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WebQuest experience: Pre-Service secondary maths and chemistry teachers

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Abstract

The aim of this study was to examine the impact of developing WebQuests on the attention, confidence, relevance and satisfaction, or motivation, of pre-service secondary mathematics and chemistry teachers in the instructional technologies and material design course. There were a total of 67 pre-service teachers, 32 pre-service secondary mathematics teachers and 35 pre-service secondary chemistry teachers involved in this study, which took place over seven weeks. The pre-service teachers in both groups designed their WebQuests suitable for the level of high-school students. The researcher used a questionnaire in the collection of the data to find the motivational level of the participants. It was given to the participants by the researcher before and after the instruction during a single class period. The paired-samples t-test, independent samples t-test and ANCOVA were used in the analysis of the quantitative data. The study showed that designing WebQuests had more effect on the attention, confidence and relevance of the pre-service chemistry teachers than of the pre-service mathematics teachers. However, in general, although developing WebQuests had positive effects on the motivational levels of both pre-service secondary maths and chemistry teachers, there were no statistically significant differences found in relation to the motivational levels of both groups.

Keywords: WebQuests, pre-service teachers, attention, confidence, relevance, satisfaction

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1. Introduction

Nowadays many research studies have shown that the use of technology has become very popular in all educational areas, such as mathematics education, science education, social studies education, health, marketing and so forth (e.g., Wei & Chen, 2006; Lim & Hernandez, 2007; Kachina, 2012). In addition, most educators are excited about the the implementation of the technology in their teaching and the self-improvement in their skills (i.e., Halat & Jakubowski, 2001; Whitworth & Berson, 2003; Heafner, 2004; Bates, 2008; Halat & Peker, 2011; Yang, Tzuo & Komara, 2011). Moreover, professional organizations recommend that new ideas, theories and research findings should be used in classrooms and that technological developments should be integrated into classrooms to help students improve their abilities and knowledge (National Council for the Social Studies (NCSS), 2002; National Educational Technology Standards (NETS-T), 2000; National Council of Mathematics Teachers (NCTM), 2000).

Furthermore, teaching and learning theories and approaches play important roles in teacher preparation programmes at universities because these theories give an opportunity to the pre-service teachers to extend their pedagogical knowledge and to design practices before teaching in real classrooms (e.g., Bates, 2008; Yang et al., 2011). In addition to knowledge of educational theories, the pre-service teachers are also expected to be capable in the use of technology for teaching and learning (i.e., NETS-T 2000).

According to several research findings (i.e., Dodge, 2001; Halat, 2008; Altstaedter & Jones, 2009; Allen & Street, 2007), WebQuest can be used in classrooms as an alternative teaching and learning technique. WebQuest has been found to have positive effects on the motivation of pre-service elementary, social studies and special education teachers (Halat, 2008; Yang et al., 2011; Halat & Karakuş, 2014). In this study the researcher chose two different groups from two different disciplines to examine their attitudes towards the use of technology in classrooms.

1.1. Purpose of the Study

The purpose of this study was to examine and compare the effects of developing WebQuests on the attention, confidence, relevance and satisfaction, or motivation, levels of pre-service secondary maths and chemistry teachers in an instructional technologies and material design course, in which the pre-service maths and chemistry teachers were required to design WebQuest-based applications appropriate for the level of high-school students. In particular, the following questions guided the study:

1-) Does the development of WebQuests play a prominent role on the attention, confidence, relevance and satisfaction of the pre-service secondary maths and chemistry teachers?

2-) Is there a difference between the motivational levels of the pre-service secondary maths and chemistry teachers who developed WebQuests?

2. Method

2.1. Participants

The current study included 67 pre-service secondary teachers. Thirty-two were pre-service secondary mathematics teachers and 35 were pre-service secondary chemistry teachers. The

researcher followed the "convenience" sampling procedure defined by McMillan (2000), whereby a group of students is selected because of availability. The participants in the study were enrolled in an educational course, called "instructional technologies and material design course", at a university situated in the western part of Turkey. The study was conducted in the autumn semester, 2014. These pre-service teachers were seniors from the Faculty of Science and Literature. They took the pedagogic courses from the Faculty of Education at the weekends.

