Evaluation of Some Educational Computer -Based Instruction Programs

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***Abstract*- Computer-Based Instruction (CBI) is an emerging way of using a computer in the teaching-learning process. In CBI teaching-learning activities can be demonstrated either in a stand-alone computer or on a computer which has been designed to reinforce materials that have been taught by instructors. For the last few decades, CBI has had a positive effect in the teaching-learning process, and typically yielding higher achievements at all levels in the developed countries. Thus, the teachers and educators of underdeveloped and developing countries should utilize it to get the maximum benefit of this emerging technology. This paper starts with the illustration of the basic concept, components, models, and effectiveness of CBI in teaching-learning process. Based on these understandings, the study evaluates four educational CBI programs that seem to be useful and model programs. Finally, it ends up with some discussion, implication, and concluding statements.**

Keywords- CAL; CBI; CBI Model; Computer Aided Instruction; Computer-Based Instruction

I. INTRODUCTION

There are a variety of terminologies used to describe the educational use of a computer, and each has a slightly different meaning. Computer-Based Instruction (CBI), a newer term than Computer Aided Learning (CAL), is an educational innovation of using a computer for teaching and learning purposes that present many difficult issues for teachers and educators. The term CBI is used primarily in the United States, while CAL is often used in Asian and European countries including the United Kingdom [17]. CBI demonstrates using computer application programs and computer connected machines, to simulate the computer as an instructor. It is almost similar to Computer Assister Instruction (CAI) which demonstrates some interactions while using computer, application programs and computer connected machines. However, there are differences between CBI and CAL. The PowerPoint Program, a very usual presentation tool, can be used in both processes.

This study is conducted based on the constructivist learning theory developed by the distinguished childhood psychologist Jean Piaget's (1896–1980). The constructivist theory urges that young students build their knowledge through interactions between their previous experiences and existing ideas [21]. Constructivism offers promising new approaches to self-learning [5]. In CBI programs, like in an interactive math game, constructivist theory is applied explicitly in the sense that a student plays an active role in solving simple math puzzles and reaching to harder problems to achieve bonus or more points. Passion of achieving highest points in such a math game creates an attraction and competition to the young mind. In such an activity, a teacher can act as a supervisor who just guides the students to initiate the game and provides support, only if needed. Thus, learning may take place in context while the control over the learning process shifts from the teacher to the students [3]. In CBI programs students become self-motivated to engage themselves inside and outside the classroom. Interactive features of CBI programs motivate students to spend and enjoy tireless hours in using these programs. However, an addiction to inappropriate CBI programs can abuse young students' valuable time without giving them any essential gain [24]. Given emphasis on these features, many educational commentators argue that effective CBI programs can offer great potential for supporting students' learning [11]. Thus, it has become a recent quest to the instructors to select appropriate CBI programs that must be appropriate for the students for effective learning. The purpose of this paper is to explore the definition, components, models, and effectiveness of CBI in the teaching-learning process.

II. WHAT IS CBI?

The process in which a computer delivers some instructional materials to its users is simply termed as Computer-Based Instruction (CBI). In a broad sense CBI can be referred to as any type of computer used for the educational purposes. The term can refer to either teaching-learning activities with a stand-alone computer or activities on the computer which have been designed to reinforce materials that have been taught by teachers [10]. CBI is designed mainly to teach its users (students) as an informative and interactive tool by keeping them engaged and making them active participant. It also allows teachers to stretch beyond their own knowledge and have them provide more facilities and information in an interactive infrastructure. CBI could be very helpful when students are at different levels of learning regarding the content.

III. COMPONENTS OF CBI

According to [4], Computer-Based Instruction has traditionally been composed of four main components: Drill and

Practice, Tutorials, Games, and Simulation and Modeling. Moreover, modern technologies such as: Hypertext, Hypermedia, Multimedia, and Animation are added as new and interactive components of CBI.

Drill and Practice programs usually deal with materials that have already been presented by the instructors. In these programs students are given a task, often selected randomly, and feedback is given immediately after it is completed. Drill and Practice is mainly used for beginners or for those students who are experiencing difficulties and get benefit from the repetition. A well-constructed program of this type should be able to keep pace with the students by offering remedial or advanced level if and when they recursion [13]. Thus, their use should be kept to situations where the teacher is certain that they are most beneficial for instruction. In the early days of the educational use of computers, Drill and Practice was probably the most extensively used CBI application.

