group gained more knowledge, based on pre-posttest scores, than participants in the traditional classroom lecture group. The findings of this study add to the already large number of studies assessing the effectiveness of computer-assisted instruction in education and the small number of studies in occupational therapy education.

**STUDY 8**: An Investigation of the Impact of Computer Assisted Instruction (CAI) on Reading Comprehensive of Middle School Sixth grade in a Rural South Carolina School District. (Gillard, Delphine: 2010)

**Objective of the study**: The purpose of this study was to examine the impact of Computer Assisted Instruction (CAI) on Reading Comprehension by analyzing test score reports of the participants before and after the implementation of Computer Assisted Instruction. The study then examined the impact of CAI on the English Language of sixth grade students in a rural district in South Carolina. This study further explored whether CAI significantly impacted the reading comprehension of students based upon race, gender and socioeconomic status.

**Research design**: The experimental research was designed, to see the impact of Computer Assisted Instruction (CAI) on Reading Comprehension of sixth grade students in a rural district in South Carolina.

**Tool used in the study**: The instrument of the study was the Computer Assisted Instruction (CAI) on Reading Comprehension of sixth grade students.
Sample of the study: Participants for this study were 1,355 sixth grade students in the public school students from a rural school district in the low country of South Carolina. A total of six middle schools were divided into three Compass Learning schools and three non-Compass Learning schools.

Technique of analysis of data: Data used in this study were examined using the following statistical procedures: Descriptive Statistics, Analysis of Variance (ANOVA), and t-test. In order to examine the hypotheses, an Analysis of Variance test was performed to investigate the relationship between student achievement, programme status (Compass Learning versus non-Compass Learning), gender, race, and meals status (free/reduced versus full price). The t-test model was used to investigate the implementation of Computer Assisted Instruction (CAI) on Reading Comprehension, 6th grade PASS ELA achievement, program status (Compass Learning versus non-Compass Learning), gender, race, and meals status (free/reduced versus full price). The sixth grade PASS ELA scale score was the dependent variable.

Major findings: The results of this study revealed that there was no significant difference in the 6th grade PASS ELA scores of Compass Learning versus non-Compass Learning students. The adjusted mean for the Compass Learning students with free/reduced-price meals was lower than that for non-Compass Learning students. On the other hand, the adjusted mean for Compass Learning students with full-price meals was higher than that for non-Compass Learning students with full-price meals. It was also revealed that there was no significant difference in the 6th grade PASS ELA scores of Compass Learning versus non-Compass Learning students while taking meals status (free/reduced versus full price) into consideration. Further, this investigation found that there was a significant difference in PASS ELA scale scores in regards to gender.

The programme status (Compass Learning versus non-Compass Learning) had no effect on student achievement in terms of the dependent variable (sixth grade PASS ELA scale score) on all the ANOVA models used to answer the four research hypotheses. Subsequent models determined that gender had an effect on student achievement with females outperforming males by an average scale score points on the sixth grade PASS ELA. Race had an effect on student achievement with white students outperforming black students.
and Hispanic students. Meals status and program status appear to have an interactive effect on student achievement. The non-Compass Learning students with free/reduced-price meals outperformed the Compass Learning students with free/reduced-price meals. On the other hand, the Compass Learning students with full-price meals outperformed the non-Compass Learning students with full-price meals.


Objective of the study: This study aims at investigating the effect of computer assisted language instruction on Saudi students learning of English at King Saud University. It is an attempt to study whether using computers in teaching English alongside the traditional method to university students is significantly different from teaching English without the aid of computers. The purpose is to compare using Computer Assisted EFL Instruction alongside the traditional method with using the traditional method alone and decide which is more suitable for the students under investigation.

Research design: This study was carried out with King Saud University students following a randomized control-group pretest-post test design. The subjects were randomly assigned to two groups. Each group was then assigned at random to either the control group or experimental group. The treatment consisted of two levels: using computers alongside the traditional method and the traditional method alone. The experimental group undertook the first level of the treatment and the control group undertook the second level. The experimental group used the computers for three 30-min periods a week for the eight-week duration of the experiment. Both groups were subjected to a pretest immediately before starting the experiment and the same test was administered as a posttest immediately after it.