2.2. Data Source

The researcher began the data collection process by giving the pre-service secondary maths and chemistry teachers a questionnaire named the *Course Interest Survey* (CIS), both as pre-test and post-test. This Likert-type questionnaire *(CIS)* included 34 positive and negative statements grouped into four parts; Attention, Confidence, Relevance and Satisfaction (Keller 1999). The CIS is designed to investigate how students are motivated, or expected to be, by a particular setting. The researcher gave the questionnaire to the pre-service teachers for 15 minutes. In the study, both pre-service secondary maths and chemistry teachers met for four hours instruction at the weekend and the study was completed in seven weeks. The reliability estimate of CIS obtained by using Cronbach's alpha measure was 0.89 for the total scale. Reliability estimates based on Cronbach's alpha were obtained for each subscale: Attention: 0.84, Confidence: 0.81, Relevance: 0.84 and Satisfaction: 0.88.

2.3. Instructional Procedures

The researcher conducted the study in an instructional technologies and material design course in which the pre-service maths and chemistry teachers were required to develop or design educational teaching and learning materials based on the high school maths and chemistry curriculum standards for each grade level of high-school students (Talim Terbiye Kurulu Başkanlığı (TTKB), 2013). The reason for developing educational materials was to help the high-school students understand the topics easily in any area, such as maths, physics, chemistry and so forth, or comprehend the concepts in difficult topics. Having this kind of experience would give the pre-service maths or chemistry teachers a chance to refine their content or pedagogical content knowledge, learn students' difficulties or misconceptions about a topic in mathematics, or in chemistry, or try to learn how to integrate technology in maths classes, or in chemistry classes and so on.

The researcher chose to do WebQuest-based projects as an opportunity for the pre-service secondary maths and chemistry teachers not only to learn how to do a project and design a website, but, more importantly, to develop engaging, appropriate pedagogical strategies for using the internet in maths or science education. Furthermore, the participants had an excellent opportunity to practise their pedagogical and content knowledge in a virtual environment with WebQuests before going into the classes. These were the main objectives of the course as suggested to the pre-service teachers in the study.

Although this is not a treatment and control type study, there were two groups, maths and chemistry classes. The researcher was curious about the effects of developing WebQuests on the motivation of the pre-service secondary teachers from two different scientific areas, maths and chemistry. The pre-service secondary teachers in both maths and chemistry classes were required to design WebQuests as a group project including two persons.

2.4. WebQuests Development Procedure

Most of the pre-service secondary teachers in this current study did not have any information about the theoretical structure of the WebQuest and did not know how to develop a website. At the beginning of the study, the researcher explained the theoretical structure of a good WebQuest and showed some examples taken from the previous studies done by the researcher, as well as several WebQuests from the website run by Bernie Dodge. After becoming familiar with the WebQuest and its structure, the researcher explained how to use a webpage editor, Microsoft FrontPage, and develop a simple website.

When the pre-service secondary teachers were comfortable with theoretical parts of the WebQuests and use of a webpage editor, they chose their partners for their project work. All groups included two pre-service secondary teachers, except one that included three pre-service secondary chemistry teachers. Two pre-service maths teachers in each group worked together and chose a topic in mathematics, or geometry, such as functions, sets, logarithm, 3-D figures, ratio and proportions, triangles, word problems, factoring and so on. Likewise, the pre-service chemistry teachers in each group worked together and chose a topic in chemistry, such as periodic table, atomic models, crystallization, mixtures, vitamins, chemical bonds, acids and bases, acid-base solutions and so forth. The participants in each group wrote their stories or scenarios adapted from cartoon movies, such as Harry Potter, Winky-Po, Super Mario, Louie, SpongeBob and Scooby Do, on a topic they chose. After the seven-week process of developing WebQuests, the pre-service secondary maths and chemistry teachers in each group presented their WebQuests to their classes and shared their opinions with their peers about their projects.

