A Study on Learning Effect among Different Learning Styles in a Web-based Lab of Science at Elementary Schools

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Abstract

The purpose of this study is to explore the learning effect related to different learning styles in a science web-based virtual laboratory at elementary school level. The design of a on-line virtual-lab allows teachers to integrate Information and Communication Technology (ICT) into science teaching. The results of this experimental teaching method demonstrate that: (a) students in the experimental group using the on-line virtual-lab achieved better grades than those in the control group under conventional class introduction, (b) in the experimental group, grade achievements out of different learning styles are not obviously different from each other. The web-based virtual learning environment is suitable for various learning styles, (c) students with "accommodator" style achieved most significantly in the project, and (d) up to 75% of the students surveyed indicated that they would prefer using the web-based virtual lab to learn than reading textbooks only. The result of the experimental teaching and the survey show the feasibility and effectiveness of the conception of a web-based learning environment being studied. It encourages further development of the idea..

1. Introduction

This study primarily highlights the investigation of how a web-based-lab learning environment influences the effectiveness of school science teaching. Therefore, a web-based virtual lab for elementary school science courses was established to examine the effectiveness and its influence on students' learning habits. This study helps to seek for a new direction for integrating information technology into science courses at elementary schools. Topics discussed include: the meaning of integrating information technology into teaching, information-integrated teaching and on-line teaching, on-line learning research and development, and learning styles.

1.1 The Research and Development of On-line Learning

Given the widespread use of the Internet and the boom in homepage design, web-based classrooms and homepage teaching materials will become a key medium in on–line learning for most people. "Acting to enhance the quality of Internet education in elementary and secondary schools" (Ho, 1998) analyzed 177 websites that are registered with Taiwanese search engines and suitable for elementary and secondary students. In terms of medium characteristics, most teaching websites (88%) were static; moreover, in terms of content functions, most websites (54%) provided teaching materials, and some (34%) provided testing bases. Thus, it is assumed that applying Internet technologies to more motivational teaching and more active learning is feasible.

1.2 Learning Styles

A learning style describes a relatively stable response mode cultivated in the wake of learners' perceptions of their interactions with the learning environment, generally including personal cognitive patterns, affective characteristics, and physiological habits. Kolb's Learning-Style Inventory (Kolb, 1985) catagorized group's experiential learning behaviors into two dimensions and four learning modes, that is, diverger, assimilator, converger, and accommodator. These four learning modes will be used in this study for realizing the effect in the web-based-lab learning environment.

Proceedings of the Fifth IEEE International Conference on Advanced Learning Technologies (ICALT'05)
0-7695-2338-2/05 $20.00 © 2005 **IEEE**

2. Methodology

The method in this study includes research methodology, web-based lab operation and experimental research.

2.1 Research Method

The method of this study comprises three major steps. The first step involves pre-test, sampling, and grouping; the second step comprises experimental treatment, and the final step comprises post-testing and a questionnaire survey about web-based-lab teaching.

2.2 Operation of Web-based Lab

In the virtual web-based science lab (VWBSL), users can operate each lab tool freely and observe the experimental process (as indicated in Fig.1). The system records each step of the operating process and this information can be provided to the teachers for observing, analyzing and correcting any students' mistakes made during the experiment. Teachers can also examine the functions of recorded files. The complete operating records will enable them to monitor the situations of the lab-use and to realize the individual student's learning. Teachers thus can help students find out their mistakes and help them make necessary corrections.

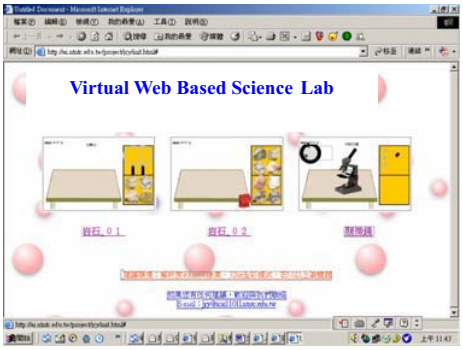

Figure 1. Portal of VWBSL

3. Discussion

The statistical findings and discussions of this study are presented hereafter:

3.1 Influence of the experimental treatment on students' achievement in Science

From Table 1 and Table 2, we can find the teaching effectiveness generated by different experiment-operating learning is significant ($F=3.812$, $P <. 05$), indicating great different achievement between the experimental groups and control groups science learning with/without operating experiments. That is, the web-based lab system proposed here effectively elevates learning achievement of elementary school students in Science.

