EFFECT OF WEB BASED INSTRUCTION ON ACHIEVEMENT IN BIOLOGY IN RELATION TO MULTIPLE INTELLIGENCES

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Abstract

This study sought to explore the effect of web based instruction on achievement in Biology in relation to multiple intelligences among secondary school students (IX class students) in Amritsar district. A total number of 200 students participated in the study. Data were collected by administering achievement test and the Roger’s Indicator of multiple intelligences. Data were analyzed quantitatively using the Statistical Package for the Social Sciences (SPSS). The study was experimental in nature with 2 X 8 factorial design. Two way ANOVA was used to study the main effect and interactional effect. Independent test was conducted to compare means scores of experimental and control groups on the variables of achievement and multiple intelligences. The study revealed that students achieved higher when taught through web based instructional strategy as compared to their counterparts. It further showed that no significant difference was found in achievement in Biology of both groups with different multiple intelligences. In addition f-value for interactional effect (instructional strategy and multiple intelligences) came out to be significant, showing that interactional effects of both variables do partially effect achievement in Biology. Similarly, there was a statistical significant difference was found in achievement of students with linguistic, Musical, Interpersonal and Naturalist intelligences in online environment.

Keywords- achievement in Biology, multiple intelligences, traditional mode of instruction, web based instruction

I. INTRODUCTION

In order to achieve the instructional objectives in K-era and digital age, teachers have to provide diversified, exploratory and soundly constructed learning experiences. Barley (1999) has expressed that over the past decades education was traditionally meant for bringing students to sources of knowledge, but the time has come to bring sources of knowledge to the students. So teachers have to use a broad variety of technology based instructional programmes/ methods that must be effective in delivery instructional material in a wide-range of learning environments and to diverse group of students with different learning styles and multiple intelligences. Effective technology can reinforce and enrich students’ learning in interactive environment, which encourage
the creativity through e-learning applications in different modes like visualization, simulation and modeling (Manner, 2003; Repnik and Grubelnik, 2010).

Among various instructional technologies, the strategy that has evolved as a useful tool in leading students towards meaningful learning and better learning outcomes is Web based instruction (WBI). Web-based instruction is teaching and learning supported by the attributes and resources of the Internet (Khan, 1997; Relan and Gillami, 1997). As in the educational environment of the 21st century, it is necessary to create educational programmes that are student-centered rather than classroom or university centered (Jackson, 2000). So WBI has gained popularity in education by allowing learner control (Alomyan, 2004), providing practice of self-discipline, time management (Daugherty and Funke, 1998), and 24/7 accessibility (Chuang, 2000). It can be easily delivered to the learners in an individualized manner.

WBI presents multiple representations of a single concept that helps in augments students’ ability to remember and retain information for a longer period of time. Being powerful instructional strategy, WBI enhances the quality of instruction by providing enriched content and results in higher achievement of students. Driscoll (1998) theorizes that cognitive skills that involve solving problems, applying rules and distinguishing among items are best suited for web-based training. Although it caters cognitive learning at the beginning but later it enhances learning in the other domains-effective and psychomotor. Berenson, Boyles and Weaver (2008) found that emotional Intelligence as a predictor for success in online learning Using the web to repeatedly demonstrate a psychomotor task that requires expensive use of materials saves time and money compared with showing the same task repeatedly in a traditional classroom setting (Henke, 1997).

Web based instruction has not only increased cognitive and psychomotor learning rather it has also extended an excellent pedagogical platform accommodating learner’s multiple intelligences. Human beings have eight different kinds of intelligences that reflect different ways of interacting with the world. Each person has a unique combination or profile (Gardner, 1993). Gardner’s theory (1993) provided a wealth of evidence that learners utilize a variety of different mental processes and a number of intelligences are available to individuals. Out of these intelligences, specific intelligences being dominant and others remain recessive. In view of Wilson (1998), Gardner’s theory is helpful in creating a better lesson plan that is diversified and supportive of those students who have a difficult time reaching their level of potential. The success of any instructional system depends on the perfect coordination between teaching styles and learners’ learning styles which is a challenging job on the part of the teacher in the large heterogeneous classrooms. WBI is probably one of the most flexible types of instruction, providing a forum where all intelligences can be represented and cultivated regardless of the physical location of the student (Nelson, 1998).

