STUDY OF THE EFFECTIVENESS OF WEB-BASED TUTORIALS AND THE RELATIONSHIP BETWEEN SELF REGULATED LEARNING AND LEARNING PERFORMANCE USING WEB-BASED TUTORIALS

Swati Nere and Eugenia Fernandez
Purdue School of Engineering & Technology, Indiana University Purdue University Indianapolis
799 W. Michigan St., ET 301, Indianapolis, IN, U.S.A.

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Abstract: This study was designed to examine the effectiveness of Web Based Tutorials (WBTs) and the correlation between students' self efficacy score for self regulated learning and their learning performance using WBTs. Participants were graduate students (N = 14) enrolled in a statistics course during a single semester. The results of this study showed that WBTs were effective for learning statistics concepts. However, there was no correlation between students' self efficacy score for self regulated learning and their learning performance using WBTs. Additional investigation showed that the classroom instruction mode was more effective than the WBT instruction.

1 INTRODUCTION

Distance education is a rapidly growing medium that is used in almost every field for training and education. This is due to its basic advantages, namely convenience, learning at one's own pace, and around-the-clock online accessibility. Web-based tutorials (WBTs) have become an important and integral part of distance education (Davidson-Shivers & Rasmussen, 2006).

Research has shown that effective use of WBT and multimedia can increase student learning (Forsyth & Archer, 1997; Kazmerski & Blasko, 1999; Liu, 2004; Mackey & Jinwon, 2008) and help students to understand complex concepts that sometimes are difficult to understand in a face-to-face class setting due to time limitations. Thus, it is clear that computer-based demonstrations and tutorials may prove beneficial to students' learning in a course.

Students' academic success is also related to their use of self-regulation strategies. In educational literature, it is often referred to as Self-Efficacy for Self-Regulated Learning (SESRL, henceforth referred as SRL). It is a relatively new area in social cognitive learning theory. SRL is a comprehensive construct that focuses on students' performance and achievement of learning processes in educational settings by focusing on how students motivate, plan, monitor, and evaluate personal progress (Zimmerman, 1989).

This research investigates the effectiveness of WBTs and the relationship between students' self-regulation strategies and their learning through WBTs.

2 PROBLEM STATEMENT

In face-to-face class instruction, it can become difficult for students to learn complex concepts due to time limitations. Statistics is an example of a course that involves learning many complex concepts and procedures. In such cases, WBTs can be used as an supplemental tool, providing out-of-classroom instruction to enhance conceptual learning.

Despite the many advantages web-based tutorials offer, they can pose problems associated with a lack of SRL skills. SRL skills include goal setting, self-monitoring, self evaluation, use of learning strategies, help seeking, and time planning and

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management (Zimmerman, 2008). Learning through WBTs is student-centered in that students must practice self-regulatory skills to accomplish their learning goals (Dabbagh & Kitsantas, 2003). It is expected that experienced students regulate their own learning skilfully. However, many often stick to high school or grade school learning strategies that prove to be insufficient to the college environment (Hofer, Yu, & Pintrinch, 1998).

Secondly, although online classes and web-based tutorials are part of distance education, they have some differences. Online classes make use of synchronous/asynchronous communication tools like chat, email, and forums. On the other hand, web-based tutorials typically involve one shot exposure, require shorter learning span, and don't have facilities where students can participate in synchronous/asynchronous communication.

Lastly, while there is an ample research on SRL, less research (Beile & Boote, 2004) has been done in relation to WBTs. In view of this, research is necessary to determine if WBTs are effective in students' understanding of higher level concepts and whether students' performance in WBT learning is related to their self-regulation strategies.

The research on the effectiveness of WBTs shows that students are satisfied with learning through WBTs (Aberson, Berger, Emerson, & Romero, 1997, 2007; Bliwise, 2005; Buzzell, Chamberlain, & Pintauro, 2002; Daeid, 2001; Donovan & Nakhleh, 2007; Michel, 2001; Nedic & Machotka, 2006; Wilson & Harris, 2002;). Belawati (2005) found that students' participation in online tutorials improves course completion rates and achievement. In view of this, the outcome of this study will be helpful in the design of more WBTs for conceptual learning of the difficult topics in statistics. With the knowledge construction provided through WBTs, classroom time can effectively be used on the application of the concepts.

