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USING COOPERATIVE E-LEARNING TEACHING STRATEGY TO ENHANCE STUDENTS' CREATIVITY IN SECONDARY SCHOOL BIOLOGY: A STUDY OF SELECTED SCHOOLS IN NAKURU COUNTY, KENYA

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ABSTRACT

Creativity and innovation are among the key pre-requisites for industrialization. One of the key defining features of the 21st century is the use of information communication technologies (ICTs) in every sphere of life. For Kenya to realize her vision 2030 of transforming to a newly industrialized, middle-income country that provides a high quality life to all citizens by the year 2030, there is need to integrate the use of ICTs in education. This would enhance creativity and innovation and spur industrialization and economic growth. This study investigated the effects of Cooperative E-Learning (CEL) teaching strategy on students' creativity in biology. Solomon Four Non-Equivalent Control Group design was used. The study involved four County secondary schools in Nauru County and focused on Form Two (second grade in the secondary school cycle) students. Convenience sampling was used to select the four schools. A total of 200 students participated in the study. The instrument that were used in this study a Creativity Achievement Test (CAT). with a reliability coefficient of 0.98. Data generated was analyzed using Analysis of Variance (ANOVA), t-test. Statistically significant values were accepted at α =0.05. The findings show that the students exposed to CEL teaching strategy were more creative than students exposed to conventional teaching methods. It is concluded that CEL is an effective strategy that can enhance creativity and innovation and should be incorporated in the teaching of school biology and teacher education programs.

Keywords: Creativity, Cooperative e-learning, Constructivist teaching, Self learning, School biology.

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Contribution/ Originality

Creativity is a key pre-requisite in any meaningful learning process. It enhances a learner's capacity to develop a deeper understanding of scientific phenomena. Science educators, therefore, need to develop approaches that can be used to enhance creativity in lessons. Information communication Technologies (ICTs) have become key features in the teaching and learning of science. The findings of the current study demonstrate that Cooperative E-Learning (CEL) teaching strategy is an innovative strategy that has the capacity to enhance learners' creativity in biology lessons.

1. INTRODUCTION

Creativity is defined as the ability to generate or recognize ideas, alternatives, or possibilities that may be useful in solving problems (Franken, 2007). It is the ability to be aware of problems, think of possible solutions to the problems and test the practicability of the solutions. Creativity is seen as any act, idea, or product that changes an existing domain, or that transforms an existing domain into a new one. Therefore, creative individuals have the ability to view things in new ways or from different perspectives. Creativity is not a talent but away of operating and it can be taught. It is also not restricted to the arts since it can be applied to any human endeavor. At the same time, intelligent quotient (IQ) is not related to creativity but one requires a minimum level of IQ to be creative (Cai *et al*., 2009). Creativity plays an important part in innovation and invention and is important in professions such as business, economics, architecture, mathematics, music, science, engineering and teaching (Cai *et al*., 2009). Pink (2005) notes that creative thinking is increasingly necessary to accomplish goals in our complex, interconnected world. Educational researchers and psychologists tout the social, emotional, cognitive, and professional benefits of possessing creative abilities (Sternberg, 2006). Franken (2007) argues that creativity is linked to fundamental qualities of thinking such as flexibility, tolerance of ambiguity or unpredictability and enjoyment of things thereto unknown. This places emphasis on divergent thinking as opposed to convergent thinking. Convergent thinking involves aiming for a single correct solution to a problem whereas divergent thinking involves creative generation of multiple solutions to a set of problems. Halford and Wilson (2002) argue that school must be the place for introducing new ideas, explicit representation of imagination, using mental processes to create novelty. Schools should thus be seen as incubators of creativity and innovation. Therefore, enhancing creativity among learners should be a function of a school system. Indeed, this is crucial for innovation, industrialization and socio-economic development. This strongly suggests that creativity can be enhanced through classroom instruction. It is, therefore, hoped that if students are taught in a manner that encourages divergent thinking, this would enhance their creativity and hence make them come up with new ideas on how to tackle issues which may contribute to the realization of Kenya's dream, vision 2030 by the year 2030.

According to Derek (2003), e-learning is the delivery of learning, training or educational program by electronic means. He explains that e-learning involves the use of computer or

electronic devices like a mobile phone in some way to provide training, educational or learning material. Victor Jeurissen, global practice leader for IBM management development solutions defines e-learning as the use of innovative technologies and learning modules to transform the way individuals and organizations acquire new skills and access knowledge (Moeng, 2004). Indeed, many developed and developing countries have integrated the use of ICT in the education both to enhance and more effectively personalize the learning process. Alsalloum *et al.* (2012) argue that some of the key benefits of e-learning include exceeding the constraints of time and place in the educational process and enabling educational institutions to achieve the optimal distribution of their limited resources, taking into account the individual differences among learners and enabling them to complete their learning process in suitable environments and ease of access to teachers even outside official working hours. Others include raising a student's feeling of equality in distributing the opportunities in the educational process, breaking the barrier of fear and anxiety they have ,and enabling learners to express their ideas and search for facts and information by means that are more useful than those followed in traditional classrooms .Lastly, it allows spreads the culture of self-learning and training in the society which can improve and develop the abilities of learners at lower cost and less effort.

