EFFECTS OF WEB BASED INQUIRY SCIENCE ENVIRONMENT ON COGNITIVE OUTCOMES IN BIOLOGICAL SCIENCE IN CORRELATION TO EMOTIONAL INTELLIGENCE

By

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ABSTRACT

This research study is the report of an experiment conducted to find out the effects of web based inquiry science environment on cognitive outcomes in Biological science in correlation to Emotional intelligence. Web based inquiry science environment (WISE) provides a platform for creating inquiry-based science projects for students to work collaboratively using evidence and resources from the Web. All projects make use of some content from the World Wide Web, as well as additional Web pages authored for purposes of the project. This approach helps students learn to use the Internet for inquiry, critiquing Web sites, designing approaches, or comparing arguments. The term cognitive outcomes is applied to science standards for intellectual capacity attained by the students as a result or consequence of learning science. Emotional Intelligence is the silent partner of rational Intelligence – equal in importance, yet frequently overlooked and rarely schooled or tested. In order to find out the efficacy pre-test and post test for non equivalent group design and static group comparison design were conducted.

The tools which were used in the study include the test on cognitive outcomes in Biological science and scale of Emotional intelligence. The total sample consists of 128 students. The significance of difference between means, analysis of covariance, Pearson's product moment correlation and standard error were used for data analysis. Analysis of data showed that students intervened using web based inquiry science environment attaining significantly higher scores than conventional group student's cognitive outcomes. Cognitive outcomes in Biological science and Emotional intelligence were negligibly correlated and web based inquiry science environment has no significant influence on enhancing Emotional intelligence.

Keywords: Web-based Inquiry Science Environment, Cognitive Outcomes, Biological Science, Emotional Intelligence.

INTRODUCTION

Web based inquiry science environment (WISE) provides a platform for creating inquiry-based science projects for students to work collaboratively using evidence and resources from the Web. All projects make use of some content from the World Wide Web, as well as additional Web pages authored for purposes of the project. This approach helps students learn to use the Internet for inquiry, critiquing Web sites, designing approaches, or comparing arguments. Typical projects engage students in designing solutions to problems, debating contemporary science controversies, investigating scientific phenomena, or critiquing scientific claims found in web sites.

WISE projects incorporated Java applets to enable online discussions, data collection, drawing, argument creation, resource sharing, concept mapping and other built-in components. All student work is saved on central project servers that enable student accounts and teacher accounts to be coordinated, with special Web environments designed to support teachers and students. WISE provides a user-friendly interface to facilitate the authoring of new projects, with numerous technology-based components including online discussions, data collection, drawing, argument creation, resource sharing,

concept mapping and other built-in tools. The term cognitive outcomes is applied to science standards for intellectual capacity attained by the students as a result or consequence of learning science. Emotional intelligence is the silent partner of rational Intelligence – equal in importance, yet frequently overlooked and rarely schooled or tested. The skills which belong to highly developed Emotional intelligence include; to be independent from our own feelings, ability to adjust ourselves to them, ability to recognize, name and direct our feelings, discern the nuances of feelings, and use them in a positive way and able to derive actions from them.

Need and significance of the study

When young children first approach to a structured educational setting their fledging social and emotional skills and understandings are challenged in new and more complex ways. They will need to interact and negotiate with a large number of unfamiliar peers with different levels of social and emotional competencies, interests, cognitive abilities and interaction styles (American Association for the Advancement of Science, 1990). Equally important, the ability to interact competently and positively with others is as important for success in life as the acquisition of academic skills and knowledge.

Most of what students learn is predetermined by the curriculum and thus the nature of education is essentially a process of socialization into a pre existing epistemological world. The knowledge source of World Wide Web can be utilized for teaching Biological science effectively. Accordingly the research reported here was aimed at documenting and explaining the effectiveness of Web based inquiry science environment in enhancing cognitive outcomes in Biological science, if any.