Tool used in the study: The computer assisted language learning (CALL) was the tool of the study. It was an approach of teaching and learning foreign language where the computer and computer assisted instruction resources such as the internet were used to present, reinforce and assess material to be learned. In order to answer the question of the study, the researchers developed instructional software (Computer-Assisted EFL) and investigate the effect of Computer-Assisted EFL Instruction alongside the traditional method on the university students’ achievement in English. The instruction software consisted of two
main parts. The first part contains reading texts, explanation of the grammar items and presentation of the vocabulary items. The second part of the instructional software consists of exercises and drills on the reading passages and the grammar and vocabulary items. The instructional software was developed depending on the textbooks of Najem 101.

Moreover, the researcher also developed a 20-item-multiple choice test. Test items had 4 choices, only one of which is correct. The students were instructed to answer the questions by circling the correct choice. The test included items dealing with reading texts, vocabulary questions and understanding certain grammatical constructions. In scoring, students’ achievement was computed out of 100, allotting 4 points for each correct answer and 0 for each wrong answer. The time interval between the pretest and the posttest was 8 weeks; a period long enough to minimize the effects of the pretest on the results and the conclusions of the experiment.

**Sample of the study:** The population of the study consisted of all students who studied the English language course (Najem 101) in the second semester of the academic year 2007–2008. The sample of the study consisted of 60 students who were chosen randomly through the random sampling techniques in the statistical package SPSS. Then the 60 students were randomly assigned into experimental and control groups of 30 students each.

**Technique of analysis of data:** An independent samples t-test was used to measure the gain scores of both groups on the pretest and then on the posttest. A One-Way Analysis of Covariance (ANCONA) was used to measure the gain scores of the subjects in order to eliminate any possible differences between the two groups on the pretest. The usability of the test was tested through a pilot study of 25 students who were excluded from the sample. The reliability coefficient of the test was calculated using Cronbach-Aalpha and was found at 0.92. The test was also given to a jury of six professors at King Saud University, two from the Department of English language and four from the Language Unit Department, to elicit their views as to the accuracy, clarity, and appropriateness of the instrument. Then the test was reviewed and modified according to their recommendations. The instructional software was also given to the same jury to make sure that it suits the level of the students.
Major findings: This study investigates the effect of computer assisted instruction (CAI) on Saudi University Students' learning of English. It compares using the computer alongside the traditional method with using the traditional method alone. The researchers hypothesize that the students who were taught through computer assisted English language instruction alongside the traditional method show better achievement than those who were taught through the traditional method alone. This hypothesis was tested at the 0.05 level of significance. The data were collected through a pretest-treatment-posttest design for equivalent groups and analyzed via the statistical package SPSS.

An independent samples t-test was carried out to determine whether there are any statistically significant differences between the achievements of the two groups on the pretest. It was shown that the difference between the achievement of both groups on the pretest is not statistically significant at α= 0.05. Thus, since there is no statistically significant difference between the control and experimental groups on the pretest, the two groups were assumed equivalent. Another independent samples t-test was conducted to determine whether or not there is a statistically significant difference between the two groups' achievement on the posttest. It was shown that there is a statistically significant difference at a =0.05 between the achievement of the experimental group and that of the control group on the posttest in favour of the experimental group.

It was indicated that using the computer in English language instruction to the university students has a positive effect on students' achievement. The mean score for the experiment group on the posttest was 81.65 while that of the control group was 69.85. Moreover, in spite of the fact that the difference between the achievement of the experimental group and the control group on the pretest was not statistically significant, to eliminate initial differences, a one-way ANCOVA was carried out. It was found that there is a statistically significant difference between the experimental group and the control group on the posttest. The achievement of the experiment group, measured by the difference between the pretest and the posttest, was significantly better than that of the control group.

It can be concluded that the difference in the achievement of the students was attributed to using computer in English language instruction.

Furthermore, the differences between the two groups may be attributed to many other reasons.
First, using computer in English language instruction is a novelty. This novelty may have encouraged the students to deal with the computer enthusiastically, which may have been reflected in better achievement.

Second, computers depend on programs that are based on individual learning and consider the level and pace of the individual. This may enhance learning as the learner may feel that student is in control of the whole learning process.

Third, using computers allows the students to repeat the same piece of information or drill as many times as necessary for them to understand. Moreover, they are able to refer to the learning material any time they want.

Fourth, using computers in instruction makes the students become less shy of committing mistakes, which encourages them to learn much better and then improve their achievements.