According to [4], It can be argued that there were two main reasons for this; (1) they were comparatively easy to program, which was important as there was little available commercial software and so teachers who wished to use computers often had to write much of the software themselves; (2) the programs could show off effectively the capabilities of the computer and this was important for the computer-enthusiast teacher as it could help to win over colleagues to the cause, and hopefully, result in more money being spent on computers in schools.

CBI Tutorials attempt to teach new materials to students. They typically present information, and then question the students to determine their level of understanding. CBI Tutorials are able to monitor the students' progress and to present remedial or advanced level of assessment, if needed. However, from the practical point of view tutorials have limitation in their ability to assess the level of students' understanding. For example, a teacher can accept a partially correct answer, and let the student to probe deeper to get the correct one; however, a computer cannot cope with even a slightly wrong answer. But, a tutorial program is only capable of responding to the answer given, usually by typing characters on a keyboard of clicking on an answer choice. In the classroom situation, when teachers ask questions, they can assess their students' level of understanding of the topic, and the degree of comfort with the material, etc., by not only listening to the answer given, but also by observing the body language of the students, and the speed with which the answer is given, and so on. While a lot of researches have been conducted in producing Intelligent Tutoring Systems that should overcome this problem; however, educationalists have apprehension about the possibility of true type intelligent Tutorials.

Educational Games are basically computer games that help students to build their higher-level thinking skills through simulating with some imaginary situations, stories or scenarios. A Game, and a Drill and Practice program possibly have same content, but they may reach different end results. Educational Games have a place to play in the classroom especially as a way of increasing students' motivation level. Educational Games have tremendous contribution to different aspects of students' development. However, there is an even stronger anxiety that computer games have negative social and cognitive effects on children. So, they should be used with care as many students, especially teenagers, spend a lot of time playing games, and it is important to restrict the classroom computers for playing games.

Simulation programs allow students to model real-life situations, and allow them to manipulate and experiment with them. There exist some simulation and modelling programs for the students in which they solve problems - and thus learn to think in the ways innovative and creative thinkers do. The major difference between a computer game and a simulation program is that a computer game normally models an imaginary situation whereas a simulation program models a real-life situation. They are normally used in situations where the real object is too hazardous, too time-consuming, or too expensive. For instance, students would not normally be able to observe the evolution of a species, e. g, dinosaur, as it would take too long; however, they could observe the whole process in a short period of time on a simulation program.

IV. CBI DESIGN MODELS

There are three different CBI design models: Lineal, Modular, and Hyperchoice. Each of them has advantages and disadvantages over each other. Some places of the design require text description (Linear fashion); some places require step by step progression (Modular fashion); and in other places students are asked to go to related linked pages for more information (Hyperchoice fashion). Which of the designing models should be used completely depends on the nature and features of the problem. While designing a simple CBI program, it is effective to use linear model (e.g. how to use a microwave oven in heating food), as it is the simplest. However, while designing a lengthy, complicated or informative CBI design, (e.g. how to design and upload a personal web page) modular or hyperchoice models will be more appropriate. As technology based tools are improving day by day, it is a common phenomenon to get influenced by the newer models.

V. ADVANTAGES OF CBI

By using a CBI program, students start to learn through the use of tutorials, continue to learn through guided practice, add to their understanding by watching animations or running simulations, enjoy applying the learned material by playing games, and finally show that they have learned the material by taking tests.

According to the Multimedia Science, Science Software by [19], some of the advantages of CBI are:

- Students can learn at their own pace.

- Learning becomes more student-centered.
- Students become more independent as learners.
- Teachers have more time to facilitate and answer students' questions.
- Students receive immediate feedback and teachers can see the test results [19].