Student self-efficacy for self-regulated learning is becoming an interesting area of research in educational literature. Zimmerman (1994) has shown that self-regulation is a reliable predictor of academic performance. According to Zimmerman (1990), self-regulated learning theories of academic achievement are distinct from other means of learning due to two main reasons, namely how students select, organize, or create beneficial learning environments for themselves, and how they plan and control the form and amount of their own instructions. Zimmerman (1990) has concluded in his overview study of SRL and academic achievement that systematic efforts can be launched to teach self-regulation to students who approach learning passively. According to Zimmerman (1990), "A self-regulated learning perspective on students' learning and achievement is not only distinctive, but it has profound implications for the way teachers should interact with students and the manner in which schools should be organized (p.4). Accordingly, it is important to know the relationship between SRL and students' learning performance using WBTs.

The main purpose of this study is to determine the effectiveness of web-based tutorials for understanding statistical concepts and examine the relationship between students' SRL and their learning performance using WBTs. More specifically, the objective of the study is to seek answers to the following research questions:

1. Is a web-based tutorial effective in helping students understand difficult concepts in statistics?
2. Is there any difference between students' learning using WBT instruction and classroom instruction mode?
3. Is there any relationship between students' SRL and their WBT learning performance?
4. Are students' SRL independent of their learning style?
5. How satisfied are students with learning using WBTs?

By participating in this study, students will increase their awareness of their SRL strategies. Results of the study will provide insight to both students and teachers on how to improve and stimulate SRL strategies respectively.

3 LITERATURE REVIEW

A growing body of research exists on the effectiveness of learning and teaching through WBTs. Most of these studies compare online and face-to-face learning approaches. Some of this research shows that WBTs are more effective than classroom instruction while others show that WBTs are as effective as classroom instruction. For example, researchers (Aivazids, Lazaridou, & Hellden, 2006; Day, Raven, Newman, 1998; Melara, 1996) found that web-based tutorials can accelerate the learning process with the same level of achievement as a classroom lecture. O'Neal, Jones, Miller, Campbell, and Pierce (2007) showed that web based instruction is as effective as traditional teaching for disseminating special education course content to pre-service teachers. Fernandez (1999)

found no significant difference in learning through a classroom lecture and using a web-based tutorial. Similar results were found in a study by Nichols, Shaffer, and Shockey (2003) which compared student learning through an online tutorial to a traditional lecture and also found that students were satisfied with online instructions. Belawati (2005) found that students' participation in online tutorials improves course completion rates and achievement. Sweeney, O'Donoghue and Whitehead (2004) suggested that a balance is needed between face-to-face and web-based tutorial learning approaches.

The effectiveness of WBTs has been investigated in almost every subject, for example, chemistry (Donovan & Nakhleh , 2007), engineering (Nedic & Machotka, 2006), library sciences (Michel, 2001), forensic science (Daeid, 2001), medical science (Buzzell, Chamberlain, & Pintauro, 2002), and psychology (Wilson & Harris, 2002). All of these studies found that WBTs are as effective as classroom instruction.

Aberson, Berger, Emerson, and Romero (1997, 2007), and Bliwise (2005) explored the effectiveness of WBTs for difficult to understand statistics concepts. All these researchers found that students were more satisfied with WBT learning and hence attempts were made to improve the learning through the design of more WBTs.

Recent research related to SRL shows that SRL is one of the reliable factors that can be linked to personal and academic achievement of students. Zimmerman and Martinez-Pons (1988) developed a structured interview procedure that involved a number of contexts or descriptions of instructional problems that students often encounter. In analysis, the researchers identified 14 self-regulated learning strategies, namely self evaluation, organization and transformation, goal setting and planning, information seeking, record keeping, self-monitoring, environmental structuring, giving self-consequences, rehearsing and memorizing, seeking social assistance, and reviewing (notes, books or tests). After studying the responses of 40 students from advanced academic track and 40 students from lower academic track, the researchers found that students' use of self-regulated learning strategies was strongly associated with their superior academic functioning.

