Effects of Web Quest on Content Knowledge Acquisition and Motivation of Basic Physics Students

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Abstract – The purpose of the study was to investigate the effects of webquests on students' gains in basic physics content knowledge and students' intrinsic motivation. The methodological framework of the study was based on a pretest-posttest experimental design with a control group (i.e. quasi-experimental design). A total of 62 fourth year high school students in two groups (N=31 in experimental, and N= 31 in control) participated in the pretests and posttests. The results showed that there was no significant difference between the mean achievement scores of the experimental and control groups in pretest. There was a significant difference between the pretest and posttest mean scores of the experimental group as well as in the control group. However, the difference between the mean achievement gain scores both in experimental and control groups was not statistically significant. Furthermore, this study showed that webquest activity for teaching and learning physics had great effect on the intrinsic motivation of the students. As a result, experimental findings suggest that webquest can be used to motivate learners and facilitate learning.

Keywords: webquest, knowledge acquisition, intrinsic motivation, instructional technology, quasi-experimental design, physics

1. Introduction

Since then people have welled onto the Internet, teachers have been inundated with current innovations aimed at integrating technology into classroom instruction (Watson, 1999). Consequently, there is an increasing number of computers in schools and Internet connectivity is becoming a hackneyed. However, Pierson (2001) and Calma (2004) argued that educational reform efforts should not only intensify on acquiring more machines for classrooms but also on developing teaching strategies that complement technology use for teaching and learning. Strickland (2005) also articulated that if technology is necessary to the future success of students, it makes sense that it should also be a salient part of instruction.

What is a WebQuest? This instructional technique has been around since 1995 after it was introduced by Bernie Dodge and Tom March at San Diego State University. According to Dodge (1997), this is “an inquiry-oriented activity in which some or all of the information that learners interact with comes from resources on the internet, optionally supplemented with videoconferencing” (p.1). This technique can be classified according to the length of time it is incorporated into the classroom. A short-term WebQuest is intended to be completed in one to three class periods whereas the longer term WebQuest will normally take between one week and a month in a classroom setting. Dodge added that each type has an intended purpose. Specifically, short-term WebQuest allows students to get the desired web-based information and able to synthesize within the designated course duration. On the other hand, longer term WebQuest allows students to have a profound analysis of the subject matter and subsequently able to apply the knowledge and comprehension in creating a tangible product or real-life application. According to Dodge (1997), either long term or short term, WebQuests should have certain critical attributes. These attributes include an introduction, task, information sources, process, guidance, and conclusion. Some attributes usually included, but not critical such as group activities and motivational elements. In addition, WebQuests can be interdisciplinary or within a single discipline.

With the ongoing acceptance of WebQuests by both teachers and students, it has spread to other countries like Brazil, Spain, China, Australia and Holland (Dodge, 2007). This strategy has now been utilized across various disciplines in education (Chuo, 2007). Like many educational pursuits however, it is essential to continually evaluate the impact of this strategy on the teaching and learning process.

According to Watson (1999) and Rodriguez (2003), since the inception of Webquest in 1995, it has become a prime means of engaging students in constructive web-based learning activities and eventually reforming traditional practice. Meanwhile, Fox (1999), Santavenere (2003), Mohn (2003), Bartoshesky & Kortecamp (2003), Leite, McNulty, & Brooks (2005), Murray (2006), and Gaddy (2007) also further described that students or teachers showed positive attitude and perceptions towards WebQuests. While WebQuests are often mentioned as an exemplary strategy for the effective integration of technology in teaching and learning, Abbit and Ophus (2008), argued that “one overarching issue with what is known about the WebQuest strategy is the scarcity of research on the effects of this strategy on teaching and learning” (p.42). Furthermore, according to Vanguri, Sunal, Wilson & Wrigth (2004) the development of higher-order thinking skills with content-based learning in the WebQuest format may prove to be successful, but further research is needed in this area.

