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A PROGRAM FOR UNDERSTANDING MATHEMATICAL PROBABILITY CONCEPTS IN SECONDARY SCHOOL KENYA

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ABSTRACT

The pace of technological development in educational setting is on the increase in Kenya. The literature is replete with studies indicating that Computer Based Instructional programs enhance students learning outcomes. With the introduction of e-learning in Kenyan schools now at the pilot stage, there is need to develop computer-based programs in the area of mathematics where little or no studies have been done.

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INTRODUCTION

The Computer-Based Instruction (CBI) is an area that has been recently lauded for its capability to foster the teaching of concepts and skills that are otherwise difficult to teach using the regular techniques (Kiboss, 2002; Tanui, 2003; Wanjala, 2005; Wati, 2011; Wekesa, 2003). The use of CBI is perceived to enhance students understanding of mathematical concepts. The computer can be a good instrument in fostering interpersonal relationships as well as creativity in students and in assisting teachers to effectively teach in a more successful manner. Computers can play a vital role in making the subject matter real, dynamic, and engaging for students. They can offer students a collaborative environment and the opportunity to explore and try out alternatives in problem solving. This study was therefore designed to explore the instructional potential of the CBI in mathematics instructional process on the topic of probability.

Rationale for Computers in Teaching Mathematics

The use of CBI is perceived to enhance students understanding of mathematical concepts.

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Computers can be a good instrument in fostering creativity in students, as instrumentally assisting teachers to effectively teach in a more successful manner and can improve student interpersonal relationships. Computers can play a vital role in making the subject matter real, dynamic, and engaging for students. They can offer students a collaborative environment and the opportunity to explore and try out alternatives. Computers also can receive and present information in a variety of forms (text, graphs, pictorial representations etc) and can allow users to manipulate the information in a variety of ways. They can also provide a positive and an enjoyable working/learning environment, in which interaction and discussion are permitted (http://www.Apple-Leadership in K-12Education.html.). Indeed, the use of CBI is therefore critical for its perceived role in ensuring that learners develop their intellectual and imaginative powers (creativity), enquiry, analytical and creative mind of approach to situations, understanding and judgment; problem solving skills; ability to see relationships within what they have learnt and they already know; ability to communicate mathematically; appreciation and enjoyment of mathematics by doing mathematics through a variety of appropriate mathematical activities. The increasing availability of electronic calculators and computers at low costs is of greatest significant for the teaching and learning of mathematics.

It is highly probable that computer and other new information technologies might influence the cost, management and availability and/or efficiency of the instructional delivery of mathematics to the large classrooms. The central concern of this study was to create a cost beneficial and appropriate CBI system that may provide a collaborative learning environment directed at rectifying the impoverished mathematics instruction in Kenyan secondary schools. In third world countries, particularly in Kenya, multimedia usage in teaching and learning is in its infancy stage (Kiboss, 2002; Wanjala, 2005, Wasike, 2013). Traditionally, a CBI is a powerful educational innovation that was conceived as a process of individualizing learning through the use of computer systems. The protagonist of this institution claims that CBI has great potential and promise to improve the students' cognitive, affective and psychomotor behaviours in the primary, secondary and tertiary levels (Blomeyer, 1991; Kulik and Kulik, 1991). In fact Allesi and Trollip (1991) have identified CBI methodologies as tutorial, drill and practice, simulation, instructional games and testing. This means that CBI does not only present information or message just like a book or video tape or television, but also controls the information during the teaching-learning process. According to Rosanshine and Stevens (1986) CBI has three main aspects namely presentation of information, guiding the learner and providing learner practice.

The use of computers in individualized instruction is lauded due to the capacity to control the large chunks of information and to make it possible for the individual learner to learn at their own pace, view learning as fun rather than an intimidating exercise, control their learning and repeat the program on request. The manner in which the learning environment is organized is critically important because learners might not learn all that is taught in a single exposure to teaching (using conventional methods of instruction). But the need to create conducive learning environment and to employ effective approaches is inevitable if learners' motivation and interests are to be sustained (Simpson and Oliver, 1990). This might entail the planning of activities, which may involve the use of interactive multimedia to support collaborative groupings that are likely to encourage each learner to interact directly with materials (Gavora and Hannafin, 1995). It is highly probable that the latest development of new information technology might bring about group oriented learning environment that can meet the need of large class (Kiboss, 1997; Makau, 1999: Tanui, 2003; Wanjala, 2005; Wati, 2011; Wekesa, 2003). This is because there are some challenges to be addressed through the CBI namely:

- Increased enrolment and hence large classes imply a much wider range of abilities and interests which must be catered for;
- Higher expectation from the public about the products of the educational systems for creativity and resourcefulness on the part of the teacher;
- The need to make mathematics learning an enjoyable activity;
- The fact that news media often open new channels of communication and experiences undreamt of in the past implies the need to develop new approaches to teaching method practices;
- The increasing demand for skilled labour e.g computer literacy suggest the need to expose learners to experiences which will equip them to meet such a challenge;
- The current emphasis which considers the teacher as a manager of learning environment rather than dissemination of knowledge warrants a closer attention;
- The emergence of the school as a learning resource center places enormous responsibility on the curriculum developers and researchers;
- Curriculum innovation demand new and creative teaching/learning methods etc.