Keraro *et al.* (2007) argue that the teaching approach that a teacher adopts is a strong factor that can influence students' motivation to learn. A teacher may adopt a competitive, cooperative or individualistic approach in teaching and hence motivate learners differently. Myths have developed about the virtues of competition and the evils of cooperation. For example, it is argued that since society is highly competitive, learners must be educated to succeed in a "survival for the fittest" world. Although competition creates winners, it also creates proportionately many more losers. Many scholars in science education recognize that knowledge is socially constructed in collaborative groups (Alexpoulou and Driver, 1996; Bianchin, 1997; Kelly and Green, 1998).

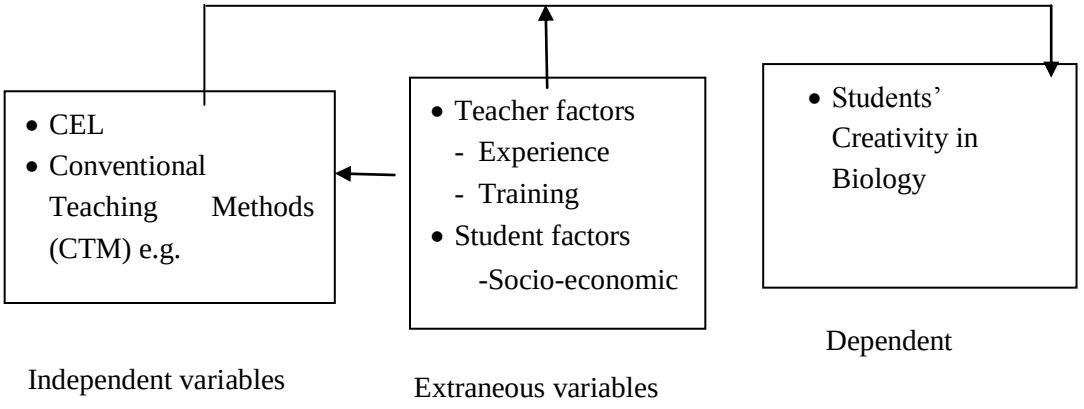
Latour and Woolgar (1986) argue that creativity emerges from interactions. Interactions among scientists and among groups of scientists play a catalytic role in the creation of knowledge (Feldman *et al.*, 1994; Simonton, 2004). This, therefore, points to classroom activities that provide learners with opportunities to interact in a social setting, thinking imaginatively and divergently. It focuses on enhancing creativity within a social-cultural milieu. Indeed, this is why cooperative learning teaching approach is now receiving prominence in science education. Cooperative E-learning (CEL) approach combines the benefits of cooperative learning and ICT and is likely to foster creativity and enhance achievement in Biology. Given that the world is embracing information technology, the study explored the possibility of using ICT as an aid in cooperative learning to foster creativity in Biology teaching.

1.1. Conceptual Framework

The conceptual framework that guided this study was based on the constructivist theory of learning. Constructivists believe that a teacher should serve as a facilitator who attempts to structure an environment in which learners organize meaning on a personal level (Cooper and

Robinson, 2002). The study was based on the assumption that a teaching strategy that involves students actively is more likely to lead to enhance creativity and meaningful learning as opposed to conventional methods. Figure 1 diagrammatically represents the conceptual framework

Figure-1. Interaction of variables that influence students' creativity in Biology



Learning is influenced by various factors, ranging from teacher factors, learner characteristics and teaching strategies used as shown in Figure 1. The study used qualified Biology teachers with a minimum of four years teaching experience to control for the teacher factors. Socioeconomic status of students may influence how effectively they adapt to the new teaching strategy. Learners were trained on the E-Learning techniques for two weeks before the start of the study. Only schools that were already using computers for instruction were selected for the study. The study involved Form Two students (second grade in the secondary school cycle) who were of comparable age and ability.

1.2. Purpose, Objective and Hypothesis of the Study

This study was aimed at determining the effect of using CEL teaching strategy on students' level of creativity. Its specific objective was to determine whether there was a difference in students' level of creativity in Biology between those taught using CEL and those taught using conventional methods. The null hypothesis (Ho) tested was "there is no statistically significant difference in the level of creativity between students exposed to CEL and those exposed to conventional methods.