Research Purposes and Questions

The purposes of the study were to evaluate the impact of a webquest activity on students' content knowledge acquisition and intrinsic motivation in learning physics. Findings from the study may not only provide empirical support for stakeholders to adopt webquests but also inform the design and implementation of this activity. The following research questions guided the study:

1. Is there a significant difference between the mean achievement scores of the students in the experimental and control groups in the pretest?
2. Is there a significant difference between pretest and posttest mean scores of the experimental group?
3. Is there a significant difference between pretest and posttest mean scores of the control group?
4. Is there a significant difference between the mean achievement scores of the students in the experimental and control groups in the posttest?
5. To what extent does a webquest activity motivate students to learn physics?

Null hypotheses

1. There is no significant difference between the mean achievement scores of the students in the experimental and control groups in the pretest.
2. There is no significant difference between pretest and posttest mean scores of the experimental group
3. There is no significant difference between pretest and posttest mean scores of the control group
4. There is no significant difference between the mean achievement scores of the students in the experimental and control groups in the posttest.

2. Methods

2.1 Research Design

The researcher utilized the nonequivalent control group design with pretest and posttest measures (a type of quasi-experimental design) to compare the academic achievement of students who did not participate in the webquest (i.e. control group) activity with those who participated in the webquest activity (i.e. experimental group) for 35 days.

2.2 Sample

In this study the researchers followed the "convenience" sampling procedure where a group of participants is selected because of availability. The sample for this study was tenth-grade physics students of Philippine Normal University- Institute of Teaching and Learning. Two groups of students (N= 31 and N=31) in Physics class were utilized during the school year 2012 - 2013. An experimental group consisting of 31 students (11 males and 20 females) and a control group consisting of 31 students (11 males, 20 females) were selected on the basis of class membership. Only scores of students who had completed both the pretest and posttest were included in the data analysis.

2.3 Instruments

The data were collected through the following instruments: the California Physics Standard Test [CPST], and. Science Motivation Questionnaire II (SMQ-II). The tests were administered in the paper-and-pencil mode.

To determine the proficiency level of the participants in specified Physics skills or concepts, the researcher administered the California Physics Standard Test [Released Test Questions]. The released test questions were adapted from the Physics Standard Test. Initially, the test questionnaire consists of eighty-nine [89] questions which represent various topics in Physics but to ensure its appropriateness for assessing the desired skills and concepts that have been covered within the research period, the teacher-researcher adapted forty-two [42] questions which cover motion, forces, and conservation of energy. These items were in multiple-choice format taken within a 60- minute period. Each item has four choices and one keyed answer.

To assess the intrinsic motivation of participants after their involvement in the webquest activities, the researcher has adapted items for intrinsic Motivation from the Science Motivation Questionnaire II of Shawn M. Glynn of the University of Georgia, USA. The Science Motivation Questionnaire II is a reliable and validated survey instrument that assesses science motivation based on 5-factors (intrinsic motivation, self-efficacy, career motivation, self-determination, grade motivation).

2.4 Procedures

Both experimental and control groups were administered a pretest [CPST] before the experimental process to assess their prior knowledge in targeted physics lessons. After that, the researcher provided a brief overview about webquest to the experimental group. The participants were told that they would be completing a webQuest about various physics concepts and the researcher wanted them to experience what it would be like if they had to perform like a scientist or engineer for instance [i.e. playing various roles in class]. Before they went to the computer lab they did a KWL chart on which they were asked what they knew, what they wanted to know. Then they were split up into pairs or small groups of four members. The four-week webquest consisted of a mix of whole group and small group activities with hands-on work and discussions. Students worked in small groups to complete a challenge to make a roller coaster. The whole group worked through a webquests online in order to complete the challenge. At the end of each day, whole group debriefing provided an opportunity for groups to share ideas and show work in progress. Then, the same achievement test [CPST] that was used as pretest was also administered as a post-test to both groups after the experimental process.

2.5 *Data Analysis*

The data obtained from the pretests and posttests were analyzed. The mean scores and standard deviations were calculated for each group. The t-test was used to determine the differences between the experimental and control groups. Likewise, at the end of the experimental process, students were asked to complete a survey: Science Motivation Questionnaire II to report their completion of and assesses their motivation level for the entire webquest activity.