By utilizing the principles of the dynamics of the internet and Gardner’s multiple intelligence theory, instructional designers/teachers can develop learning experiences that help the students to master the concepts with increased level of motivation. The more engaging the content becomes to the user, the more likely for educational success. The learner will retain new knowledge and remain an active learner during the entire instructional process (Osciak & Milheim, 2001). New Internet-based tools (communication, listservs, chat forums, computer conferencing, and class Web sites) provide multiple avenues for learning as well as the overall design of effective Web-based instruction (Nelson, 1998). These tools appeal to learners with different intelligence. The use of multiple intelligence, humour, and teaching composition in the classroom increases success rate by nearly 17% (Andrioti, 2010). Dara-Abrams (2002) evaluated application of Multi-Intelligent Adaptive Hypermedia to Online Learning by combining adaptive hypermedia and asynchronous Web communication technologies with the cognitive Theory of Multiple Intelligences. The formative evaluation indicated that application of the Theory of Multiple Intelligences, the Entry Point Framework, multiple representations and the Teaching for Understanding Framework will improve the prototype, offering rich multi-intelligent adaptive hypermedia content presentations and moving toward an implementation of “anytime, anywhere, anyone, anyhow” online learning.

All eight intelligences can be utilized effectively in web-based instruction just as in a traditional classroom setting. By designing web-based instruction which adheres to these intelligences, instructional designers will be creating
course content which is more engaging to the end user. Combined research on how technology in relation to multiple intelligences helps cognitive and psychomotor learning would assist organizations and educational institutions to become aware of the level of performance of their learners during a course of instruction. This method of instruction is not a fad, and it is not for the lazy (Abernathy, 1999b, p.36). The continual growth in the use of this pedagogy and its potential to resolve the barriers and problems of education at secondary level, a need was felt by the investigator that schools should incorporate web based instruction as an instructional strategy as it has the potential to develop the various skills and abilities among students and make them better informed and higher achievers.

II. RESEARCH QUESTIONS

This study was guided by the following research questions:

i) What is the difference in achievement of secondary school students in Biology when taught through web based instruction and conventional mode of instruction?

ii) What is the difference in achievement of secondary school students in Biology with different multiple intelligences?

iii) To what extent the interactional effect of instructional strategies and multiple intelligences effect the achievement of secondary school students in Biology?

III. METHODOLOGY

3.1 Design of the study

The present study was experimental in nature. Experimental group was taught through web based instruction and control group through to the conventional mode of instruction. In the present study, 2×8 factorial experimental design was employed. Web based instruction and conventional mode of instruction were independent variables. Classifying independent variable is multiple intelligences. Achievement in biology was a dependent variable.

3.2 SAMPLE OF STUDY

The sample size of this study comprised a total of 200 students from three secondary schools in Amritsar city.

3.2.1 Equating the groups

The sample comprising of 200 students were randomly divided into two groups- the experimental group (N=100) and the control group (N=100). In order to make equivalent groups, matching was done at the pre-test stage for two variables- variable of achievement in Biology (pre-test) and intelligence. t-test was employed to compare mean scores on the variable of achievement in Biology and Intelligence. Insignificant t-ratio showed that both the groups were matched and equivalent. The experimental group was taught with web based instruction and the control group was taught with conventional mode of instruction.

3.2.2 Sample Distribution

As the present study involved two instructional strategies (web based instruction and conventional method) and eight types intelligences, hence the students were distributed at two stages on the basis of instructional strategies and the basis of multiple intelligences.

Stage I. Sample Distribution on the basis of Instructional Strategy

On the basis of instructional strategies (vide Table 1), sample was distributed into two groups i.e. web based instruction and conventional mode of instruction.

Table 1 Distribution of Sample on the basis of Instructional Strategies (N=200)
### Stage II Sample Distribution on the basis of Multiple Intelligences

To distribute the sample on the basis of Multiple Intelligences, Roger's Multiple Intelligences Test was employed. For the purpose of the study, the students of both groups (experimental and control group) were to be distributed on the basis of eight types of multiple intelligences (MI₁ - Linguistic, MI₂ - Musical, MI₃ - Logical Mathematical, MI₄ - Spatial, MI₅ - Bodily/ Kinesthetic, MI₆ - Intrapersonal, MI₇ - Interpersonal, MI₈ - Naturalist).

#### Table 2 Distribution of sample on the basis of multiple intelligences

<table>
<thead>
<tr>
<th>Group</th>
<th>Multiple intelligences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MI₁</td>
</tr>
<tr>
<td>WBI</td>
<td>7</td>
</tr>
<tr>
<td>CMI</td>
<td>14</td>
</tr>
<tr>
<td>Total</td>
<td>21</td>
</tr>
</tbody>
</table>

### 3.3 TOOLS USED

Following tools were used in the study:

- Achievement test (parallel form) in Biology for IX class was used as both pre-test and post-test, (Kaur, 2013).
- The Roger's Indicator of Multiple Intelligences (RIMI) by Rogers (2011).
- Web based instructional Package (Kaur, 2013) was used for teaching to experimental group.
- Group General Test of Intelligence (Ahuja, 2005) was administered to equate the students on the basis of intelligence test scores.