Fifth, students using the computers might have felt that they were not being watched or judged and, thus, that the work they did was their own private property. Therefore, they were relaxed about pooling information and seeking help from other students.

Finally, computers have many positive characteristics such as speed, accuracy, variability of presentation and flexibility of use and control, which explains why it outdoes other presentation modes such as books.

This study represents a preliminary effort to empirically examine the effect of CAI on university students’ learning of English in the Kingdom of Saudi Arabia. Further research is needed for a thorough understanding of this issue and for the confirmation of its findings. This is especially true when conducting research with more variables than those in the present study. It is also recommended that this study be replicated with a larger number of participants and over the whole semester or the whole year. In addition, it would be interesting to compare results across levels of proficiency as well as gender. Researchers are further recommended to study the effect of using computer on the school students’ learning of English.

Objective of the study: The purpose of this study was to design and develop a Computer assisted instructional module and to investigate its effects on students' attitudes and achievement in matrices and transformations. The study was investigated under four questions: (1) What are the effects of the CAI module on students' achievement in matrices and transformations? (2) Is there any significant difference in the achievement on matrices and transformations between subjects exposed to CAI module and those not? (3) What are the effects of the CAI module on students' attitudes towards Mathematics course? (4) Is there any significant difference in attitudes towards lessons on matrices and transformations between subjects exposed to CAI module and those not?

Research design: The quasi-experimental research was designed, to see the effect of Computer Assisted Instruction (CAI) on students’ attitude and achievement in Matrics and transformation between form four students who received instruction using CAI module or conventional instruction method. Computer assisted instruction (CAI) was applied to the experimental group and conventional method was given to the control group.

Tool used in the study: The Mathematics achievement test (MAT) and the students’ Questionnaire (SQ) were the main instruments. The MAT instrument assessed the Students’ achievement on the concepts of matrices and transformations while SQ assessed their attitudes. Piloting of MAT and SQ gave Cronbach α coefficient of 0.72 and 0.8 respectively. The other was the students’ interview guide.

Sample of the study: The target population of this three – week research study was form four students from schools offering computer studies. The rationale for this criterion was to have students who are homogeneous in their knowledge and operation of the computer. The assumption was that prior computer use was necessary to enhance student learning with the CAI module. The students were drawn from Uasin Gishu district. Six classes from six schools were selected through cluster random sampling. In situations where there was more than one stream in the school, one stream was selected at random.

Seventeen schools that met the criterion were categorised into Boys’, Girls’ and mixed. For each category of school type, two schools were randomly selected. Eventually,
the two treatments (CAI and Conventional instruction) were assigned at random to each of the two schools in each category.

As a result, 205 students, 105 in experimental groups and 100 in control groups participated in the study. 117 students were male and 88 were female. The Mathematics teacher in each of these classes was assigned to teach their class. Three teachers were trained on how to implement the CAI module.

**Technique of analysis of data**: Mean (\(\bar{X}\)), Standard Deviation (S.D.), ANCOVA, t-test, were employed for analysis of data. All statistical significance were tested at alpha = 0.05 level. Analyses of the pretest achievement and attitude scores were conducted to establish the homogeneity of subject groups.

**Major findings**: The results of the study revealed that the factorial ANOVA of achievement revealed not statistically significant difference for the main and interaction effects and school type. Also a 2 x 2 x 3 factorial ANOVA of attitude revealed not statistically significant difference for both main and interaction effects and School Type. These analyses indicated that the subjects were homogeneous in Mathematics achievement and attitude on pretest scores.

The results of this study also indicated that there was a significant difference in the Mathematics achievement and attitude of students. These indicate the need for teachers to provide opportunities for all students to engage in CAI groups in Mathematics. It is not suggested here that all Mathematics content be studied using CAI mode, however, Mathematics educators are encouraged to recognize the effectiveness and benefits of this alternative approach and to structure more CAI lessons in their classrooms. A possible explanation for the effectiveness of CAI learning in this study involves students’ active involvement in the learning process through frequent and student-machine interaction. However, differences were found according to gender within treatment groups.

**STUDY 11**: Effect of Computer Assisted Instruction (CAI) on Science Achievement of Higher Primary Students. (Mohammad Reza Iravani and Hadi Delfechresh: 2011)

**Objective of the study**: The purpose of this study was to bring a definition of CAI and types of it. Also due to importance of CAI in teaching and learning process and more clearly on academic achievement of students, it has done the teaching by CAI software
package in science subject for 3 months and in higher primary schools. The study was to investigate the effect of CAI academic achievement in science subject of student in experimental group and control group.