Review of related studies

Inquiry and technology within elementary and secondary school science curriculum focuses on WISE (Web-Based Inquiry Science Environment) that was developed to provide effective designs for inquiry activities and assessments, technology supports for students and teachers, authoring partnerships to create a library of inquiry projects, and professional development programmes for teachers (Slotta, 2002). Furberg (2009) demonstrates the value of a socio-cultural perspective for gaining a deeper understanding of student's engagement with web based learning environments. Such a perspective can give valuable insight into how to (re)design prompts, and how prompts can be productive parts of student's learning. The teacher's classroom practices shifted meaningfully over time, thus moving WISE from the peripheral to the center of the science class instruction (Williams, 2008).

Students applied the processes of practicing digital responsibility; practicing digital literacy; organizing content; collaborating and socializing; and synthesizing and creating. These processes informed a model of the networked student that serves as a reference for future instructional designs (Drexler, 2010). Student's creativity was motivated by the online interactivities and the teacher's inquiry. The difficulties and limitations of the teaching and learning environment included strong attraction toward the Internet, poor ability of students in word processing and discussion online, student's utilitarianism due to the pressure of entrance examination, and large amount of time spent on explorative activities (Jang, 2009). It is assumed that effective learning has to be organized through pedagogically constrained gateways by manifesting certain affordances in the context in order to build up the dynamic semiosphere model for learners. (Pata, Pedaste & Sarapuu, 2007). Emotions are reliably associated with several cognitive outcomes, including increased attentional control, working memory, metalinguistic awareness, and abstract and symbolic representation skills. Overall mean effect sizes varied from small to large, depending on the cognitive outcomes measured, and were moderated by methodological features of the studies (Adesope, Lavin, Thompson & Ungerleider, 2010). The concept mapping strategy was found to be advantageous only for students whose cognitive ability was below the median for the sample and who were placed in groups with other students having low cognitive ability (Haugwitz, Nesbit & Sandmann, 2010).

Objectives of the study

The objectives formulated for the present study were;

- To design learning plan based on Web based

inquiry science environment.

- To develop suitable testing materials to measure the cognitive outcomes in Biological science.
- To find out the relationship between cognitive outcomes in Biological science and Emotional intelligence in pupils taught through Web based inquiry science environment and to study the effects of the strategy on Emotional intelligence.

Hypotheses of the study

The hypotheses formulated for the present study were;

- Students taught through Web based Inquiry science environment will differ significantly from students taught through conventional method of teaching with regard to cognitive outcomes in Biological science.
- There will be significant relationship between cognitive outcomes in Biological science and Emotional intelligence in pupils taught in Web based Inquiry science environment and the strategy have significant effect on Emotional intelligence.

Sample of the study

Students of ninth standard in the secondary schools of Kerala were considered as the population for the study. For the experimental part of the study the investigator felt it difficult to conduct the experiment on large sample because class size has great role in the acceleration of cognitive outcomes. It is noticed that in recent years there has been a marked increase of interest in small groups. Smaller groups are advocated because they are seemed to allow for greater participation and involvement by the students.

The experimental part of the study comprises the intervention of WISE and its comparison with the conventional treatment. The experimental part was conducted using experimental and control groups. The experimental part of the study was conducted in five secondary schools on a sample of 128 students of intact standard IX classes with 32 students each as the experimental and control group. The survey part of the study involves a total sample of 128 students of standard IX. The experimental and control groups were selected by giving adequate representation to efficiency level, gender and locality of the students. The same population was used as samples in experimental and survey part.

Experimental and survey design

The method adopted for the present study was experimental cum survey design. The pre test - post test non equivalent group design (Best & Kahn, 1995) was selected to determine the effects of Web based Inquiry science environment on cognitive outcomes in Biological science. Static group comparison design (Best & Kahn, 1995) was adopted to find out the relationship between cognitive outcomes in Biological science and Emotional intelligence. The same design was followed to determine the efficacy of Web based Inquiry science environment on Emotional intelligence. The investigator created an action plan for teaching Biological science incorporating Web based inquiry science environment. The tools which were used in the study include the test on cognitive outcomes in Biological science and scale of Emotional intelligence.

