STUDENTS' REACTIONS TO THE USE OF COMPUTERS IN SCIENCE EDUCATION IN SELECTED KENYAN SECONDARY SCHOOLS

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Abstract

Different people react differently to the same experience. A current trend in science instruction is to integrate technology into classroom in a variety of ways. A Computer Based Instruction (CBI) courseware was used to teach cell theory that has posed difficulties for teachers and students as part of the classroom innovation. Students' attitude towards the innovation and their attitude towards the biology classroom environment were collected through two 5-point bi-polar Likert-scale items and unstructured written interviews. The innovation resulted to better perception of the biology classroom environment and attitudes towards cell theory. Classification of students' unstructured responses confirmed the existence of a series of metaphors for technology use in educational settings.
Key words*: computer based instruction, metaphors.*

Introduction

The pace of both technological development and the introduction of new technologies in educational settings are on the increase (President's Committee of Advisors on Science and Technology, 1999). However, the impact of microcomputers on school and classroom learning is relatively unknown in Kenya. The systematic evaluation of computer use in education often lags behind development and the facilities and stage of professional and organizational development in Kenya seem to reflect this (Reeves, 1997; Kiboss, 2000).

Since the recognition of the importance of computers in the curriculum by the Kenyan ministry of education 15 years ago (Makau, 1990), computers have remained novelties, rare rewards or the focus of after school activities. This is attributed in part to economic and social problems. The acquisition of computer hardware and software programs involves a considerable monetary investment. To justify their expenditures and confidence, stakeholders in education require answers but not sensational beliefs and lofty assertions about computers' cost-benefits (President's

Committee of Advisors on Science and Technology, 1999). The social problem stems from the pupil/teacher perception about the place for technology in educational settings. While evidence indicates that learning can be enhanced greatly by use of technology, its potential will be realized only if there will be successful infusion and computers made an integral part of the regular instruction and curriculum.

The topic cell division is a form three topic under the concept reproduction and introduces students to sexual and asexual reproduction and genetics. Cell division is a continuous process but series of stages are assigned marking the significant features at a given time. The stages involved are; interphase, prophase, metaphase; anaphase and telophase.

The dynamics and chromosomal orientation during the process are pertinent to the understanding of the concept by the students of biology. Yet the process does not come out vividly in conventional instructional methods and in biology textbooks. Lack of these dynamic features of the process of cell division has necessitated the development of an integrated learning environment that employs the animated colour graphic features of a computer program to simulate the process of cell division into normal classroom teaching/learning situation. It is against this background that a study was conducted to explore the instructional potential of a CBI courseware on teaching and learning of cell division. This paper therefore presents the students reactions to the use of computers in science instructional process in terms of their metaphoric inferences, perception of their learning environment and their attitudes towards cell theory.

Methodology of Research

Implementation of technology is a dynamic process that involves the interaction of institutions and individuals with an innovation. This is a non-linear but simultaneous interaction that is best assessed qualitatively. Besides, a true analysis of technology's benefits often requires qualitative research methods (Kiboss, 2000). As such, this study utilized the field-based approach that has become more prominent in educational research. The field-based research attempts to understand schools in terms of the complex patterns of social interactions. The research design involves collection of data in a natural setting while schooling and social interactions are taking place.

The study involved exposure of students to a course learnt via the computer after which their attitude and perceptions about the innovation were collected using two questionnaires code named; Student Attitude Questionnaire (SAQ) and Biology Classroom Environment Questionnaire (BCEQ) and one unstructured interview guide code named; Student Interview Guide (SIG). SAQ and BCEQ, which contained a 5-point bi-polar type scale items were used to collect data on students' attitude towards the new technology and their perceptions towards the biology classroom environment. Students were asked to indicate whether they strongly agreed, agreed, were undecided, disagreed or strongly disagreed with the statements. The mean scores in tables 1 and 2 were calculated by assigning weights of 5, 4, 3, 2, and 1 respectively to these responses. The mean scores are therefore constrained between 1 and 5, with a higher mean score associated with a more positive attitude and perception. The items are reported in order of the mean score.

Results of Research

The data collected was analyzed descriptively as themes arose. Generalization beyond individual responses was achieved by making inferences to students' responses, which were classified as having intended meaning. This was done by classifying students' unstructured responses in context of inferred metaphors for technology according to Kissane et al. (1995). This was done by examining the extent to which various students' responses seemed to reflect any of the six metaphors as below:

a. Laboratory
b. Tool
c. Teaching aid
d. Curriculum influence

e. Cheating device; and
f. Status symbol. Kissane et al. (1995).

Table 1. Students Reactions to Computer Use in Classrooms by percentage.