VI. EFFECTIVENESS OF CBI IN TEACHING-LEARNING PROCESS

Numerous studies are conducted to measure the effectiveness of CBI in teaching-learning process. Studies have looked at the various types of CBI, and a variety of educational subjects in which CBI is being used. The overall findings have reported the idea that the use of computer-based education, as a supplement of tutor-directed instruction, produces substantially higher student achievement than traditional teaching on its own. One meta-analysis examined 32 classroom-based studies that quantitatively compared the results of instruction with the computer to a traditional classroom [2]. The analysis concluded that CBI generally increased the achievement levels of elementary students. A subsequent meta-analysis of 254 studies, which looked at the effects of CBI on achievement, confirmed the findings that CBI had a positive effect on students [15]. The studies included participants from kindergarten to college students.

Another meta-analysis, based on the analysis of the 59 research reports, suggests that the use of computer-based instruction, as a supplement to conventional instruction, produces higher achievement than the use of conventional instruction alone; students learn material faster, and retain what they have learned better with CBI than with conventional instruction alone; and the use of CBI leads to more positive attitudes toward computers, course content, quality of instruction, school in general, and self-as-learner than the use of conventional instruction alone. Economically disadvantaged students become more benefited from CBI than students from higher socio-economic background. CBI is more beneficial with lower-achieving students than higher-achieving ones, and for younger students than older ones. Therefore, CBI has slightly greater effects with science and mathematics content than with regarding language and art. However, there are no significant differences in the effectiveness of CBI with male and female students [10].

One research on "The learning value of computer-based instruction of early reading skills" measured that children at high risk for learning disabilities, who received the intervention program with computer materials, significantly improved their phonological awareness, word recognition, and letter naming skills relative to their peers who received a reading intervention program with only printed materials and those who received no formal reading intervention program [18].

Another research on "Computer-based instruction for young Braille readers in mainstream education", evaluated that computers are most important as reading and writing tools for the young students which open up new possibilities for text editing in Braille. Using computer-based instruction students became more motivated and could, to a greater extend, do the same work as their peers sometimes even in co-operation in the classroom [12]. Another research finds that computerized training and testing programs have a significant learning effect on children having difficulties in learning pre-reading skills [8].

CBI can be used alone or supplement traditional classroom delivery and print-base materials. It can provide tests, practice, and exploration. Facts, concepts, and principles can be introduced, and then various practical activities and tests can be conducted using computers as instructional medium [9]. According to [4], teachers are achieving technological integration by using more CBI in their classrooms, due to the increased availability of less expensive hardware and software.

Thus, CBI has had a positive effect in the teaching-learning process, and typically yields higher achievements at all levels. So teachers and educators should utilize CBI to get the maximum benefit of this emerging technology. However, studies of computer usage in educational purposes indicated that computers are often used insufficiently [17]. So as with any innovation in curriculum and instruction, teachers must be aware of and plan for a variety of problems and promises concerning technological integration, particularly in CBI.

VII. METHODOLOGY

This paper starts with an extensive literature review of Computer-Based Instruction that illustrates the basic concept, components, models, and effectiveness of CBI in teaching-learning process. Based on the reviewed literature and some checklists that were developed and solely used for evaluating the effectiveness of computer-aided instructions as well as published in referred journals (such as: [16, 20, 22] the authors developed a "Checklist" (see the Appendix) to evaluate any standard CBI program. The checklist is formed with four major sections: Information, Design of Information, Technology, and Design of Technology-Use. Each section is comprised of eight independent criteria; and each of the criteria is scored with a number 1 to 5 scale with 1 being lower score and 5 being higher score. Thus, a maximum of 40 score is possible for each of the four sections that yield a maximum of 160 score for the entire checklist.

The Information section was designed to evaluate a CBI program in terms of its language, resources, and designer's information level. The Design of Information section was designed to evaluate a CBI program in terms of its activity goals/objectives, targeted grade level, level of thinking, closeness of resources related to the task/activities, requirements of assignments/exercise that match main objectives, and evaluation criteria that match the activity processes and objectives. The

Technology section was designed to measure whether the screen layout is balanced, and graphics are positioned appropriately, easiness of finding user's location within the program, finding the stop and way to exit options, help or assistance instructions, download or print options, and how friendly the interactions between user and the program. Finally, the Design of Technology-use section was designed to measure whether the CBI web is appropriate for performing this activity; technology skills needed for the activity match learners' developmental level; interface design is appropriate to the grade level and the topic/subject area; organization of resource links matches the activity processes; use of multimedia matches the objectives of the activity; the interactions are designed to meet the learning objectives; and mapping of the contents and activities is available.

