The study examined the effect of probability tutorial software in the teaching and learning of mathematics in selected secondary schools of Bungoma County, Kenya. Two research questions were raised viz: i) what are the effects of tutorial software on the students’ achievement in mathematics. ii) Are there any significant differences between the achievement of the students exposed to the computer instruction programme and those not exposed to this programme? The study was based on the information processing theoretical construct. According to this theory, the learner during instruction is involved in active information processing that engages him/her to directly attend to the stimulus conditions and using his thought processes acts and reacts to the information. Tutorial software, questionnaires, and an achievement test were used to collect information from the subjects. In the study a total of 120 subjects were randomly assigned to three treatment groups. All the groups were taught the same mathematics course content by the same teacher. However, two groups received their instruction through the computer mode while the other group received their instruction directly from the teacher. Two groups were pre-tested prior to the implementation of the tutorial software treatment. At the end of the mathematics course all the three groups were post-tested. An analysis of the findings of the study indicates that; i) the tutorial software resulted in significant learning gains. Several implications of the findings are highlighted in the study as reported in this paper. The conclusion reached in this study is that the tutorial software perse was responsible for the significant cognitive and affective gains observed in the study. Basing on these findings, the researcher recommends that; whenever the issue at hand requires effective instructional approaches by the teacher for mastery of learning, then mathematics teachers should embrace the use of computer-assisted instruction.
Introduction
Education is viewed as a vehicle for any socio-economic development of a society. It improves the welfare of the society and makes the educated have an edge over the uneducated in almost all spheres of development. Education according to the human capital theory, leads to increased productivity of the educated. Most governments in the world, including Kenya, employ it as a basic strategy for human resource development (Republic of Kenya, 2002). Economic development depends on the human labour force. The labour force’s effectiveness and stability are determined by the quality of education. Wasike (2006) observes that mathematics plays a central role in scientific process and development. Its fundamental role lies in its application in most social sciences and engineering, biological science and medicine, military and aerodynamic advancements and household chores. Development can’t therefore be realized without addressing the issue of quality education.

Mathematics is one of the many subjects in the school curriculum. However, there is greater pressure for children to succeed in mathematics than in many other subjects in the school curriculum.

The importance of mathematics is expressed in the Cockroft Report (1982, p1), which observes:

There is no doubt that there is general agreement that every child should study Mathematics at school; indeed the study of Mathematics together with English is regarded by most people as being essential.

The importance of mathematics to the child and society can be viewed from many perspectives. For many it is seen in terms of arithmetic skills which are needed for use in everyday life situations e.g. at home, office and the workshop. Others view mathematics as the foundation for further studies and the basis of scientific and modern technology.

Due to the overall importance in various aspects of life, mathematics is a basic requirement for the study of several other subjects in higher institutions of learning and even in several employment sectors. Therefore mathematics being a service subject has some influence in future courses or employment opportunities of students. Poor performance in the subject implies that a large number of students are being examined for purposes of selection for further studies and employment opportunities where they may not excel.

However, in-spite of its importance, performance in mathematics has not been impressive. This has led to a general perception in some quarters that the teaching of mathematics at secondary school level has not to date made sufficient effort to deal with the backgrounds and needs of present day students.

Parents, teachers, politicians, educators, and the general public have expressed a lot of concern about the poor performance in mathematics.

Kiragu (1986, p1) asserts that:

Despite national efforts made in developing a curriculum that is appropriate to the needs of this country, coupled with teacher training efforts, performance in secondary school examinations has been relatively poor over the last ten or so years and particularly in mathematics.
Mango (1987) while addressing parliament in Kenya called for a probe into the teaching and learning of mathematics due to the poor performance of students in the national examinations.

Despite the concerns raised and efforts made to improve results in mathematics, performance in the subject has continued to be poor over the years. The formidable problem currently facing mathematics education in Kenya is the need to improve the student’s performance in mathematics.

Mathematics has been pointed as a subject area that requires practice, if the objectives of teaching the subject are to be achieved. Stuart stated that ‘Williams (1988, 101) paraphrased a Chinese proverb. ‘Tell me mathematics and I forget; show me mathematics and I may remember; involve me----- and I will understand mathematics, I will be less likely to have mathematics anxiety. And if I become a teacher of mathematics, I can thus begin a cycle that will produce less mathematics anxious students for generations to come.