Table 1、 Mean scores and standard deviations of the natural science achievement on the pretest, on the posttest, and on the posttest after adjustment

Group	Number	Pretest		Posttest		Posttest (after adjustment)	
		Mean score	SD	Mean score	SD	Mean score	SD
Exper-imental group	57	77.04	10.96	84.98	8.501	85.00	1.253
Contr-ol group	55	77.49	12.64	81.62	12.76	81.59	1.275
Total students	112	77.45	11.76	83.33	10.89		

Table 2、 Summary of the analysis of covariance for different experimental treatments

Source of variance	Sum of the squares of deviations	Degree of freedom	Square root	F value
Inter-group (experimental treatment)	324.227	1	324.227	3.624*
Intra-group (error)	9752.254	109	89.470	

*P<.05

3.2 The influence brought by operating experiment on learning effectiveness of students with different learning styles

From Table 3, "Summary of the Analysis of Covariance of the Experiment-operating of the Experimental Group" indicates that the science achievement of different learning styles in the experimental group fails to reach a visible level ($F = 1.532$) after receiving the web-based-lab teaching. That is, after conducting the "web-based lab system" teaching, the learning effectiveness is not obviously visible among students with different learning styles. Consequently, the web-based lab system can accommodate students with different learning styles.

The major factors of different learning effectiveness are then analyzed. The analytical result indicates that only the students with "Accommodator Learning Style" show better achievement between the experimental group and the control group: the scores obtained by the experimental group are remarkably better than those achieved by the control group (Table 4). This result attributes to the accommodator learning style comprising two main learning characteristics: tangible experience and active verification. Therefore, learners with accommodator learning style have unique plan implementation, task completion and ability to integrate accomplishments with new experience. The web-based virtual lab thus is extremely suitable of this style.

Table3、Summary of the analysis of covariance for different learning styles in the experimental group

Source of variance	Sum of the squares of deviations	Degree of freedom	Square root	F value
Inter-group (experimental treatment)	291.293	3	97.098	1.556
Intra-group (error)	3245.898	52	62.421	

*P<.05

Table 4、Summary of the analysis of covariance of the "accommodator" learning style between the control group and the experimental group

Source of variance	Sum of the squares of deviations	Degree of freedom	Square root	F value
Inter-group (experimental treatment)	689.285	1	689.285	14.355*
Intra-group (error)	1536.553	32	48.017	

*P<.05

4. Conclusions

In whole, the findings indicate that the web-based lab for science teaching positively influences the effectiveness of natural science learning of primary school students. The findings are presented as the following:

4.1 The influence of the web-based lab for science teaching on students' science achievement

From the results of the group experiments, the learning effectiveness achieved by the experimental group is higher than that of the control group, and moreover, the difference is significant. The experimental group that received the web-based lab science teaching thus achieved better learning effectiveness than their control-group counterpart that received traditional instruction.

4.2 The influence of the web-based lab for science on the learning effectiveness of students with different learning styles

According to the results obtained from group experiments, learners of the "accommodator" learning style display a significant progress in science learning, but the interactions between learning styles and the use of web-based lab are not significant, indicating that after undergoing different experiment operations, students with different learning styles do not display significant differences in science learning achievement. Simultaneously, in the experimental group, the achievement in science learning of different learning styles also fails to reach to a significant degree. Regardless of the learning styles, all students benefit from using the web-based lab. Therefore, the web-based lab system is better than traditional teaching methods in meeting with the needs of students with different learning styles.

Acknowledgments

The National Science Council of Taiwan, ROC, supported this research under grant NSC 92-2520-S-024-001.

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