Metaphor	CMS Lessons	Regular Lessons	Total
CURRICULUM INFLUENCE: Students' views on the need to introduce a new element of technology into the curriculum.	76	24	100
STATUS SYMBOL: An inclination of students' views on technological devices and their features, rather than on their actual use.	69	31	100
NUISANCE: Students' views on the computer as unwelcome intrusion into the learning environment.	23	77	100
LABORATORY: Students' views associated with the use of computer as a device or an environment for exploration of biological ideas.	81	19	100
TOOL: Students' views that particular biological processes might be presented by the computer better than by the conventional teaching methods.	79	21	100
TEACHING AID: Students' views on the understanding of otherwise a difficult/complex biological concept.	69	31	100

Table 2. Mean scores on selected SAQ items.

	Mean
1.The biology lessons taught via the new technology were interesting	4. 62
2. The biology lessons taught via the new technology were meaningful	4. 44
3. The biology lessons taught via the new technology were clear.	4. 40
4. The biology lessons understandable	4. 29
5. I like the biology lessons taught without the use of the new technology	2. 55
6. The biology lessons taught by the teacher were easy	1. 82
7. The biology lessons taught via the new technology were unfriendly	1. 70
8. The biology lessons via the new technology were difficult	1. 66

Table 3. Mean scores on selected BCEQ items.

	Mean
1. Everyone was expected to participate in the group work	4. 96
2. Gaining access to the biology lessons on the computer was easy and exciting	4. 92
3. Scientific concepts and principles illustrated by the new technology's picture and diagrams were clear	4. 85
4. The new technology's directions were clearer than the teacher's directions	4. 18
5. Ideas were tested and discussed cooperatively in class	4. 07
6. We did new and interesting activities via the new technology	4. 07
7. Students were friendly and worked together as a team in the class	4. 07
8. We got enough time to complete our work	3. 70
9. We depended on each other more than the teacher	3. 07
10. Typing on the keyboard was difficult and frustrating	3. 06

Discussion of Students' Metaphoric Inferences for Technology

According to Kissane et al. (1995) metaphors help to explain different reactions of different people to the same experience. The pupils' responses were read and classified under these metaphors by four independent persons, with a high degree of inter-rate agreement. The few responses on which they seemed to disagree on their placement, the four met and resolved on them.

Of the 90 written responses that referred in some way to computers, 78 reflected a positive view to the use of computers, 3 reflected negative view and 9 appeared ambivalent. Examples of agreed inference about underlying metaphoric thinking are given below. In all cases, pupils' responses have been reported verbatim without any correction to spelling or grammar.

Curriculum Influence

A close look at the table reveals that the metaphoric inference of curriculum influence had the highest percentage responses for the treatment than the control groups (76% and 24% respectively). The subjects in the treatment group expressed their liking for the CMS program and desired that they should have learnt all the other topics through the use of CMS. A group made a passionate appeal that the use of the computer should be allowed even in the National examinations. To them, cooperation among themselves and the easy with which group discussions came up was something they had not experienced before. This finding seems to concur with Laid law (1963) cited in Ndirangu (1991) that group learning provides opportunities to pool resources and aggregation insights that enrich individual learners as every participant contributes ideas. The following responses seemed to indicate the need to infuse technology into curriculum

> I really wished all the topics we had learnt were represented that way.
>
> It should be recommended by the government to be used even in the examination
>
> It should be introduced in all subject for easy understanding and seeing how thing happen.
>
> It was a co-operation lesson.
>
> Discussion is coming out making students share idies.
>
> I experienced that we can also learn by ourselves without the help of the teacher.

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Status Symbol

Both the treatment and the control seemed to value the numbers, size and/or models of computers and/or laboratories rather than their actual uses. It is noteworthy to mentioning however, that the subjects who made reference to this metaphor from the treatment group were fewer (31% and 69% respectively). This is an indication that most of the subjects in the treatment group saw the computers in the classroom from their functionality as opposed to the their physical endowment. The following 4 responses seemed inclined to a view of computers as status symbol rather than their actual use.

> I felt that I had advanced in terms of using the computer.
>
> One becomes advanced.
>
> I would like the system to be established in our school.
>
> The teacher should caution the students on wise use of the scarce resource (computer) in the school.

Nuisance

This is a metaphoric inference to computer as unwelcome intrusion into the learning/teaching environment. Though this metaphor was not strongly evident among the treatment group that had 23% as compared to the control group that had 77%, a few subjects in the treatment group seemed to find typing at the computer keyboard confusing as the keyboard has many buttons. Others argued that learning through CMS was not viable in Kenyan schools due to lack of necessary facilities and electricity in most of the schools. The following 3 responses tended to underscore the view that computers should not be used in the teaching/learning situations.