**Research design:** The quasi-experimental research was designed, to see the effect of Computer Assisted Instruction (CAI) on academic achievement in science subject between students who received instruction using CAI and conventional instruction method. Computer assisted instruction (CAI) was applied to the experimental group and conventional method was given to the control group.

In this study 8 standard students (boys and girls) were selected for exposure to the CAI software package in Science subject, in the control group students had taught by traditional method which was teacher, class and chalk, blackboard, but the experimental group had taught by CAI software package. In order to study the effectiveness of the developed CAI two types of research design were utilized. Two groups, control group and experimental group randomly selected for boys’ school design and two groups Pre-test and Post-test in science achievement in control group and experimental group for girls’ school design. The pre-achievement scores in science of students in pervious semester and non-verbal intelligence test scores (SPM) have been obtained as co-variates for this research study. The educational software in science subject was referred to a software program which was included an explanation of all contents of science subject textbook with animation, description of examples and answer all practical questions, self – evaluation for each part of textbook at the end, questions samples for final exam at the end of the textbook and some entertainment in forms of game, conversation, story and drill. This was noticed to be known that the educational software was used in this study had been created in association with ministry of education in Iran and all higher primary schools (middle) are using this software to teach science along with teaching teacher in the classroom. This software has been created by ministry of education and no one before has used it for its research and firmly has approved by educational technology experts.

**Tool used in the study:** The Computer Assisted Instruction (CAI) on science subject was the main instrument. The science achievement test was used as instrument to assess the Students’ achievement.
Sample of the study: The sample of this three months research study was 200 higher primary students (boys and girls) of Ahwaz city in Iran. It has collected around 200 academic achievement scores in science subject in form of pre-test and post-test from two different groups (control and experimental group). Pre-achievement scores in science in previous semester and non verbal intelligence scores have obtained as co-variates for the study.

Technique of analysis of data: Mean ($\overline{X}$), Standard Deviation (S.D.), ANCOVA, t-test, were employed for analysis of data.

Major findings: The results of the study revealed that the mean scores of post-test in experiment group is greater than post-test of control group. The result from an ANCOVA analysis include data on the post-test science achievement scores for the experimental and control groups after using the pre-achievement scores in science in previous semester and non verbal intelligence (SPM) as co-variates. Data indicated that the gain scores of students in the experimental group were significantly higher than the control group.

It can be concluded that CAI software package has effect on academic achievement in science subject of students in experimental group and scores of students in experimental group were higher than the students who were teaching by traditional method in control group and also the results revealed that there is no significant difference between boys and girls in academic achievement scores in science of experimental group after implement the CAI software package teaching method and both of two groups have been got higher scores in science subject.


Objective of the study: The study investigated the effect of Computer Assisted Instruction (CAI) on Junior Secondary School Students’ achievement in Social Studies. The study equally examined the interaction effects of treatment of academic ability on students’ achievement in Social Studies.

Research design: The study makes use of 2 x 2 randomized pre-test, post-test factorial design in a quasi-experimental setting. Two research assistants were trained on how to use the instruments. SSAT and SAAT were administered on the experimental and control
groups prior to the instruction. The scores obtained after administering SSAT served as pre-
test while the scores obtained from SAAT was used to classify the students into high and low
ability groups. The students who scored below the mean score in SAAT are classified as low
ability students while those whose score range between mean score and above were
classified as high ability students.

The students in the two groups were taught three topics: (i) Leadership and
followership (ii) Science and Technology and (iii) Transport and communication, the
experimental group with the use of Computer Assisted Instruction (CAI) and the control group
with the use of conventional method. At the end of the six weeks the post-test in Social
Studies achievement was administered on the two groups.

**Tool used in the study**: Four major instruments were used in the study. These
include:

(a) Social Studies Achievement Test (SSAT). This is a 60-item multiple choice
test. It covers three levels of cognitive domain i.e. knowledge comprehension and
application. This instrument has a reliability estimate of 0.87.

instructional package for the purpose of instruction in the classroom. The instructor guide
which contain three major topics in Social Studies: (i) Leadership and followership (ii) Science
and Technology and (iii) Transport and communication. The programmed Computer Assisted
Instruction consists of a lesson plan for each lesson, and each of the lesson plan contains
specifics such as: subject, content (topic), objective to be achieved at the end of the
instruction, instructional materials, and assessment. The CAIGSS has a reliability value of
0.79.