2.5. Data Analysis

In the analysis of the data, the researcher first used the paired samples t-test to find out the differences between pre-and post-test scores based on the CIS for groups, mathematicians and chemists. This statistical procedure also helped the researcher see the effects of instruction on the pre-service teachers' motivation for each group. Then, the independent samples t-test statistical procedure was used with $\alpha = 0.05$ on the pre-service teachers' pre-test scores from CIS to determine whether there were any differences between the motivational levels of mathematicians and chemists. The independent samples t-test showed mean score differences in regard to motivational level between the two groups, favouring the mathematicians. Finally, the researcher used one-way analysis of covariance (ANCOVA) with $\alpha = 0.05$, because of the initial differences with reference to the pre-service teachers' motivational levels between the groups. ANCOVA enabled the researcher to compare the motivational levels of mathematicians and chemists.

3. Results

The results of the independent samples t-tests used for the analysis of the pre- and post-tests showed that the mean scores of the pre-service secondary mathematics teachers with regard to attention, confidence, relevance and satisfaction based on the pre-CIS test scores were numerically higher than the mean scores of pre-service secondary chemistry teachers. Table 1 and Table 2 demonstrate that the numerical difference for each subscale was statistically significant. In other words, at the beginning of the study and at the end of the study, the motivational levels of the pre-service secondary mathematics teachers were greater than those of the pre-service chemistry teachers in the instructional technologies and material design course.

Table 1. *Independent Samples t-test results based on the CIS scores*

	Group	N	Mean	t	p
Pre-Attention	Maths	32	31.59	3.69	0.001
	Chemistry	35	28.37		
Pre-Confidence	Maths	32	34.90	2.81	0.007
	Chemistry	35	32.65		
Pre-Relevance	Maths	32	37.09	4.21	0.000
	Chemistry	35	32.20		
Pre-Satisfaction	Maths	32	36.34	3.46	0.001
	Chemistry	35	33.05		
Pre-Motivation	Maths	32	139.93	4.74	0.000
	Chemistry	35	126.28		

Table 2. *Independent Samples t-test results based on the CIS scores*

	Group	N	Mean	t	p
Post-Attention	Maths	32	31.56	2.61	0.012
	Chemistry	35	29.17		
Post-Confidence	Maths	32	33.81	1.10	0.273
	Chemistry	35	32.80		
Post-Relevance	Maths	32	37.96	3.41	0.001
	Chemistry	35	33.77		
Post-Satisfaction	Maths	32	37.78	3.95	0.000
	Chemistry	35	34.00		
Post-Motivation	Maths	32	141.12	3.57	0.001
	Chemistry	35	129.74		

A positive change can be seen in the motivational levels of both groups after seven weeks of instruction in the classes. According to Table 3, there were positive changes to the motivational levels of the pre-service secondary maths and chemistry teachers between the pre- and post-CIS scores. However, the positive changes in the motivational levels of the chemists between pre-and post-CIS scores were statistically significant, while the increase between pre-and post-CIS scores in reference to the motivational levels of the mathematicians was not statistically significant. Although developing WebQuests played a prominent role on the motivational levels of both mathematicians and chemists, the result of the ANCOVA statistical procedure indicate that the adjusted mean scores of both groups in reference to the motivational levels are almost equal. As can be seen in Table 4, there were no differences found in regard to the motivational level between the pre-service secondary mathematics and chemistry teachers in the instructional technologies and material design course.

Table 3. *Descriptive Statistics and the Paired Samples T-Test for Participants' Motivation Based on the CIS Scores by WebQuests*

Groups	N	Pre-test		Post-test			Post-test*	
		M	SD	M	SD	t	M	SE
Maths	32	139.93	8.13	141.12	10.50	-0.94	135.08[a]	1.6
Chemistry	35	126.28	14.74	129.74	15.29	-2.09**	135.26[a]	1.5
Total	67							

Note. a: Evaluated at covariates appeared in the model: Pre-motivation =132.80,
*Estimated Marginal Means, CIS: Course Interest Survey. ** $p=0.044 < \alpha=0.05$

Table 4. Summary of ANCOVA for Participants' Motivation Based on the CIS Scores by WebQuests