3. Results and discussion

Research Question 1*: Is there a significant difference between the mean achievement scores of the students in the experimental and control groups in the pretest?*

Table 1. *Significance of the Difference between Mean Scores of the Experimental and Control Groups on Pretest*

Groups	**N**	$\bar{X}$	**SD**	**df**	**t**	***p***
Experimental	31	7.90	1.33	60	-0.09	0.464
Control	31	7.97	3.82			

p < .05

To establish if there is a significant difference in mean scores of the experimental and control groups prior of the webquest, an independent-samples t-test was conducted. As indicated in Table 1, the difference between the mean scores of the experimental group (7.90) and control group (7.97) was found to be not statistically significant (t = -0.09, df = 60, p = .464). Hence, the researcher failed to reject null hypothesis 1. The finding suggests that both groups could be treated as equal based on their pretest scores.

Research Question 2: *Is there a significant difference between pretest and posttest mean scores of the experimental group?*

Table 2. *Significance of the Difference between Mean Scores of the Experimental Group on Pre-Posttest*

Groups	N	$\bar{X}$	SD	df	t	*p*
Pretest	31	7.90	1.33	30	-13.19	.0001
Posttest	31	26.19	8.69			

p < .05

As indicated in Table 2, it is interesting to note that a paired samples t-test result indicated that there is a significant difference between the pretest (7.90) and posttest (26.19) mean scores of the experimental group (t = -13.19, df = 30, p = .001). Hence, the researcher rejected the null hypothesis 2. The students had notably higher scores in the posttest than in the pretest. That is, the webquest activity had a statistically significant impact on students' gains in physics content knowledge at the .05 significance level. This result is not in contrast with the several research findings of Mohn (2003), Brown & Zahner (2006), Tsai (2006), Ikpeze & Boyd (2007), Gaddy (2007), Gowen (2010), and Cheng, Tzung, & Wei, (2011).

Research Question 3: *Is there a significant difference between pretest and posttest mean scores of the control group?*

Table 3. *Significance of the Difference between Mean Scores of the Control Group on Pre-Posttest*

Groups	N	$\bar{X}$	SD	df	t	*p*
Pretest	31	7.97	3.82	30	-14.97	.0001
Posttest	31	25.94	7.95			

p < .05

With reference to the paired samples t-test results in Table 3, there is a statistical significant difference between the pretest (7.97) and posttest (25.94) mean scores of the control group (t = -14.97, df = 30, p = .001). Thus, the researcher rejected null hypothesis 3. The finding suggests that traditional way of teaching had a statistically significant impact on students' gains in physics content knowledge at the .05 significance level.

Research Question 4: *Is there a significant difference between the mean achievement scores of the students in the experimental and control groups in the posttest?*

Table 4. *Significance of the differences between the mean achievement gain scores of the experimental and control groups***.**

		Pretest		Posttest		Achievement Gain Score				
Groups	N	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	df	t	*p*
Experimental	31	7.90	1.33	26.19	8.69	18.3	7.72	60	+0.18	0.4288
Control	31	7.97	3.82	25.94	7.95	18	6.68			

p < .05

The hypothesis of this study was that achievement of the students in experimental group (using webquest) would be significantly greater than the achievement of the students in control group who were exposed to traditional way of teaching. However, results showed (see Table 4) that both groups of students learned the desired lessons because both group's post-test scores measuring achievement of content knowledge were greater than their pretest scores and both were statistically significant. Moreover, the data shows that the experimental group had mean scores between $\bar{X}$ =26.19 and $\bar{X}$ =7.90 respectively on pretest and posttest. The control group had a pretest mean score of $\bar{X}$=25.94 and posttest score of $\bar{X}$=7.97. The mean achievement gain score of experimental group is $\bar{X}$ =18.3 while the control group is $\bar{X}$ =18. With reference to the independent-samples t-test result, the difference between the mean achievement gain scores was not statistically significant (t = +0.18, df = 60, p = .4288). Hence, the mean achievement gain score of the students who were exposed to webquest activity is not significantly higher than that of the students who were exposed to traditional way of teaching. Consequently, the researcher failed to reject null hypothesis 4. Contrary to what the researcher's original expectation, control group (under traditional teaching) did not fair better than the experimental group (under webquest). The results of this study suggests that webquest activity could also benefit academic performance in basic physics students.

