Experiments in education and pedagogy in life science with special reference to computer-assisted instruction

N. B. Biswas¹* and Ranjita Chanda²

¹AM School of Educational Sciences, Assam University, Silchar, India.
²Department of Education, Assam University, Silchar, India.

Accepted 17 June, 2013

Research in science education is dynamic and multi-dimensional and has extension in social sciences especially with the help of Educational Technology (ET). One of such attributes of ET is Computer-Assisted Instruction (CAI). A randomized pretest posttest design was used for comparison of Life Science teaching through CAI and Traditional Method (TM). The classroom materials were developed into units. Findings suggest that student achievement and retention in Life Science through CAI is more effective than TM of teaching and can be used as a complement to usual learning method.

Key words: Computer-assisted instructional approach, usual learning approach, pedagogy, life science.

INTRODUCTION

With the advent of human race, science began its journey holding hands with myths, discoveries and superstitions. The history of Life Science tracks down to the period of forests dwellers’ knowhow of plants and animals to their struggle for existence. Life Science (commonly known as Biology) gathered an impetus during post-Renaissance and post-Industrial Revolution with mass inventions and speculations.

During the 18th and 19th centuries, biological sciences, including Zoology and Botany, became distinct disciplines. These disciplines flourished gradually with the emergence of several newer disciplines. In addition to all the developments in the field of science, the art and science of teaching those subjects also grew parallel. Science education is the integration of concepts of science along with the pedagogical aspects developed in the pupil through observation and experiment with the help of practical activities comprising systematic study of the physical and natural world. Therefore, different educationists advocated for different methods of transaction of contents and experiences to the learner resulting in the development of teaching pedagogy. Early methods of teaching laid their foundation on textbooks and lectures, whereas nowadays conventional methods and techniques have been replaced by innovative methods and techniques which are the product of Educational Technology (ET). The teachers are no more disseminators or propagators rather they are the facilitators of knowledge. To facilitate knowledge, every educator needs to be aware of the modern techniques to fulfill the objectives of learner and methods of teaching Life Science, that include Heuristic method, Project method, Demonstration method, etc., which need to be complemented (not fully replaced) with Information and Communication Technology (ICT) to provide meaningful instruction.

Rationale

Research in science education is so dynamic and multi-dimensional in nature that it is not only confined to the fields of fundamental sciences but its applicability has its extension in the fields of social sciences too. ET is assisting in the enhancement of pedagogy by making teaching more interesting. Presently, the use of computers has become an integral part of the education process. Various innovative techniques like Personalized System of Instruction (PSI), Programmed Instruction (PI) and Computer Assisted Instruction (CAI) are used to augment methods of teaching. India initiated Computer Literacy and Studies in School (CLASS) in 1984 for senior secondary students (NPE, 1986). Looking into the utilization of computers in schools, most of the effort at present is spent in equipping computers, training

*Corresponding author. E-mail: biswasnb1952@gmail.com.
teachers and generating software programs to apply the attributes of ET to use technologies in classroom instruction. One of such attributes is CAI which is a demanding area in the contemporary phase. In the present paper, the researchers reviewed 33 studies that are related to CAI only. In western countries, lots of research have been conducted relating to the effects of the use of computers as a teaching tool on student achievement, attitudes, learning rate, retention, etc. (Cotton, 2001), but in India, much research has not been carried out in this field (Ranade, 2004). As far as CAI is concerned, the best-supported finding in the review of literature supports its use as a supplement to conventional instruction that positively affects the achievement of the learner (Reed, 1986; Singh et al., 1991; Traylor, 2003; William, 1984; Edwards et al., 1975; Mahajan, 1994; Joshi and Mahapatra, 1995; Agarwal, 1995; Rangaraj, 1997; Joy and Shaju, 2004; Burns and Bozeman, 1981; Klein, 2005; Gilbert, 2006; Ragasa, 2008; Kordel, 2008; Cavucci, 2009; Jenks and Springer, n.d.; Wilson, 1993; Elliott, 1985; Barnett, 1985; Rubens, 1986; Niemiec, 1984; Anandan, 2009; Ismail et al., 2009; Philip et al., 2011). The finding holds true for learners of different levels of learning like elementary level (Niemiec, 1984; Cavucci, 2009), secondary (Kann, 1987), vocational education (Elliott, 1985), and high school level (Reed, 1986; Morris, 1986; Chiang, 1986). Greater benefits of CAI are experienced by under-achievers (Reed, 1986) in conjunction with trainee support system (Rose, 1992). Some researchers compared the effectiveness of CAI in different curricular areas. Although the findings are not conclusive, they indicate that the CAI activities are most effective in the field of science including Biology (Singh, 2005), Chemistry (Gupta, 1988), Mathematics (Singh et al., 1991; William, 1984; Burns and Bozeman, 1981; Barnett, 1985; Elliott, 1985), and Physics (Jeyamani, 1991; Chiang, 1986; Rangaraj, 1997). The review of the studies on CAI as a variable also reveals the fact that CAI results in better retention (Morris, 1986; Kann, 1987; Basturk, 2005; Gupta, 1988; Cotton, 2001).