Ensuing from the foregoing is the fact that mathematics as a subject needs a different approach rather than the conventional method of instruction. It is not that students are completely ignorant about the mathematical concepts; their ideas very often may be enormous or inadequate. Therefore, if mathematics teachers are to improve students' cognitive and affective abilities in mathematics, they must find out conceptual understanding held by CBI. Currently the problem to augment teaching with the available technological resources can no longer be ignored.

The New Pedagogy

Computer use unlike the traditional lesson where students sit passively and listen to the teacher, simplifies the otherwise mystic concepts in active classroom discourse (Makau, 1999). Students are also able to participate actively and simultaneously. They are again able to transcend the competency level of their teacher in that they will discover new things. This is possible because students using the computer can manipulate data and come up with some meaningful conclusion on their own and in doing this, they internalize the concepts taught in a lesson (Makau, 1999). When students use the computer, they can develop problem-solving skills necessary to solve scientific problems (Apple Computers Report, 2002). This approach can also provide a classroom environment that is rich in opportunities for cooperative learning, organized around the main themes with an abundance of interdisciplinary, real-world problems for students to tackle, and a shift of the learning responsibility to students. The use of computers in learning therefore epitomizes the new integrated pedagogy. According to Walkins and e (1994), this pedagogy recognizes the role of computers and related digital technologies in promotion of more active and productive learning.

Recent literature on the use of computers in learning mathematics and other subjects now focus on redefining pedagogic roles for teachers to include setting joint tasks with learners, promoting use of multi-media technologies and their affordance that enhance learning, promoting learners self-management and metacognition, scaffolding learning and collaborative learning (http://www.kfupm.edu.pdf). The CBI program takes care of these attributes. Research evidence shows that scaffolding is learning support where learners build knowledge and understanding by linking new concepts to the previous ones through a mental framework of linking concepts (http://www.kfupm.edu.pdf). This involves adjusting and extending instruction so that the learner is challenged and able to develop new ideas and skills. The teacher can scaffold learning to meet the needs of the learners by manipulating the task, materials, presentation so that they can analyze, evaluate and internalize what they learn. The computer program such as the CBI program in question is based on this premise.

On the other hand, affordances are properties of a system as perceived by the user which allow certain actions to be performed and encourage learning in a systematic and proactive manner (http://www.kfupm.edu.pdf) such as SMART boards and hopefully the CBI program. The use of a presentation program such as the CBI to display key points is of great benefit to many students. This is because presentation supports visual learners, by providing a clear understanding of the logic or structure of what is taught. It also reinforces the points of the talk that are important and better supports students with limited language skills and learning abilities (Apple Computers Report, 2002). The use of tutorial, simulations and games is reported not only to reinforce concepts, but also to permit the use of higher efficiency inherent in any instruction that is selected to meet the needs of an individual. They also tend to improve the effectiveness inherent in learning under conditions of active student participation (Kiboss, 1997). Besides, the arousal and maintenances of attention throughout the instructional process may be achieved by embedding the proper perception of the lesson elements into the CBI design (Allessi and Trolliip, 1991; Kiboss, 1997). From the foregoing, there is substantial evidence to indicate that mathematics instruction at the secondary school level could greatly benefit from the use of CBI, especially in those areas that are difficult to teach or where student motivation is lacking.

The Design of the CBI Software

The design of the CBI was adapted from Wanjala (2005) and modified as per the current KIE (2002) approved mathematics syllabus, the teachers' guide, students' textbook and other relevant materials for secondary school mathematics. This utilized the Visual Basic authoring language that is capable of creating, presenting and managing computer-based learning courseware (Park and Hopkins, 1993). It allows the use of automatic completion list that guide the user when writing the code. Its interactive language called the Compiler can easily locate semantic and syntax errors and correct them. This makes it easy to compile, execute, package, and deploy the CBI program (see the Appendix for the main menu layout).