Validity and Reliability of the Test

Validity of the test is defined as the accuracy with which the test measures what it is supposed to measure. Since the test was constructed keeping in view of the weightage for content and instructional objectives on the one hand and the expert comments on the other, it was treated as a valid test. Also to ensure criterion validity the correlation between the scores of the test with the marks of school examination in science was also found out. For this the marks obtained by the students were collected from the school records. Thus the concurrent validity was calculated using the Pearson's correlation coefficient method and was found to be 0.72. Practical application of criterion referenced test results in assignment of individuals to either 'mastery' or 'non mastery' category or one of several categories, each of which indicates a particular level of mastery. The only and relevant score available is the one that indicates the level of mastery attained. Methods of estimating reliability of such tests must take into account the nature of the scores available.

The variability in the distribution of criterion referenced test scores depends heavily on the choice of criterion level.

Therefore the usual correlational methods for determining reliability of such tests are not appropriate. It seems reasonable to view criterion referenced measurement as a procedure for assigning students to one of several ordered categories, each corresponding to a particular mastery state or level. In the simplest case, which is detailed here, there are only two such states master or non master.

Results and discussion

Arithmetic mean, standard deviation, test of significance of difference between means and analysis of covariance (Scheffe, 1959) were used to compare the relevant variables between experimental and control groups. Pearson's product moment correlation, Standard error and test of significance of difference between means (Garett & Woodworth, 1973) were used to find out the relationship between cognitive outcomes in Biological science and Emotional intelligence. The results are tabulated in Table 1 to Table 5.

Effectiveness of Web based Inquiry science environment over the conventional method of teaching

The obtained value 7.71 is greater than the table values at .01 levels and at .05 levels and is significant even at .01 level, (C.R. =7.71; p<.01). The mean of the post-test scores of the experimental group is greater than that of control group. So then it can be tentatively concluded that web based inquiry science environment has a greater effect on the student's cognitive outcomes in Biological science than the Conventional method. It clearly implies that WISE can be effectively brought into the normal class rooms for improving cognition.

Effectiveness of Web based Inquiry science environment over the conventional method of teaching (using ANCOVA)

To determine the effectiveness of Web based Inquiry science environment over the conventional method of teaching the final (Y) scores were corrected for differences in initial (X) scores. For that, the SS_y have been adjusted for any variability in 'Y' contributed by 'X'. The adjusted sum of squares of 'Y', that is SS_{yx}, were computed and the F ratio (F_{yx}) was calculated. The summary of analysis of covariance of pre-test and post-test scores of pupils in experimental and control groups is given in Table 2.

F_x=0.40

F_y=33.69

F_{yx} = 51.45

df = 1/125

From Table F for df 1/125

F at 0.05 level = 3.94

F at 0.01 level = 6.90

The obtained F_x and F_y ratios were tested for significance. The calculated value of F_x is 0.40, it is not significant even at .05 level (F_x=0.40; p>.05). The value of F_y obtained (F_y= 33.69; p<.01) is significant at .01 level. This indicates that there is significant difference in post-test between the performance of pupils in experimental and control groups. The obtained F_{yx} ratio is highly significant (F_{yx}=51.45; p<.01). It is clear from the significant F_{yx} ratio that the two final means which depend upon the experimental and control variables differ after they have been adjusted for initial difference in the pre-test scores.

The adjusted means for post-test scores ('Y' means) of pupils in the experimental and control groups were computed using correlation and regression. The difference between the adjusted 'Y' means of post-test scores of pupils in

Group	Number of pupils	Mean	Standard deviation	Critical ratio	Level of significance
Experimental group	64	27.06	5.14	7.71	p<.01
Control group	64	20.06	5.13		

Table 1. Comparison of the difference between the mean scores of cognitive outcomes in Biological science in post test of experimental and control group

Source of variation	df	SSx	SSy	SSxy	SSyx	MSyx	SDyx
Among means	1	5	1207	73.7	1035	1035	4.48
Within groups	125	1416	4513	1682.9	2513.4	20	
Total	126	1421	5720	1757	3548		

Table 2. Summary of ANCOVA of pre test and post test scores of pupils in Experimental and Control Groups

Groups	N	Mx	My	Myx(adjusted)
Experimental group	64	8.98	26.44	26.20
Control group	64	8.61	20.30	20.50
General means		8.80	23.37	23.37

Table 3. Comparison of data for Adjusted Means of post test scores of pupils in experimental and control group

experimental and control groups are given in Table 3.