Our classrooms are often composed of students from different backgrounds, with different levels of motivation and are also of a wide ability range. This poses challenges to the teacher and calls for a variety of methods and approaches to teaching, which incorporate a variety of resources.

Most mathematics lessons are considered to be barren and boring by many students. The mathematics taught is considered abstract and learning is seen in terms of memorizing facts, algorithms, procedures and formulae ready for reproduction during examination time. The teaching method is basically talk and chalk and there is no effort to involve practical activities to engage and enhance students’ understanding. This is a teacher centered approach where emphasis is on teaching at the expense of learning. At the end of most mathematics lessons, few students understand what was taught, some understand some of what was taught while the majority often have very little understanding of what was taught.

Learning by rote commonly associated with conventional/Traditional teaching cannot prepare children adequately for the standards required in information driven society. The conventional method is the predominant mode of instruction in primary and secondary schools (Gagne; 1975).

Despite its predominance, the method has draw backs. The method provides more information than can be handled by learners in a given time, encourages learner memorization, passiveness and declining attention, lacks in individualization of instruction, and provides for limited learner- learner and learner- teacher interaction (Weir, 1989; Makau ; 1990 and Konana; 1995). Traditional/conventional methods of instruction has been cited as contributing to poor learning and consequent poor performance of students in examinations (Kanguru, 1986; Konana, 1995; Mbuthia, 1996; Too, 1996; Bii, 2001).

The use of CBI is perceived to enhance students understanding of mathematical concepts. The computer 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 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 enjoyable working/learning environment, in which interaction and discussion are permitted.

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).

The computer has the ability to allow it’s users to explore, investigate, and pose problems, and to offer flexible representations of situations, of which at least one is on the symbolic, formal level. Computers have permeated learners’ culture through games. Turkle (1985) pointed out that such games offer the player a high degree of control within a limited domain. This ability of the computer (or rather sensitively written software) to allow users to interact in a personally powerful way is the common thread that runs through the various cultural manifestations of the computer in society.

Technology allows for the “doing” of science, providing hands-on experiences for students. There are a growing number of sciences learning opportunities on classroom networks, as part of telecommunications services in the form of microcomputer based laboratories. Simulation software allows students to interact with environments otherwise unavailable to them. Innovative software has been designed to encourage students to apply mathematics skills to real world problems in order to gain a deeper understanding of the concepts. Technology helps them make connections, analyze ideas and develop conceptual frameworks for thinking and problem solving; they can do real science, apply mathematics and share their findings with others (Ruthie Blankenbaker [2004]).

The research has shown that using computers for performing graphing functions seem to aid students understanding of mathematics concepts and removes the drudgery of creating the physical graph (Mokros, J. and Tinker,R.F.(1987)). Students who use computers for mathematics problem solving improve interpersonal relationships and increase creativity (Niess, M. (1992)).

It has also been shown that students spend more time analyzing and interpreting data when they use computers in an integrated problem-based curriculum (Mevarech Z. and Kramarski, B. (1992)). Computer tools in mathematics help students understand and master high-level mathematics concepts, working through a progression of conceptual levels (Linn, M. Songer, N.B. Lewis, E.L. and Stern, J. (1991). Great expectations have been raised about the impact of computers in mathematics education. For instance, Driver and Scanlon (1988) argue that new information technology such as computer simulations and/or animation can serve as an aid in making the reasoning of children more explicit and in visualizing the consequences of their thinking in individual or small group settings.

Mathematics is pointed as a subject area that needs a different approach rather than the convectional 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, affective and psychomotor skills in mathematics, they must find out conceptual understanding held by computer instructional software. Currently the problem to augment teaching with the available technological resources can no longer be ignored. Therefore it is against this backdrop that the study reported in this paper set to investigate the effectiveness of Computer Instructional software on students’ achievement in mathematics and students learning behaviours regarding their creativity, interests, and responsibility during mathematics lessons.

1. **Purpose and Objectives**
   The purpose of this study was to investigate the effect of tutorial software on students’ achievement in mathematics. In a nutshell, the study specifically finds out that there are significant differences in students’ achievement during mathematics lessons between students exposed to the computer and those not exposed to this programme (Taught conventionally).

2. **Hypotheses**
   The following two null hypotheses were posited for testing at an alpha level of 0.05 significance.

   - Computer instructional software has no significant effect on students’ achievements in mathematics.
   - There is no significant difference in achievement in mathematics between students exposed to the computer instructional software and those not exposed to this programme (Taught conventionally).