The lessons contained in the CBI program employed Dynamic Visual Displays (DVD) of verbal and nonverbal information which were relayed by the computer. A DVD is the presentation of any type of pictorial and graphical movement during instruction (Park and Hopkins, 1993). The essence of this DVD verbal and nonverbal information was to facilitate the learners encoding and decoding (retrieval) of information during the instructional process. The materials in the program were organized in a format that renders the learning of complex factual information on probability easier and interesting. This exploited computer attributes, making the program distinguishable from the ordinary textbook. The materials were presented in form of short notes, examples and exercise that allow key concepts to be learnt as a coherent whole rather than in isolation from one another.

Validation of the CBI Program

The CBI program used in this study underwent several reviews during its adaptation. This involved two computer education experts and four high school teachers knowledgeable in mathematics education who assessed the content validity in terms of the general design format, sequencing, language level and grammar, subject content and pedagogical issues.

The comments and/or suggestions from the experts were incorporated into the revised CBI program before the pilot test stage using Allessi's and Trollip's (1991) seven-step CBI evaluation model. This model was used because it is more convenient and easy to use as it follows ordered steps as outlined below. The first step entailed the involvement of six student-helpers from all ability of levels (i.e those with high, middle and low ability levels). Such a combination was deemed necessary because it could provide a spread of capabilities necessary to informally test the suitability of the CBI program to the needs of the population. In the second step, the student-helpers were oriented to the CBI system. This was done in order to familiarize them with the basic operation skills necessary for them to follow the CBI program. After the brief operation training, the student-helpers were pre-tested in order to determine their knowledge and attitudes prior to the treatment. At the fourth step, the students were exposed to the treatment. In addition, their feelings, difficulties and/or experiences as they interacted with the CBI lesson material were closely monitored. Step five involved an informal interview of the students to get their views regarding the course content and CBI. In the sixth step, the students were post-tested on the exposure to the CBI program. Finally, the problems and/or errors that were detected were used in further revision before the CBI program was actually implemented in a real classroom setting for the study.

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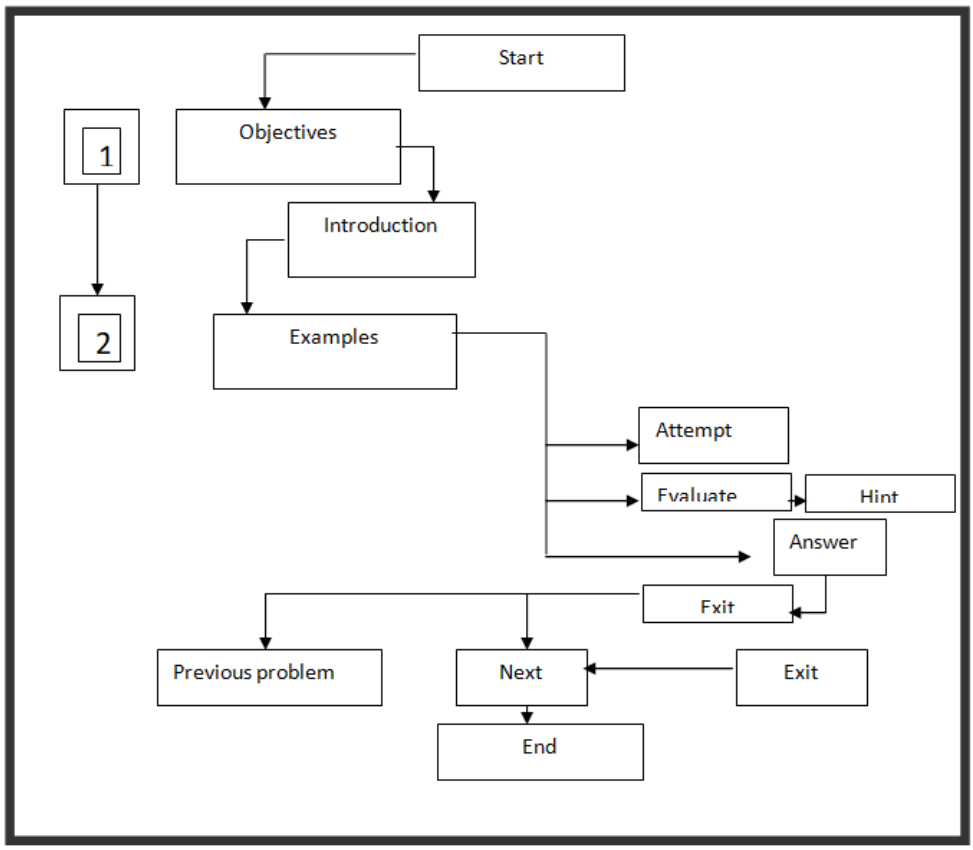
APPENDIX

MAIN MENU OF COMPUTER INSTRUCTIONAL PROGRAM

An item is selected by pointing with the mouse pointer, then clicking the mouse button.



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