2. METHODOLOGY

The design that was adopted in this study is the Solomon Four Non-Equivalent Control Group design since the school authorities do not normally allow classes to be dismantled so that they can be re-constituted for the purpose of research (Gall *et al.*, 1996).

The design is as follows: -

Group I O1 X O2

Group II O3 - O4

Group III - X O5

Group IV - - O6

Where: O1 and O3 are pre-tests; O2, O4, O5 and O6 are post-tests. X is the treatment where students were taught using CEL. Group I is the experimental group which received the pre-test, the treatment X and the post-test. Group II received pre-test and post-test while group III received treatment and post-test only. Group IV received post-test only. The design controls all major threats to internal validity associated with interaction of selection and history, selection and instrumentation, and selection and maturation (Cook and Campbell, 1979).The conditions under which the instruments were administered were kept as similar as possible in all schools to control for interaction between selection and instrumentation. The schools were assigned randomly to control and treatment groups to control for interaction between selection and maturation (Gall *et al*., 1996). Schools were used as sampling units and a list of county secondary schools in Nakuru County was used as a sampling frame. Convenience sampling technique was used to select four schools. The study involved county secondary schools to ensure that the subjects of the study had comparable academic abilities. This is because selection of students joining secondary schools is based on their overall performance at Kenya Certificate of Primary Education (KCPE) examination that is administered at the end of the eighth grade in the primary school cycle. Schools that participated in the study had well equipped computer labs with enough working computers giving a ratio of at least one computer to four students. This justified the use of convenience sampling to select the sample schools. The total sample size was 200 students whose ages ranged between 15 and 16 years. Sampled schools were a good distance a part to minimize experimental treatment diffusion. In schools that had more than one Form two stream, simple random sampling was used to pick one stream for the study. The student numbers in each group were as follows:

Group 1(Experimental group), N=42

Group II (Control group), N=55

Group III (Experimental group), N=45

Group IV (Control group), N=58

The instrument that was used for data collection is the Creativity Achievement Test (CAT). The CAT was developed by the researchers and validated by five experts in science education before being used as pre-test. The CAT items tested recognition of relationships and sensitivity to problems as aspects of creativity. All test items had a range of scores between 1-6. Reliability of the test was estimated by the use of Cronbach's alpha (ά) because the items were not dichotomously scored (Thorndike and Thorndike, 1994) and yielded a reliability coefficient of 0.98.

This was above the recommended threshold of 0.7 and thus suitable for the study (Frankel and Wallen, 2000). The test items were re-organized and used as post-test. The researchers in collaboration with computer programmers developed an instructional module which teachers

used during the treatment period. Teachers and students involved were trained on the use of the module and cooperative learning before the start of the treatment. The CAT pre-test was administered to Groups I and Group II followed by a five week treatment period. After treatment, a CAT post-test was administered to all the groups. Data generated was analyzed using one-way ANOVA and t-test. Analysis of variance (ANOVA) was used to determine whether the four groups differed significantly among themselves on creativity. The t–test was used to test the hypothesis (**Ho1)** because of its superior quality in detecting differences between two groups (Gall *et al*., 1996; Wiersma and Jurs, 2005)

3. RESULTS

The results of the t-test of the pre-test scores on CAT for group I and II showed no statistically significant difference $t(95)=1.65$, $p>0.05$. This implies that the groups were comparable before commencement of the study.

3.1. Effects of CEL on Students' Creativity in Biology

After the experimental groups were subjected to the intervention, they were tested on creativity using the CAT. The CAT post-test scores were analyzed to determine the relative effects of the CEL teaching strategy on students' level of creativity in Biology. This was done using one-way ANOVA. The CAT mean scores obtained by the students were 7.21 for group I, 2.12 for group II, 6.55 for group III and 2.44 for group IV. This shows that the experimental groups had higher mean scores compared to control groups. The one-way ANOVA results based on these means gave an F statistic of 109.92 which was statistically significant at the alpha level of 0.05. To find out between which groups the statistically significant difference occurred, a post-hoc pair-wise comparison was carried out using Bonferroni test. Table 1 shows post-hoc comparison results of the post-test CAT means for the four groups.

Table-1. Post-Hoc Comparison Results of the Post-test CAT Means of the Four Groups

	(I) Group	(J) Group	Mean difference (I-J)	P-value
Bonferroni	1	2	5.08*	0.00
		3	0.65	0.74
		4	4.76*	0.00
	2	1	-5.08*	0.00
		3	-4.43*	0.00
		4	-0.32	1.00
	3	1	-0.65	0.74
		2	4.43*	0.00
		4	4.11*	0.00
	4	1	4.76*	0.00
		2	0.32	1.00
		3	-4.11*	0.00

*Statistically significant at 0.05 level

The results indicate that statistically significant differences occurred only when control groups were compared with experimental groups. No statistically significant difference was found when means were compared between groups I and III, and II and IV.