It is revealed that some of the researches have been carried out on the implication of CAI in teaching-learning process with reference to subjects like Chemistry, Mathematics and Physics, but a handful of studies has been conducted on the use of CAI in teaching of Life Science which persuaded the present researchers to raise certain issues like: What is the impact of CAI in the teaching of Life Science? Can CAI replace the traditional method of pedagogy in teaching of Life Science? To find out the answers to these questions, this study entitled “Experiments in Education and Pedagogy in Life Science with special reference to Computer Assisted Instruction" was designed with the objective to study the relative effectiveness of the Computer-Assisted Instructional Approach (CAIA) and Usual Learning Approach (ULA) in teaching Life Science achievement and retention, and it is hypothesized that there exists significant difference between CAIA and ULA in teaching Life Science achievement and retention among the students of class XI with regard to pretest, posttest and delayed test scores.

MATERIALS AND METHODS
Sample
The target population in this study was the students of class XI. A total of 46 students of two schools (23+23) who had Life Science were selected by adopting purposive sampling technique without disturbing the original classroom set-up, and a research involving CAI was automatically conducted in the institution where computers are available for the students to use.

Tools
The tools used for collection of data were Formative tests and Criterion test which were self-developed. Textbook materials were developed into units for conducting the experiment and were presented through Power-Point in the case of CAIA.

Experiment
This study was based on ‘Two Group Randomized Pretest Posttest Design’ and was conducted on 46 students. The experimental group was treated with CAIA and the control group was treated with ULA. In both groups, the Criterion test (pretest) was administered as a measure of previous knowledge. Once scoring was done, the obtained scores were tabulated. The experimental group was exposed to Power-Point presentations. Formative evaluation was taken immediately after each topic. Instruction to the second group was given by using ULA along with Formative evaluation. Post tests were administered as summative test at the end of the instruction. The same Criterion test was administered after a month to find out retention among students.

RESULTS AND DISCUSSION
After conducting the experiments and administering the tests, the mean scores, median, mode and standard deviations were determined for computing the results for both methods which are as follows.

Table 1: The mean scores of CAIA group for the pretest was 38.35, posttest was 51.87 and delayed posttest was 55.13. It indicated that there was a difference in the pretest and posttest as well as delayed posttest scores. The median values (39, 49 and 53) show that 50% of the students scored more than these scores in the pretest, posttest and delayed posttest respectively.

The mode values (40, 49 and 49) are indicative of the
Table 1. Descriptive statistics for the Computer Aided Instructional Approach group.

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Pretest score</th>
<th>Posttest score</th>
<th>Delayed posttest score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>38.35</td>
<td>51.87</td>
<td>55.13</td>
</tr>
<tr>
<td>Median</td>
<td>39</td>
<td>49</td>
<td>53</td>
</tr>
<tr>
<td>Mode</td>
<td>40</td>
<td>49</td>
<td>49</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>6.85</td>
<td>9.05</td>
<td>8.72</td>
</tr>
</tbody>
</table>

Table 2. Descriptive statistics for the Usual Learning Approach (ULA) group.

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Pretest score</th>
<th>Posttest score</th>
<th>Delayed posttest score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>31.75</td>
<td>44.83</td>
<td>47.79</td>
</tr>
<tr>
<td>Median</td>
<td>30</td>
<td>42</td>
<td>45</td>
</tr>
<tr>
<td>Mode</td>
<td>25</td>
<td>38</td>
<td>45</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>7.24</td>
<td>7.37</td>
<td>7.19</td>
</tr>
</tbody>
</table>

Table 3. Co-efficient of correlation among the pretest, posttest and delayed-test of TM and CAI.

<table>
<thead>
<tr>
<th>Groups</th>
<th>CAIA</th>
<th>ULA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Post</td>
<td>0.87</td>
<td>0.77</td>
</tr>
<tr>
<td>Post-Delayed</td>
<td>0.96</td>
<td>0.95</td>
</tr>
<tr>
<td>Pre-Delayed</td>
<td>0.88</td>
<td>0.73</td>
</tr>
</tbody>
</table>

Table 4. N, Mean, SD and ‘t’ values for the pre, post and delayed test scores between CAIA and ULA groups.