### 3.4 PROCEDURE

The following procedure was adopted for present study:

**Phase I (Matching the Groups and Pre-testing)**

Before implementing the web based instructional package, the two groups-experimental and control groups were randomly selected and were matched on the basis of pre-test scores and intelligence so that equivalent groups could be formed.

**Phase II (Administration of Test)**

In this phase, scores were obtained pertaining to achievement in Biology by administering achievement test to students as pre-test on both groups and Multiple Intelligence Indicator was also administrated to both the groups.

**Phase III (Implementation of the package)**
The students of Experimental group were taught the selected content using web based instruction and students of control group were taught same content by conventional mode of instruction. The duration of instructional treatment will be 21 sessions in each case for each school.

Phase IV (Post-testing)

In this phase, both the groups experimental and control group were administered the achievement test (Parallel form) in Biology as post test.

Collected data were subjected to statistical analysis using Statistical Package for Social Science (SPSS). Inferential statistics were employed in analysing the data.

IV. RESULTS AND DISCUSSION

Presentation of findings is in inferential statistics. These results are presented and discussed as follows in respect of research questions in the form of Main Effect (Instructional Strategies, Multiple Intelligences) and Interactional Effect (Instructional Strategies X Multiple Intelligences). Two way ANOVA was employed. F values were calculated with regard to gain scores of class IX students on the variable of achievement in Biology. Table 3 summaries the results of two way ANOVA.

Table 3: ANOVA 2×8 factorial design showing effect of instructional strategy and Multiple intelligence on achievement of secondary school students in Biology.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Sum of Square</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructional Strategy (A)</td>
<td>176.46</td>
<td>1</td>
<td>176.42</td>
<td>18.42*</td>
</tr>
<tr>
<td>Multiple Intelligence (B)</td>
<td>122.80</td>
<td>7</td>
<td>17.54</td>
<td>1.86</td>
</tr>
<tr>
<td>Instructional Strategy × Multiple Intelligence (AxB)</td>
<td>156.92</td>
<td>7</td>
<td>22.47</td>
<td>2.38*</td>
</tr>
</tbody>
</table>

*Significant at 0.01 level.

4. 1 Main Effect- difference in achievement of secondary school students in Biology with respect to instructional strategies

F-ratio (vide Table 3) for the effect of instructional strategies (WBI and CMI) came out to be 18.42 which is significant at 0.01 level of confidence. To further compare the mean score of achievement of students taught by WBI and CMI, independent test was conducted (shown in table 4).

Table 4: Mean Score of Achievement of students in control and experimental groups

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental Group</td>
<td>100</td>
<td>8.08</td>
<td>3.48</td>
<td>4.30*</td>
</tr>
<tr>
<td>Control Group</td>
<td>100</td>
<td>6.15</td>
<td>2.81</td>
<td></td>
</tr>
</tbody>
</table>

*Significant at 0.01 level

Table 4 reveals that, there is statistically significant difference between achievement in Biology of students taught by WBI (M= 8.08, SD= 3.48) and CMI (M= 6.15, SD=2.81; t =4.30 (significant at 0.01 level of confidence). The finding implies that there is difference in achievement between two groups. It means students taught by WBI achieved higher as compared to their counterparts. It is because, WBI provides the platform of individualized
instruction, 24 X 7 accessibility, involving more senses by providing video, audio and static images. Being based on the philosophy of constructivism, it caters to both individual as well as social aspect. The above result is also consonant with the findings of Lebec (2003).

4. 2 Main Effect- difference in achievement of secondary school students in Biology with respect to multiple intelligences

Results from the Table 3 reveals no significant difference (f-value-1.86) in achievement in Biology of secondary school students with different multiple intelligence. This means that the participants of both the groups (experimental as well as control group) do not show significant statistical difference in achievement in Biology with different intelligences. This can be attributed to students’ knowledge and their interest in the subject Biology. Although the IQ of students varies but Science being the compulsory subject in school so each students has to achieve get through this subject irrespective of different intelligences. In addition to this, the job of teacher has become changeling so she tries to match her teaching style with students’ learning styles by using different A-V aids, thus accommodating students with different intelligences. The findings are partially in line with the findings of Ozdileka(2010) whose study revealed that there were positive low correlations between achievement and mathematical-logical, visual-spatial, and interpersonal intelligences. It was also found out that bodily-kinesthetic learners’ achievement level were lower than mathematical-logical, visual-spatial, and musical learners. Similarly, naturalistic learners’ scores were lower than the mathematical-logical and visual-spatial learners.