Sources	Type III Sum of Squares	df	Mean Square	F	p
Pre-test	6,768.46	1	6,768.46	94.13	0.00
Group	0.394	1	0.394	0.005	0.94
Total	1,237,855.00	67			

4. Discussion and Conclusion

The current study indicated that developing WebQuest-based applications in the instructional technologies and material design course had positive impacts on the motivational levels of both pre-service secondary maths and chemistry teachers. This finding supports the results of several research studies, such as Halat and Jakubowski (2001), Halat (2008), Altstaedter and Jones (2009) and Halat and Peker (2011). For example, the study of Halat (2008) with prospective elementary school teachers on the implementation of WebQuests showed that the prospective elementary school teachers who developed the WebQuest-based activities indicated more positive attitudes towards the mathematics course than the others who did the regular course work. Moreover, Altstaedter and Jones (2009) stated that WebQuests could be an alternative and effective way to motivate undergraduate students in a foreign language course.

In particular, the study also documented that having WebQuest experiences in the instructional technologies and material design course played a prominent role on the attention, satisfaction, confidence and relevance of the pre-service secondary teachers. Although the mean scores of the pre-service secondary maths teachers for the variables, such as attention, satisfaction, confidence and relevance were numerically higher than the mean scores of the pre-service secondary chemistry teachers, there were statistically significant differences found with regard to the attention, satisfaction and relevance between the pre-service maths and chemistry teachers, favouring the pre-service maths teachers. However, in general, even though developing WebQuests had a great impact on the motivational levels of both pre-service secondary maths and chemistry teachers, there were no statistically significant differences found in relation to the motivational levels of both groups.

This result is in contrast with the findings of some research studies (e.g., Halat, 2008; Yang et al., 2011; Halat & Karakuş, 2014). For instance, according to the study of Halat and Karakuş (2014), "there was statistically significant difference detected with reference to motivation between the treatment and control groups favoring the treatment group. In other words, the pre-service social studies teachers who designed WebQuest-based applications in an instructional technologies and material design course indicated a greater motivational performance than the others who did not design WebQuest-based applications in their course work." (p. 27). Similarly, Yang et al. (2011) claimed that developing WebQuest-based applications had positive effects on the pre-service special education

teachers, who expressed that, after dealing with WebQuests, they were well motivated to use more technology and web resources in their future career.

Moreover, this study showed that it was an excellent opportunity for the participants to have this kind of experience in the classroom for their educational career. This is because developing WebQuest- based applications appropriate for high-school students in the instructional technologies and material design course gave the pre-service secondary maths and chemistry teachers a chance to practise their pedagogical and mathematical or chemistry content knowledge in a visual environment, gave them experience in how to integrate technology into their teaching and showed them how effectively the internet as a resource could be used in the classroom.

As a conclusion, the current study found that dealing with WebQuest activities in the courses enhanced the motivational levels of both pre-service secondary school maths and chemistry teachers. There was no statistically significant difference detected in reference to the motivational levels between the pre-service secondary maths and chemistry teachers. In other words, developing WebQuest-based applications had an almost equal impact on the attention, satisfaction and relevance of the pre-service maths and chemistry teachers.

The findings of this current study imply that using WebQuests in the classroom would be useful for educators and pre-service teachers because it motivates the pre-service teachers in the classroom. Moreover, WebQuests could be used as an alternative way to teach topics in different subject matters, such as mathematics, chemistry, history, physics and so forth. This supports the claims of Summerville (2000) and Joseph (2000), who expressing the view that most disciplines have tried to integrate the use of technology somehow into their fields because everybody agrees with its benefits and advantages. The findings of the study underlined the suggestions of the National Educational Technology Standards (NETS-T) (2000), stating that new ideas, theories and technologies should be utilized in teaching, to help students enhance their productivity and creativity.

There were several limitations to the study. At the beginning of the study, both the pre-service secondary maths and chemistry teachers did not have adequate knowledge of the webpage creators, such as Publisher, FrontPage and so forth, nor how to design a WebQuest. In particular, the pre-service chemistry teachers were also not eager to complete their projects because of the fact that they had difficulties finding professional, well-designed websites.

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