Validity of the checklist was measured through the face validity process. To do this, the checklist was given to four middle to high school teachers who have practical experience in using computer-based instructions in their classroom teaching. Those four reviewers were given an initial checklist of 48 items; 12 items for each if the four major sections of: Information, Design of Information, Technology, and Design of Technology-Use. They were asked to determine whether each item was appropriate for measuring effectiveness of a CBI program or not. Only items on which at least three out of four teachers agreed were appropriate for measuring effectiveness of a CBI program were considered acceptable for use on the final checklist. Based on these criteria, 8, 9, 8, and 9 items in the Information, Design of Information, Technology, and Design of Technology-Use sections, respectively were found as having at least three out of four reviewers' agreement as appropriate for measuring effectiveness of a CBI program. However, to maintain consistency of the checklist first 8 items from each of the four sections were deemed appropriate for this study. However, due to the simplicity of the study validity of the study was not measured-that could be considered as a limitation of this study.

VIII. EVALUATION REPORT

According to the above guidelines, four CBI programs that seemed to be more appropriate for the elementary to middle school levels were evaluated in this study. Table 1 shows the scores obtained in the evaluation process for each of the CBI programs. Figure 1 shows the graphical representation of the evaluated scores.

TABLE 1 SCORE OBTAINED IN THE EVALUATION PROCESS

CBI Program		Information (40)	Design of Info. (40)	Technology (40)	Design of Tech-Use (40)	Total (160)
1.	Math Game	40	38	38	40	156
2.	Swim Workout	39	38	38	38	153
3.	Shortest Distance	40	38	39	40	157
4.	Digital Storytelling	40	40	40	40	160

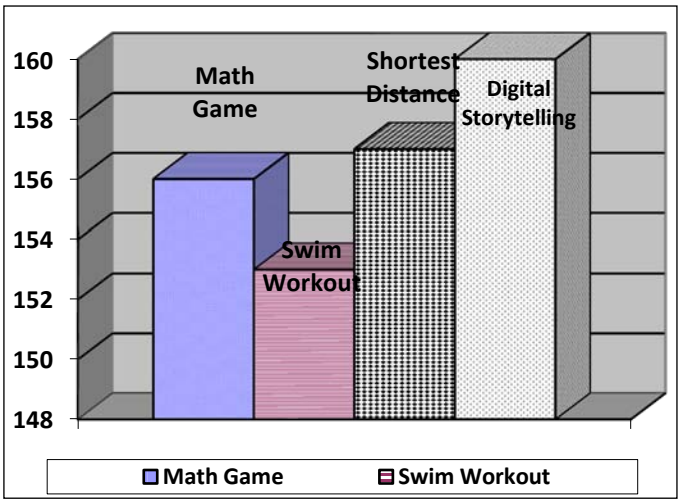

Fig.1 Graphical representation of the evaluated scores

Math Game was the first CBI program that was evaluated in this study. It is available at: http://www.sheppardsoftware.com/mathgames/mathman/mathman.htm. This is an excellent CBI website on "How to practice arithmetic while gaming". It provides enjoyable events and interactive techniques to practice various mathematical calculations. Teachers of elementary schools can use this program to practice simple mathematical calculations, like: addition, subtraction, multiplication, division, and simplification calculations to the young children, in the manner of gaming. It has an interactive graphical interface, and easy to play access. Students at very elementary levels can enjoy this game.

Through the evaluation process it obtained 40 points in the Information section, 38 points in the Design of Information section, 38 points in the Technology section and 40 points in the Design of Technology Use section – thus, a total of 156 points

out of 160 possibly highest points. Overall, it is designed with adequate number of information and technology, and their balanced used. When testing this program for evaluation, we were very much fascinated in its design techniques, use of information, and simplification of instructions. It really encouraged us to develop new CBI programs in future.