(c) Teacher Operational Guide for Social Studies Instructional (TOGSSI) The teacher Operational Guide for Social Studies is an instructional guide employed in
teaching the control group by utilizing the conventional method of teaching. It consists of
lesson plan written for each lesson. Each of the lesson plans contains specifics like:
subject, content (topic), objective to be achieved at the end of the instruction, instructional
materials, specific activities, and assessment. The TOGSSI has reliability coefficient of 0.71.
(d) Students’ Academic Ability Test (SAAT) consisted of 30-item multiple choice achievement test with five options per item A to E which the students were to choose the correct option. The SAAT has reliability coefficient of 0.78.

Sample of the study Simple random sampling was employed in selecting four co-educational schools from Ife Central and Osogbo Local Government Areas. Simple random sampling was employed in selecting 40 students in each of the schools selected. In all, 160 students constituted the sample for the study. Subjects were therefore classified into the experimental and control groups.

Technique of analysis of data: A two-way Analysis of Covariance (ANCOVA) was used to analyze the data obtained. Normally, one would have used a t-test analysis to compare the experimental and control group; and at the same time use t-test to compare low and high students’ academic ability, but this study is also interested in interaction effect which could only be carried out with the use of ANCOVA.

Major findings: The results of the study revealed that:

(1) There is no significant main effect of treatment (Computer Assisted Instruction and Conventional Methods) on student achievement in Social Studies.

(2) There is significant main effect of academic ability on students’ achievement in Social Studies. The high academic ability students were significantly better than the low ability students in their achievement in Social Studies.

(3) The findings further revealed that there is no significant interaction effect of treatment and students’ academic ability in their achievement in Social Studies.

STUDY 13: The Development Computer Assisted Instruction (CAI) on Introduction to Programming Subject. (Suwanna Sombunsukho et al, 2011)

Objectives of the study: The purposes of the research were to:

(1) analyze design and development computer assisted instruction on introduction to programming subject;

(2) to evaluate the efficiency of package;

(3) to evaluate learning effectiveness from education computer instructional Package;

(4) to determine learners satisfaction towards the package.
**Research design**: This study proposed to develop a computer instructional package with several components of the teaching and test its effectiveness. A computer instructional package for introduction to computer programming class created by the process of developing lessons IMMCI: Interactive Multimedia Compute Instruction, which is in accordance with the guidelines of the Faculty of Industrial Education and Technology, King Mongkut’s University of Technology under the following details.

1. Basic content analysis (Analysis Content) used as a guideline to develop a computer instructional package for introduction to computer programming class. In order to develop the package for student who want to learn on their own, it needs brainstorming chart (Brain Storm) based on three technical knowledge experts in programming. The corresponding subheading based on the relationship of the content of each is determined. Created concept chart based on the accuracy of the content as a way to cut or raise topics rational logic of the content. Used to create charts, network content (Content Network Chart) by bringing the subject headings from a chart to write a relationship network. Then, the researcher analyzed the relationship of the content by means of network analysis (Network Analysis) to complete.

2. Design Stage. Develop presentation of the strategies, objectives of the content and then create a chart presented on each page of the lesson.

3. Learning process. Determine framework which detailing the contents of the lessons in each frame, the priority content and then writing the details in order of the presentation as specified. In this step, the frame content is printed then checks the accuracy of all content by experts.

4. Presentation stage. (Implementation) is a development stage of the lesson. Researchers used multimedia presentations in the form of letters, pictures, sounds, music and narration for lesson presentation.

5. Evaluation by submission to the experts to assess the quality of multimedia technology, and then assess the user satisfaction with the sample group. The tested for effectiveness and efficiency of learning used the following test: the end of the lesson test in order to find efficiency E1/E2 and Pretests and posttest to find effectiveness of learning achievement.
**Tool used in the study:** The research tools were:

1. the computer assisted instruction on introduction to programming subject;
2. the achievement tests;
3. the questionnaire of learners satisfaction.

Data collection methods are one by given the achievement tests, pretest and posttest to student who using the package. Then, students are given the questionnaire regarding the satisfaction.