These results, therefore, indicate that: -

(i) The CAT pre-test did not interact significantly with the treatment conditions. This is because there was no significant difference in CAT means scores between the treatment groups and between control groups.

(ii) The use of CEL teaching strategy resulted in higher students' creativity than the conventional teaching approaches because Groups 1 and 3 obtained scores that were significantly higher than the other groups on CAT. The null hypothesis (Ho) is, therefore, rejected.

4. DISCUSSION

4.1. CEL and Creativity

The results have indicated that CEL teaching strategy resulted in significantly higher students' creativity scores compared to conventional teaching methods. This, therefore, demonstrates that social – interactions and active learner engagement in a learning activity fosters creativity. Current pedagogical discourses attempt to view learners as the centre of the teaching and learning process, with an active role in the production of knowledge and meaning, democratically bringing their expertise, experiences and ideas into the classroom (Williamson and Payton., 2009). Moreover, constructivist approaches to learning involve understanding and making new and valuable connections between old and new knowledge. Without invention, learning merely results in memorization and teaching as a consequence can be viewed as nothing more than imparting notions. Understanding is a form of meaning creation, just as creativity is. Creativity is therefore an aspect of learning (Craft, 2005). Non-creative learning on the other hand includes all learning that favors memorization over understanding; rote learning and learning of facts. Both creative and non-creative learning are important for education and should co-exist. It is unavoidable to go through a certain amount of non-creative learning before being able to make any new connection or embark on understanding a topic. At the same time, non-creative learning is not enough, as understanding is fundamental for the cognitive and cultural development of children and young people (Ferrari *et al*., 2009).Teachers who are amenable to change and who model divergent thinking themselves seem the most effective in stimulating creativity in students (Karnes *et al*., 1961). Besides using individual assignments to stimulate creativity, teachers should provide opportunities for students to participate in group activities (Davis, 1991). These group activities, in addition to enhancing creative thinking and enhancing academic performance, should provide students with opportunities for developing peer acceptance (Fasko, 2001). Another technique of developing creativity is the inquiry-discovery or problem solving approach, which is an indirect teaching method (Feldhusen and Treffinger, 1980). They further assert that creativity is related to the discovery process. Experience with discovery

learning enhances creative performance by forcing a learner to manipulate the environment and produce new ideas.

Woods (2002) points out that teachers play an important role in triggering students' creativity as they represent the field of experts who are to judge the creative output. They introduce a shift in pedagogy, moving towards an inclusive approach, where the environment is permissive and safe and learners are in control of their learning process. Teachers should allow co-construction of knowledge, being reflective practitioners, supporters and facilitators and not bureaucrats, nor technicians applying governmental policies without questioning them or inhibitors by being overly didactic or prescriptive. Indeed, in the current study, CEL presented this position within the constructivist perspective of teaching and learning. Teaching for creativity implies allowing students to take responsibility for their own learning. (Ferrari *et al*., 2009) argue that students should not be considered as merely receivers of information, on the contrary, it is important that they assume the role of discoverers, but support and guidance are needed in order for them to succeed. This can be enhanced when students are exposed to e-learning where electronic devices are used enabling them to control their learning. For this, teachers need to be prepared both on the pedagogical side, being aware of the means and ways to foster autonomy and student-centeredness and on the subject-knowledge.

5. CONCLUSION

The finding in this study confirmed that all the four groups of students had comparable abilities in creativity in biology before the treatment but these abilities differed significantly after the treatment in favor of the experimental groups. It is, therefore, concluded that CEL has the capacity to enhance the learners' creativity in biology compared to conventional teaching methods. CEL allows learners to share ideas and actively engage them in seeking for alternative points of view within a democratic environment. CEL, therefore, emerges as a pedagogy that can effectively foster learners' imaginative skills and creativity.

5.1. Implications of the Study

This study has shown that the use of CEL in the teaching of biology in secondary schools fosters creativity among learners. This means that learners are encouraged to think of other alternative ways of looking at issues rather than following the routine thus encouraging divergent thinking. This in a way will prepare our learners to think of new ways of looking at things which can bring new innovations. Performance of sciences at KCSE examinations has been poor. The findings of the current study indicate that there is a relationship between creativity and achievement when learners are taught through CEL. This means that when students' level of creativity in biology is enhanced, their performance in the subject will also improve. Therefore, if CEL is adopted, it is likely that it would also raise the level of achievement learners. Educational administrators and curriculum developers should emphasize the use of CEL in biology lessons and possibly other science subjects to improve the effectiveness of teachers. Teacher training

institutions should also incorporate the CEL concepts in their training curriculum so that they can empower teachers to use the strategy. Teachers can make their classes more interesting by assigning creative tasks, and thereby enhancing cooperative learning.

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