3. **The Study Area**
   The study was conducted in some selected secondary schools in Bungoma County, Kenya. Bungoma County was found appropriate for this study partly because of students’ poor performance in mathematics in the Kenya National Examinations for Secondary schools (KCSE). The formidable problem currently facing mathematics education in the district is the need to improve students’ performance in mathematics. The dominant mode of instruction is conventional and this calls for the need to explore the instructional potential of CAI in the several schools, which have adopted the use of computers in the district.

4. **Sample and Sampling Procedures**
   The sample of 120 subjects was drawn from the form three students of the 10 schools selected. The form three students were randomly assigned to the experimental and control groups I and II. The experimental and one of the control groups were pre-tested. This was administered to measure the dependent variables (achievement, creativity, interests and responsibility during the mathematics lessons). All the 120 subjects were exposed to same content of the mathematics course on the topic of the probability taught in 22 lessons for a duration of four weeks i.e. six 40 - minutes lessons per week. The experimental treatment groups were exposed to CAI while the teacher taught the other group conventionally.

5. **Research Design and Methodology**
   This study adopted an experimental design, which involved collection of quantitative and qualitative data in an attempt to answer the research questions. The experimental design chosen for the present study is Solomon three-group design, which is considered rigorous enough for experimental and quasi-experimental studies (Ogunniyi; 1992; Ary et. al, 1982; Cook & Campbell, 1979). Solomon three – group is robust in eliminating variations that might arise due to differences of experiences and contaminate the internal validity of the study (Ogunniyi, 1992; Tuckman, 1988).
It involved a random assignment of subjects to the three groups with two groups being administered the pre-test and one not. One pre-tested group and another were exposed to the experimental treatment. The three groups were post – tested after the experimental treatment.

From the form three-target population, a total of 240 subjects (N=240) were selected to participate in the study. They consisted of 108 girls and 132 boys of between 15 and 21 years of age. Their social economic status varies from low to high-income families.

6. **Instruments**

Instruments, achievement test and an observation schedule were used to collect information from the students. The scores were used to compare the groups taught using the computer tutorial software and those taught conventionally.

7. **Data Collection and Analysis**

The data obtained from the study were analyzed in terms of quantitative and qualitative descriptions. Descriptive statistics consisted of percentages, means and standard deviations. Inferential statistics used included analysis variances (ANOVA), which were employed to determine the significance of the differences in students’ achievement, creativity, interests and responsibility during mathematics lessons.
Table 1: Comparison of Mean Scores, Standard Deviations and Mean Gain Obtained By the Subjects on the MAT

<table>
<thead>
<tr>
<th>SCALE</th>
<th>OVERALL (N=240)</th>
<th>E1 (N=60)</th>
<th>E2 (N=60)</th>
<th>C1 (N=60)</th>
<th>C2 (N=60)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRE-TEST MEAN</td>
<td>29.67</td>
<td>29.92</td>
<td>29.41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STANDARD DEVIATION</td>
<td>10.21</td>
<td>11.98</td>
<td>8.42</td>
<td></td>
<td></td>
</tr>
<tr>
<td>POST-TEST MEAN</td>
<td>59.71</td>
<td>65.42</td>
<td>65.33</td>
<td>53.50</td>
<td>52.58</td>
</tr>
<tr>
<td>STANDARD DEVIATION</td>
<td>6.86</td>
<td>8.17</td>
<td>7.24</td>
<td>5.35</td>
<td>6.68</td>
</tr>
<tr>
<td>MEAN GAIN</td>
<td>30.04</td>
<td>36.50</td>
<td>24.09</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1 compares the results of the pretest and posttest scores obtained by the subjects in the groups on the MAT. A close inspection of these results shows that the subjects in the E1 group attained a mean gain of 36.50 which is higher than the mean gain 24.09 of the C1 group. It also indicates higher mean scores for the treatment groups (E1 & E2) than for the control groups (C1 & C2). In addition, the mean scores of the two treatment groups are not statistically different i.e. 65.42 & 65.33 respectively. The lack of significant statistical difference among the posttest mean scores of the two experimental groups on the MAT was probably due to the CBI programme to which they were exposed.
Table 2: Analysis Of Variance (ANOVA) Of the Post-Test Scores on the MAT.