Research Question 5: *To what extent does a webquest activity motivate students to learn physics?*

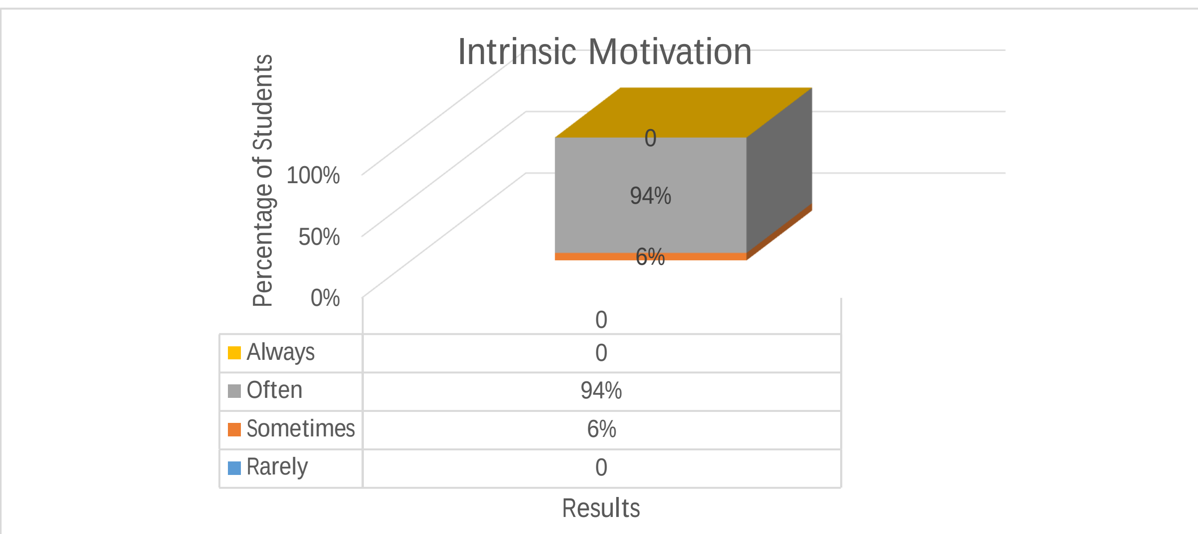

Figure 1. Percentage of student responses to intrinsic motivation questions, (N =31).

After the implementation of webquest activities, the participants were administered the Science Motivation Questionnaire II, five (5) items in the Likert scale format [0 = Never 1 = Rarely 3 = Sometimes 4 = Often 5 = Always] to assess their motivation level. There were 5 categorically similar likert items for the intrinsic motivation and to report the participant's response, the researcher computed the mean of the values. As indicated in Figure 1, it is interesting to note that 94% of the participants rated themselves 'often' motivated, and only 6% of them rated 'sometimes' motivated.

This study showed that webquest activity had great effect on the motivation and made learning enthralling for the students. This result is not in contrast with the several research findings of Mohn (2003), Murray (2006), Tsai (2006), and Gaddy (2007). The participants may have been motivated by using webquest because most of the lessons had an element of fun. Using computers and the Internet is something the students found to be fun.

4. Conclusion

This study addressed three research questions and showed the following findings:

i. the difference between the mean scores of the experimental group and control group was found to be not statistically significant.
ii. there was a significant difference between the pretest and posttest mean scores of the experimental group.
iii. there was a statistical significant difference between the pretest and posttest mean scores of the control group.
iv. the difference between the mean achievement gain scores was not statistically significant.
v. this study showed that webquest activity for teaching and learning physics had great effects on the intrinsic motivation of the students.

5. Recommendations

The main purpose of this study was to assess the impact of webQuest on students' performance in knowledge acquisition and motivation. The findings suggest that webQuest could also be used in teaching basic physics as far as knowledge acquisition is concerned. Moreover, webquest can have a positive impact on students' intrinsic motivation. However, carefully conducted research should be done at different grade levels and in a variety of disciplines. A reproduced of this study which the sample is large enough and is conducted over a much longer period of time in between the pretest and posttest could also reveal additional insight of the impact of WebQuest as teaching approach.

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