<table>
<thead>
<tr>
<th>Test</th>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>‘t’</th>
<th>Significance level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre test</td>
<td>CAIA Group</td>
<td>23</td>
<td>38.35</td>
<td>6.85</td>
<td>3.45</td>
<td>P&lt;0.01</td>
</tr>
<tr>
<td></td>
<td>ULA Group</td>
<td>23</td>
<td>31.25</td>
<td>7.24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post test</td>
<td>CAIA Group</td>
<td>23</td>
<td>51.87</td>
<td>9.05</td>
<td>2.93</td>
<td>P&lt;0.01</td>
</tr>
<tr>
<td></td>
<td>ULA Group</td>
<td>23</td>
<td>44.83</td>
<td>7.37</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delayed test</td>
<td>CAIA Group</td>
<td>23</td>
<td>55.13</td>
<td>8.72</td>
<td>3.14</td>
<td>P&lt;0.01</td>
</tr>
<tr>
<td></td>
<td>ULA Group</td>
<td>23</td>
<td>47.79</td>
<td>7.20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

most repeated scores in the three tests. The standard deviation values (6.85, 9.05 and 8.72) represent the spread of the score compared with the mean.

From Table 2, it was evident that the mean scores of ULA group for the pretest was 31.25, posttest was 44.83 and delayed posttest was 47.79. It indicated that there was a difference in the pretest and posttest as well as delayed posttest scores. The median values (30, 42 and 45) show that 50% of the students scored more than these scores in the pretest, posttest and delayed posttest respectively. The mode values (25, 38 and 45) are indicative of the most repeated scores in the three tests. The standard deviation values (7.24, 7.37 and 7.19) represent the spread of the score compared with the mean.

The delayed posttest scores in both cases indicate that the retention of the students were better in Life Science, when taught through CAIA. To find out the comparative effectiveness of TM and CAI, Pearson’s Co-efficient of Correlation (r) was computed as shown in Table 3.

Table 3 shows that the ULA pretest-posttest correlation is 0.77, posttest-delayed test is 0.95 and pretest-delayed test is 0.73 all of which represent positive correlations, whereas the CAI pretest-posttest correlation is 0.87, posttest-delayed test is 0.96 and pretest-delayed test is 0.88 which again represent that the correlations are positive.

In order to test the above hypothesis, t test was used and the details are given in Table 4. From Table 4, it is evident that the t-value for pretest (3.45), posttest (2.93) and delayed posttest (3.14) are significant at 0.01 levels, indicating that there exists a significant difference in the
mean scores of the CAIA and ULA group in the pre, post and delayed posttest. Thus, it may be concluded that there exists significant difference between CAIA and ULA in Life Science achievement and retention among the students of standard XI with regard to pretest, posttest and delayed test scores. From the mean score values, it could be interpreted that the CAIA group scored more in the pre, post and delayed post tests.

Figure 1 shows the comparison between the posttest scores of CAIA (Series1) and ULA (Series2) which represents a clear picture that CAIA is better than ULA. Thus, the hypothesis is significant and there is true difference between the performances of both groups. CAIA is more effective as compared to ULA in teaching Life Science. This finding agrees with the earlier findings of Reed (1986), Singh et al. (1991), Traynor (2003), William (1984), Edwards et al. (1975), Mahajan (1994), Joshi and Mahapatra (1995), Agarwal (1995), Rangaraj (1997), Joy and Shaiju (2004), Burns and Bozeman (1981), Klein (2005), Gilbert (2006), Ragasa (2008), Kordel (2008), Cavucci (2009), Jenks and Springer (n.d.), Wilson (1993), Elliott (1985), Barnett (1985), Rubens (1986), Niemiec (1984), Anandan (2009), Ismail et al. (2009), Philip et al. (2011) and so on.

Further, the effectiveness of CAIA and ULA on delayed performance (Figure 2) of the two groups was administered after a month and the results depicted that CAIA is effective and it supersedes ULA in terms of delayed performance on the criterion test. This finding is in line with the findings of Morris (1986); Kann (1987); Basturk (2005); Gupta (1988) and Cotton (2001). This analysis again establishes that the hypothesis is true. The results do not discard the use of ULA but suggest that ULA if supplemented with CAIA could yield better
results in terms of learning outcome not only in the field of Life Science (Singh, 2005) but also in Chemistry (Gupta, 1988), Mathematics (Singh et al., 1991; William, 1984; Burns and Bozeman, 1981; Barnett, 1985; Elliott, 1985), Physics (Jeyamani, 1991; Chiang, 1986; Rangaraj, 1997), and other subjects too. Thus, it could be concluded from the study that there exists significant difference between CAIA and ULA in teaching Life Science achievement and retention among the students of class XI with regard to pretest, posttest and delayed test scores, and CAIA proved to be a better method of instruction over ULA.

REFERENCES