4. 3 Interactional effect of instructional strategies and multiple intelligences on achievement in biology of secondary school students

Findings from the Table 3 indicate that f-ratio for the interactional effect of instructional strategies (WBI and CMI) and multiple intelligences came out to be 2.38 which is significant at 0.05 level of confidence. To find out the difference in mean score of achievement of students taught through WBI and CMI with different multiple intelligences, independent test was employed. Results are shown in table 5.

Table 5: Mean Score of Achievement of students through WBI and CMI with different multiple intelligences.

<table>
<thead>
<tr>
<th>Group</th>
<th>CMI</th>
<th>WBI</th>
<th>MI</th>
<th>M</th>
<th>S.D</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>M=5.67</td>
<td>S.D=3.32</td>
<td>N=9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M2</td>
<td>M=5.67</td>
<td>S.D=2.84</td>
<td>N=9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M3</td>
<td>M=5.67</td>
<td>S.D=3.32</td>
<td>N=9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M4</td>
<td>M=5.67</td>
<td>S.D=2.84</td>
<td>N=9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M5</td>
<td>M=5.67</td>
<td>S.D=3.32</td>
<td>N=9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M6</td>
<td>M=5.67</td>
<td>S.D=2.84</td>
<td>N=9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M7</td>
<td>M=5.67</td>
<td>S.D=2.84</td>
<td>N=9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M8</td>
<td>M=5.67</td>
<td>S.D=2.84</td>
<td>N=9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M9</td>
<td>M=5.67</td>
<td>S.D=2.84</td>
<td>N=9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M10</td>
<td>M=5.67</td>
<td>S.D=2.84</td>
<td>N=9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M11</td>
<td>M=5.67</td>
<td>S.D=2.84</td>
<td>N=9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M12</td>
<td>M=5.67</td>
<td>S.D=2.84</td>
<td>N=9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M13</td>
<td>M=5.67</td>
<td>S.D=2.84</td>
<td>N=9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M14</td>
<td>M=5.67</td>
<td>S.D=2.84</td>
<td>N=9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M15</td>
<td>M=5.67</td>
<td>S.D=2.84</td>
<td>N=9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M16</td>
<td>M=5.67</td>
<td>S.D=2.84</td>
<td>N=9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M17</td>
<td>M=5.67</td>
<td>S.D=2.84</td>
<td>N=9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M18</td>
<td>M=5.67</td>
<td>S.D=2.84</td>
<td>N=9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M19</td>
<td>M=5.67</td>
<td>S.D=2.84</td>
<td>N=9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M20</td>
<td>M=5.67</td>
<td>S.D=2.84</td>
<td>N=9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M21</td>
<td>M=5.67</td>
<td>S.D=2.84</td>
<td>N=9</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Referring to table 5, t value for the group of students taught by WBI and CMI with linguistic = (2.49), Musical = (2.84), Interpersonal = (3.61), Naturalist = (2.00) came out to be significant at 0.05 level of confidence.

**Figure 1: Showing mean score of achievement of students taught by WBI and CMI with MI1, MI2, MI7, MI8.**

Figure 1 clearly reveals statistically significant difference between mean scores of achievement of students taught by WBI with MI1 = (9.86), MI2 = (8.63), MI7 = (10.64), MI8 = (8.63) and students taught by CMI with these multiple intelligence. The results show that as WBI provides content material in text, video, audio and facility of social interaction so students with these intelligences feel comfortable in online environment rather than in traditional classroom settings. The above result is partially consistent by the findings job Ricarda (2009), Ghazi and Muhammad, (2011) and Nelson (1998).

**V CONCLUSION AND IMPLICATIONS**

The study found out the effect of web based instruction on achievement of IX class students in biology as compared to Students taught by conventional mode of instruction. However, the study found no difference between in achievement of IX class students in biology on the variable multiple intelligences. But interactional effect of WBI with linguistic, musical, interpersonal and naturalist found to be significant. It means students with these intelligences achieved better when taught through WBI. Based on the findings it can be concluded that web based instructional package should be developed in such a manner that students with diverse multiple intelligences (other than the results) should be benefitted also. So there is a need for a robust implementation of web based instruction in teaching learning process and incorporation of multiple intelligence theory in online environment.

**VI RECOMMENDATIONS:**
Web-based instruction is still in an early stage of implementation. There is need to orient teachers and students towards this new instructional strategy. Initiatives should be taken by school authority and teacher regarding how to integrate multiple intelligence theory in online environment for better results. Beside this, teachers can motivate students how to use their more developed intelligences to aid in the understanding of a subject which normally employs their weaker intelligences (Lazear, 1992).

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