Introduction to Swim Workout was the second CBI program that was evaluated in this study. It is available at: http://ruthkazez.com/IntroToSwimWorkouts.html. This is an excellent CBI website on "How to learn Swimming". It provides full instruction to its readers to learn how to learn swimming. Its instructional descriptions sequences are really helpful to simulate swimming. It provides instructions of different kinds of swimming techniques, and guidelines to be a champion in swimming. Its instructional pictorial descriptions are really helpful to simulate swimming. Its PowerPoint presentation provides a lot of images of swimming.

Through the evaluation process it obtained 39 points in the Information section, 38 points in the Design of Information section, 38 points in the Technology section and 38 points in the Design of Technology Use section – thus, a total of 153 points out of 160 possibly highest points. Overall, it is designed with adequate number of images, and descriptions. When testing this program for evaluation, we were very much encouraged in its design techniques that helped us to gain a lot of new ideas to design such a CBI program.

Shortest Distance between two points on a plane was the third CBI program that was evaluated in this study. It is available at: http://members.tripod.com/~Paul_Kirby/vector/Vclose.html. This is also an excellent CBI website on "How to find out Shortest Distance between two Points on a Plane". This program provides a clear idea of representing points on a three-dimensional sphere, and the way to calculate shortest distance between the points on the sphere. It has been designed mainly for the students of middle or high school levels. However, students higher than these grades may be also benefited by using it. It has three-dimensional graphical representations of points, and vectors that really made it clear to understand, and to find out shortest distance between any two pair of points.

Through the evaluation process it obtained 40 points in the Information section, 38 points in the Design of Information section, 39 points in the Technology section and 40 points in the Design of Technology Use section – thus, a total of 157 points out of 160 possibly highest points. Overall, it is designed with adequate number of images, and descriptions. Its design techniques with sufficient information, and use of technology encouraged us to assess it as an excellent CBI program. When we were testing this program for its evaluation, we recalled our past times when we were college students, and spent how much time in understanding shortest distance between two points on a plane.

How to Create a Digital Story was the fourth and final CBI program that was evaluated in this study. It is available at: http://courseweb.lis.illinois.edu/~jevogel2/lis506/howto.html. This is another excellent CBI website on "How to Create a Digital Story". It provides step by step instruction to design a Digital Storytelling program. Students/Users/Storywriters of advanced level in using Information Technology definitely will be benefited by this program to make digital story with the composition of personal/family photographs, recorded voice narrations and multi-media productions.

Through the evaluation process it obtained full points, 40 out of 40, in all of the four sections– thus, a total of 160 points out of 160 possibly highest points. Overall, it has an interactive graphical interface, and some relevant examples of digital storytelling programs, and list of necessary resources needed for making such a program. Its designed techniques with adequate number of information and use of technology really encouraged us to explore and evaluate more CBI programs.

IX. DISCUSSION AND IMPLICATIONS

In these days, CBI is becoming more prevalent in educational purposes not only in the United States, but also in almost all other countries in the world. Research has found a vast number of benefits in the use of CBI. Some of these notable benefits are that with effective CBI programs students themselves can learn at their own pace, and so the learning atmosphere with CBI program is more convenient and comfortable for the students than that in traditional classroom settings. Using computers to deliver uniformed and appropriate instruction can help to correct inequalities in educational opportunities that exist due to race/ethnicity, budget constraints, geographical location, household income and expenditure, school size, teachers' quality and experience, etc. [14]. This might be more appropriate for the classrooms in the developing and underdeveloped countries where the class size is very large and the study materials used for classroom instructions are very limited. Lack of technology savvy teachers is a common phenomenon in these classrooms. Students in such classrooms become deprived to having uniform and appropriate instructions by their instructors. Moreover, these groups of students are more likely to lack computer facilities in their homes. Use of CBI programs could be helpful for these types of unprivileged teachers and students to meet some sorts of their teaching-learning aids demands.

Research shows that young students in the developed countries spend a lot of time with computer, Internet, and mobile devices [7, 16] Text messaging, video watching, online games, and many social networking activities have become integral parts of their daily lives [1, 23]. These young students come to the classrooms with their intention of using computer and Internet for their classroom instructions. Due to their inclination to computer and Internet, classroom instruction using the backdated duster and chalk or marker might not be sufficient to meet their needs. Computer-based instruction could be considered as the technological phenomenon to revolutionize in the classroom teaching for the new generation of technology

inclined students. The study finds that CBI in secondary education has the potential to solve some of these problems faced at the schools in Illinois and Florida. Likely, use of CBI can meet many essential and expected demands of other schools especially in the elementary to high schools levels. This might be more appropriate for the schools in the developing and underdeveloped countries.