> Illustrations presented by the new technology was not clear on drawings that is biological diagrams.
>
> There is no availability of facilities.
>
> I found it exciting using a computer although at first I was confused as there were many buttons on the keyboard.

Laboratory

An examination of the table shows that the metaphoric inference of a laboratory as a devise or an environment for the exploration of biological concepts was higher (81%) for the treatment group as compared to 19% for the control group. The difference between the two groups seems to emanate from the instructional approaches employed in the CMS lessons and the teacher directed classes.

In the CMS augmented classes, active student participation is an integral part of the learning process employing a multi-sensory approach. Students working in groups were able to explore the biological concept on cell division at their own pace, posing questions and seeking clarification from peers with the teacher only facilitating in the learning. But in the conventional teacher directed laboratory sessions on cell division, though the subjects worked in groups, the social context was that of competition as opposed to collaboration. Similarly, the laboratory session was conducted to confirm or as a follow up to the theory. Perhaps this explains why earlier studies by Okere (1996) found low achievement by students in science process and manipulative skills. As such students do not associate the laboratory with investigation and/or exploration but rather, they see the laboratory as an extension of the science classrooms.

It was just waa. I felt very nice about the thing.

It brings the academic atmosphere a round.

I liked when I saw the cells dividing.

The new technology despite of its clear illustrations brings out the feeling of real life experience thus changing the perspective I used to view the subject.

Tool

The metaphoric inference of a computer or a laboratory as a tool had 79% of responses by the treatment group as compared to 21% of the control group. This implies that the use of the CMS program made the subjects in the treatment group to realise the inadequacies of the conventional laboratory experiments when exploring biological concepts. This could be the reason why the treatment group outperformed the control group. The subjects seem to concur with the saying that "a picture is worth a thousand words". But a simulation is worth more. They agree that the illustrations and textual information were clearly presented, one after the other.

For the control group, the success of the laboratory experiment is pegged on the availability of the appropriate apparatus and equipments, the complexity of the task and the amount of time allocated to practicals. But according to Tsuma (1998), there is a wide spread absence of learning materials and resources in many Kenyan schools. This situation makes it difficult for teachers to plan and carry out experiments effectively. As such laboratory sessions are another trying moment to students with several rules and procedures to adhere to. Experiments often do not give positive results with the teacher summing it all "you were supposed to have observed…" (Brown, 1995).

I could read the simplified notes on the computer and really feel at home and comfortable because the sentences were self-explanatory.

It was interesting and I got to learn what I had not before.

It is exciting and it also enables people like me to understand and see clearly actually what takes place in the somatic cells of the body

Teaching Aid

Students' views on the understanding of otherwise a difficult/complex biological concept were 69% and 31% for the treatment and control groups respectively. In both cases the subjects acknowledge the invaluable role played by teaching aids in the teaching/learning of biology. However, the subjects in the CMS augmented classes viewed the computer as being able to teach and teach even better some biological concepts than the teacher's exposition. The control group viewed the laboratory experiments to be done to aid the understanding of biological concepts.

The illustration presented was very much understandable because the diagrams were one after the other so the process were followed, on a text book there may only be one diagram or non-to summarise the whole process.

It was easy to understand and remember because things seen, actually not imagined, are easy to keep in mind.

The illustration presented in the new technology actually gives the learner an idea of what happens as the topic is being taught. This is due to the fact that although the

> teacher may explain things not seen and will not be seen, the computer lesson make it possible for them to be seen. It made us remember during the short exam on it.

Students' unstructured comments on the informal interview seem to concur with Kissane (1995) that there is a range of ways different people will subconsciously react to the same experience. However it is worthy to mention that there was no metaphoric inference to the computer as a cheating device. This gives credence to the CMS program.

The students' responses indicate a very positive attitude and that the CBI program was effective in improving the students' perception of the biology classroom environment. This findings lend support to earlier studies showing that the use of computers promotes positives students attitude and changed positively the way students viewed science and mathematics (Kiboss, 2002, Kiboss at al, 2004; Tamar, 1994; Wekesa, 2003).

Conclusion

Educational use of computer technology continues to grow worldwide and students appear to find the technology a useful medium for learning. Apparently, a major challenge for the educators is to incorporate technology into classroom and make it an integral part of the regular instruction and curriculum. The students' responses depict a strong desire for technology in their teaching/learning. This calls for the teachers to be ready and equipped to prepare and deliver instruction using new approaches which include technology, hands-on and collaborative learning. This requires that teachers be provided with solid foundations in the general application of technology in education.

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