SEm between the adjusted means = 0.56

t = 7.18

From Table D for df 125

t at 0.05 level = 1.98

t at 0.01 level = 2.62

Adjusted means for the post-test scores were tested for significance. The obtained value 7.18 is significant at .01 level. The significant 't' value leads to the conclusion that the two means differ considerably. This implies that the experimental group and the control group differ significantly in their cognitive outcomes in Biological science. As the adjusted mean score for the experimental group is higher than that of the control group, the experimental group can be said to be superior to control group. Then, it can be stated that the pupils taught by Web based inquiry science environment have better cognitive outcomes in Biological science than those taught by conventional method at secondary level.

Relationship between cognitive outcomes in Biological Science and Emotional Intelligence

The relationship between cognitive outcomes in Biological science and Emotional intelligence for the total sample was found out using the Pearson's product moment method and the coefficient of correlation was obtained. The details are given in Table 4.

The results presented in the table shows that the coefficient of correlation between cognitive outcomes in Biological science and Emotional intelligence for the total sample is 0.080. The table values of 'r' at .01 level and at .05 level are 0.256 and 0.196 respectively. The obtained value 0.080 is positive and lower than the table value and is not significant even at .05 level, indicating that there is negligible or indifferent correlation existing between cognitive outcomes in Biological science and Emotional intelligence. This proves that cognitive outcomes are something different from Emotional intelligence. Hence strategies to improve cognitive outcomes mismatch with emotional intelligence.

Variables correlated	N	r
Cognitive outcomes in Biological Science and Emotional intelligence	128	0.080

Table 4. Summary of the correlation analysis between cognitive outcomes in biological science and Emotional intelligence

Comparison of the Effectiveness of Web based inquiry science environment and Conventional Method on Emotional Intelligence

The scores of Emotional intelligence of the students of experimental group exposed to the Web based inquiry science environment and the control group taught through the conventional method of teaching were analyzed to determine the effectiveness of Web based inquiry science environment on Emotional intelligence in comparison with the conventional method of teaching. The Pearson's product moment correlation, standard error and test of significance of difference between means for the post test scores of the experimental and control group were calculated and Table 5 present the details of the analysis.

The obtained value of critical ratio for the experimental and control group is 0.440. The obtained value 0.440 is less than the table values and is not significant even at .05 level, (C.R. =0.440; p>.01). It means that there is no significant difference existing between the experimental and control group with regard to the level of Emotional intelligence. Hence it is inferred that Web based inquiry science environment is not having significant impact on improving Emotional Intelligence in pupils at secondary level.

Findings of the study

Major findings of the study are as follows:

- Web based inquiry science environment significantly enhances cognitive outcomes in Biological science.
- Cognitive outcomes in Biological science and Emotional intelligence have negligible or indifferent correlation.
- Web based inquiry science environment is not

Groups compared	r	N	Mean	SD	S E	t	Level
Experimental Group	0.080	64	111.53	29.22	4.70	0.440	p>.01
Control Group		64	109.45	23.92			

Table 5. Summary of the correlation analysis and difference between the means of Cognitive outcomes in Biological science and Emotional intelligence scores of experimental and control group

having significant influence on improving Emotional Intelligence in pupils at secondary level.

Implications and Conclusion

In the present study learning is enhanced in contexts, where learners have supportive relationships, have a sense of ownership and control over the learning process, and can learn with and from each other in creative learning contexts. There is an urgent need to change school curricula so that they may provide adequate opportunities to transfer skills, habits and attitudes from the classrooms to the outside world. Integrating new information in familiar contexts facilitates the organization of new information into long term memory and makes it more available in needed situations. WISE brings more information into the classroom which motivates the students, thus enhancing the cognitive outcomes.

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