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>D.F.</th>
<th>S.S.</th>
<th>M.S.</th>
<th>F-RATIO</th>
<th>SIGNIFICANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>BETWEEN GROUPS</td>
<td>4-1=3</td>
<td>9940.29</td>
<td>3313.43</td>
<td>67.78</td>
<td>0.57</td>
</tr>
<tr>
<td>WITHIN GROUPS</td>
<td>240-4=236</td>
<td>11537.48</td>
<td>48.89</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>239</td>
<td>21477.77</td>
<td>3362.32</td>
<td>67.78</td>
<td>0.57</td>
</tr>
</tbody>
</table>

Significant at 0.05 level, critical value 3.07<67.78
Table 2 shows the ANOVA results of the posttest scores on the MAT. An examination of the F-ratio in table (4.10) indicates that the F-ratio is statistically significant because the F-value (67.78) far exceeds the critical value (3.02) needed to reject the hypothesis in question. This is a clear indication that the post scores obtained by the CBI treatment groups and control groups are statistically different. It is revealed that the control groups taught by CMI had lower mean scores and hence were out performed by the two treatment groups (E1&E2).

8. Interpretation/Implications
According to the available data, there was no significant difference in general performance on MAT between the two groups (E1 & C1) pre-tested. However after the treatment, there was a significant difference on the achievement test between the control and the experimental groups in favour of the latter group. The evidence at hand therefore suggests that the students who were taught the mathematical concepts on probability using the tutorial software performed significantly better than those taught using the conventional methods. The results showed that the experimental treatment group obtained significantly higher scores than the control groups. Therefore, the two null hypotheses (HO1) suggesting that computer instructional software has no significant effect on students’ achievement and (HO2) that there is no significant difference in achievement in Mathematics between students exposed to the tutorial software and those taught Conventionally have been rejected. The finding of the study indicates that the tutorial software resulted in significant learning gains (high achievements); (ii) the computer instructional software engendered healthy classroom dynamics resulting in increased conceptualization, increased creativity amongst students, improved interests and responsibility during Mathematics lessons.

In support of these findings are earlier discussions by Dalton and associates, 1989, Kulik and Kulik, 1987; Mevarech et.al. 1987; Yeah and Allessi; 1988, Voogit (1993), Lauter back and Fray (1987); Kulik and Baryert- Drowsn (1990), Garcia (1992), and Teh (1993). These studies confirm that students demonstrate increased creativity, improved interests and responsibility during instruction and that effective learning is more assured through a computer programmed instruction medium approach i.e. CAI than with the conventional instructional approach. In general, the findings of this study are in accord with the views expressed in the aforementioned studies.

The study has provided useful empirical basis for improving the teaching and learning of Mathematics in the Secondary Schools through adoption of effective instructional approaches. For example, the results on MAT, indicating a significant difference in achievement of the students taught using the computer and those taught conventionally. The observation form also indicated a significant difference with improved interests and responsibility of the students’ taught using the Computer instructional software than those taught using the conventional methods of instruction.

9. Conclusion
The use of tutorial software in this study has demonstrated a great potential to promote cognitive, affective and psychomotor skills of Form III secondary school students in the mathematics topic of probability. Apparently, several advantages stand out from this finding.

- The problem of the concept of probability being a difficult topic to teach by
conventional methods, may be resolved by the use of a computer instructional programme that emphasizes collaborative learning, creativity, self-paced and individual learning.

- The declining performance and student’s interest in mathematics (stated in the background as the formidable problem currently facing mathematics education at the secondary school level in Kenya) may be arrested by the use of computer instructional.

- The use of computer instructional software can provide a point of departure to move away from the predominant expository teaching that gives the students very few opportunities to develop practical skills that are necessary for them to negotiate meanings, be creative and effectively participate in learning.

- The effectiveness of the computer instructional software in promoting collaborative learning may form part of the solution to the emergence of large classes in the context of inadequate human and material resources.

- This finding indicates that the computer instructional software has a potential for encouraging students participation in mathematics lessons and problem solving activities.

**10. Recommendations**

1. The researcher recommends that, mathematics teachers should make every effort to produce or obtain appropriate and well articulated computer programmed instructional materials and use them in their lessons.

2. The researcher recommends that the ministry of education should embark on a serious campaign through its various arms, to enable teachers understand and appreciate that the teaching of mathematics would be greatly enhanced in the event they use computer instructional software. Any teacher with the desire to improve students’ creativity, interests, responsibility and achievement in mathematics should be sensitized on the use of computer instructional software in mathematics.

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