Today, the Internet and computer technology are reported to have significantly altered the educational landscape. The rapid advances in technology, the need for lifelong learning, and the growth of non-traditional students have encouraged the use of the computer as a method of instructional delivery. CBI programs could play important roles in these purposes. Instruction time is often less with the computer, and students tend to have a more positive attitude toward courses that include computer-based instruction. However, CBI is a complex application. In an effective CBI program, computer takes over driving role from the teacher in providing the learner with drill, practice, and revision, as well as testing and diagnosis. The form of the teaching may be simply linear or branching, or it can be extended to thinking and problem solving by simulation. The checklist used in this study could be an effective tool for classroom teachers to select effective and appropriate CBI programs for their students and classroom instructions. The checklist is open, anyone can use it as is or can modify or update it for further improvement.

X. CONCLUSIONS

Computer-Based Instruction (CBI) is an emerging way of using a computer in the teaching-learning process. Effective CBI programs are useful for developing young students' constructive learning skills. Interactive features of CBI programs motivate students to spend and enjoy hours after hours in using these programs. However, there is a possibility that ineffective CBI programs can be used to abuse valuable classroom instruction hours. There are tons of CBI programs available online; however, many of them are misleading and not appropriate and effective for all kinds of teachers and students. Teachers in a computer-assisted classroom have little but significant role in selecting effective and appropriate CBI programs for their students. There exist some parameters that determine the effectiveness of a CBI program. Although, this study has evaluated only a limited number of CBI programs, the evaluation report and the overall evaluation procedure may encourage the instructional designers to design new and more interactive CBI programs, that will be very helpful to expertise their teaching-learning skills.

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APPENDIX: CBI EVALUATION CHECKLIST

CBI Software title: _____

URL of the CBI: _____

Instruction: For each item, please cross out only one of 1 to 5 scores, where 5 is the highest possible score.

a) Information: (Section's Sub-total Score: 40)

Score Graded on Criteria	1	2	3	4	5
1. Language is accurate					
2. Language is easy to understand					
3. Language is error free					
4. Language and materials are at the identified grade level					
5. Resources are sufficient					
6. Resources are updated					
7. Materials and resources are verifiable					
8. Designer's information is included					
Score Obtained:					

b) Design of Information: (Section's Sub-total Score: 40)

Score Graded on Criteria	1	2	3	4	5
1. Activity goals/objectives are clearly presented					
2. Task and processes are designed to achieve the goals/objectives					
3. Task and processes are designed for learners at the identified grade level					
4. Higher level thinking is engaged					
5. Processes are designed in a learner-oriented approach					
6. Resources are closely related to the task/activities					
7. Assignments/exercise requirements reflect the knowledge/skills that match objectives					
8. Evaluation criteria match the activity processes and objectives					
Score Obtained:					

c) Technology: (Section's Sub-total Score: 40)

Score Graded on Criteria	1	2	3	4	5
1. Screen layout is balanced, and graphics are positioned appropriately					
2. It is easy to find where you are in the program					
3. It is easy to find where you want to go within program					
4. Users can stop and find a way to exit when they need					
5. All resource links work well					
6. Help or assistance instructions are provided and easy to access					
7. Instruction materials can be downloaded or printed out in a clear layout					
8. Interactions between user and the program are user-friendly					
Score Obtained:					

d) Design of Technology-Use: (Section's Sub-total Score: 40)

Score Graded on Criteria	1	2	3	4	5
1. Web is appropriate for performing this activity.					
2. Technology skills needed for the activity match learners' developmental level					
3. Interface design is appropriate to the grade level and the topic/subject area					
4. Organization of resource links matches the activity processes					
5. Use of (multi-)media matches the objectives of the activity					
6. Design approach (linear or non-linear) matches task processes and objectives					
7. The interactions are designed to meet the learning objectives					
8. Mapping of the contents and activities is available					
Score Obtained:					