**Sample of the study:** The research sampling group was 30 students. The research results revealed that the efficiency was higher than a criteria set 84.33/86.92, which was higher the criteria of 80/80. After analyzing the pre-test and post-test scores for the effectiveness, the computer instructional package could increase the learning effectiveness with 64.33 which is as the provided value not less than 60. And the mean value of learner’s satisfaction was rather high at 4.39. It can be conclude that the Computer Instruction Package was good enough to be used as self study package.

**Technique of analysis of data:** For data analysis, the statistics for determining the difficulty (p) the discrimination (D), the reliability of the test were used. The analysis of the effectiveness of the computer instructional package calculated by the formula E1 / E2 refers to the efficiency of retention of learning and the criteria set at 80/80.

**Major findings:** This research was to develop the Computer Assisted Instruction (CAI) on the Structure of Computer System for higher vocational degree students majoring in Computer Business. The research result was that the effectiveness of the lesson was 84.33/86.92, higher than the criteria set at 80/80. When the effectiveness after the treatment E2 was considered and found to be 86.92 and then it was compared with the effectiveness during the treatment E1 which was 84.33, it was found that the test during the treatment was higher than the test after the treatment.

When the effectiveness during and after the study in each learning unit was considered, it was found that in Learning Unit 1, the effectiveness during the treatment E1 was 85.33, lower than the effectiveness after the treatment E2 which was 86.92. In Learning Unit 2, the effectiveness during the treatment E1 was 83.00, lower than the effectiveness after the treatment E2 which was 86.92. In Learning Unit 3, the effectiveness during the treatment E1 was 84.67, lower than the effectiveness after the treatment E2 which
was 86.92. This was probably because the contents in all 3 learning units were complicated. The subject was about the operation and the structure of computer system. When learners took the post-test, they got lower score points on average. However, the score was acceptable. Another reason was because the test after the treatment consisted of randomly selected questions which the learners understood well, resulting in learners doing better than during the treatment. Perhaps the students understood the lesson in average because it was due to the retention of the contents, resulting in good memory and higher score for the post-test than test during the study. When the Standard Deviation (SD) was considered, it was found that the SD of the test before the study was 2.01 and the SD of the test after the study was 2.56. This means that the SD of the test before and after the test was different. It could be concluded from the average score that the average score before the study was different from the average score after the study. The developed lesson was effective, increasing the learning achievement by 64.33. Therefore, the Computer Assisted Instruction on the Structure of Computer System for higher vocational degree students majoring in Computer Business could be used for instruction.

2.4 Summary

The second chapter discussed about the effectiveness of Computer Assisted Instruction (CAI) on the learning achievement.

The effectiveness of computer assisted instruction (CAI) on the learning achievement refers to the ability of computer assisted instruction (CAI) to accomplish a learning purpose in the career and technology subject for 10th grade students. The learning achievement scores were obtained from the learning achievement test for 10th grade students, before and after instructed by computer assisted instruction (CAI) in career technology subject (learning substance: electronic title “Multi-Meter”). This includes the power or the degree to be effective and the quality of being able to bring about the highest level of students’ learning achievement in knowledge, skills and attitudes or desirable performance.

The computer assisted instruction (CAI) in the present study is a form of learning that utilizes computers, and is typically intended as a way to supplement traditional teacher-based learning. The researcher attempts to present this research on
the effectiveness of computer assisted instruction (CAI) as a teaching tool, especially as it impacts on the learning achievement. This study aims to find out whether or not CAI can be effectively utilized for teaching and the eleventh grade students’ learning achievement in career and technology subject.

Thirteen past studies are reviewed in order to make sure that the present research is not repeating the work that someone has already done earlier. The researcher can get more information and ideas that relevant to research work. After viewing the past researches, it can be seen 13 past research studies on the effectiveness of Computer Assisted Instruction (CAI) on the learning achievement in reading, Science, Mathematics, social studies and occupation subjects.

The present research studies the effectiveness of Computer Assisted Instruction (CAI) on the learning achievement in Career and Technology subject which was not appearance in any research. Therefore, this research is a unique research or only one research which indicates the effectiveness of Computer Assisted Instruction (CAI) on the learning achievement in Career and Technology subject. The learning achievement of 10th grade students is the dependent variables of the present study whereas the Computer Assisted Instruction (CAI) on the learning achievement in Career and Technology subject is the independent variables.

In order to go for data collection, plan & procedure as well as the development of the Computer Assisted Instruction (CAI) on the learning achievement in Career and Technology subject will be described in chapter 3.
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