SRL has been validated by Usher and Pajares (2006) in which Bandura's Children Self-Efficacy Scale was assessed on a sample of 3,760 students from grade 4 to 11. The scale formed a one-dimensional construct and demonstrated an equivalent structure for boys and for girls, and for elementary, middle, and high school students. Thus, the scale provided a sound measure with which researchers can continue to assess students' beliefs about their self-regulatory capabilities.

Although, there is ample research on self-efficacy and SESRL, less research has been done in relation with WBTs (Beile & Boote, 2004). Dabbagh and Kitsantas (2004) point out that Web-based learning approaches are students-centered and web-based learning tools like emails, forums and chat can support students' development of self-regulatory skills that are essential for success in student-centered web-based learning environments.

The area of learning styles (the way a person takes in, understands, expresses and remembers information) has also been largely explored by educational researchers. For example, Marrison and Frick (1994) showed that academic achievement is affected by one's learning style. Diaz and Cartnal (1999) found that online students were more independent and on-campus students were more dependent in their styles as learners. Mupinga, Nora, and Yaw (2006) suggest that the design of online learning activities should strive to accommodate multiple learning styles. Garland and Martin (2005) examined the differences between the learning styles of 168 students in online and traditional face to face courses and found a significant difference: "the learning style of the online student as a group was assimilating, while the learning style of the face-to-face student as a group was diverging" (p. 73). They also found a significant relationship between male students with an Abstract Conceptualization learning mode and student engagement. The authors concluded that the learning style and gender of all students must be considered when designing online courses. In view of this, the present paper also investigates the relationship between students' SRL and their learning style.

4 ASSUMPTIONS & DELIMITATIONS

This study assumed that all participants were able to navigate through course management systems, and a Windows-based operating system, and had a basic knowledge of how to navigate a WBT.

The scope of this study was limited to the learning of four statistics concepts taught in a single graduate class, namely z test for single group, chi-square, independent samples t-test, and correlated samples t-test.

5 METHODOLOGY

The participants in this study consisted of graduate students enrolled in a semester long graduate research methods and statistics course at a large Midwestern public university. Students were informed of the purpose of the study and completed an informed consent agreement.

This study used a single group pre-test post-test repeated measures quasi-experimental design to (1) evaluate the effectiveness of web-based tutorials for learning statistical concepts using classroom teaching as a control group, and (2) to investigate the relationship between students' learning performance using WBT and their SRL.

Two pairs of related statistical concepts were selected – *z* test/Chi square goodness of fit test and independent-groups/correlated-groups *t* tests. WBTs were designed for two of these statistical concepts: *z*-test for single group and *t*- test for independent groups, referred to as WBT-1 and WBT-2 respectively. The two WBTs can be viewed at https://dnet.cit.iupui.edu/wbt1/index.htm and https://dnet.cit.iupui.edu/wbt2/index.htm respectively. The other two concepts (Chi-square and t-test for correlated groups) were taught using classroom instruction. These two topics were used as a control group for the related experimental components.

Gagné and Briggs (1979) have emphasized that in order to implement an effective learning process, it is important to evaluate students' understanding of the concepts as well as to get the feedback from students during evaluation. In view of these suggestions, a pre-test was administered prior to the start of each concept mentioned above. Due to the timing of the concepts in the course, the pre-tests for the *z* test and Chi square were combined as were the pre-tests for the independent-groups and correlated-groups *t* tests. After each concept's learning exposure, a post-test was administered. A difference score (post-test – pre-test) was then computed for each concept. Figure 1 provides a graphical representation of this procedure. Table 1 shows how each change score was used.

Riel and Harasim (1994) have suggested that user feedback is one way of examining if the learning environment is successful in meeting learning outcomes. In view of this, a tutorial satisfaction questionnaire was used at the end of the two post-tests for topics taught using WBTs.

Student's learning style was determined by administering one of the most widely used online questionnaires, Keirsey Temperament Sorter II (Keirsey, n.d). The learning style, demographic survey, and students' SRL scale were administered prior to the start of any experimental components. The students' self regulation strategies were evaluated using one subscale from the Children's Multidimensional Self-Efficacy Scales, namely self-

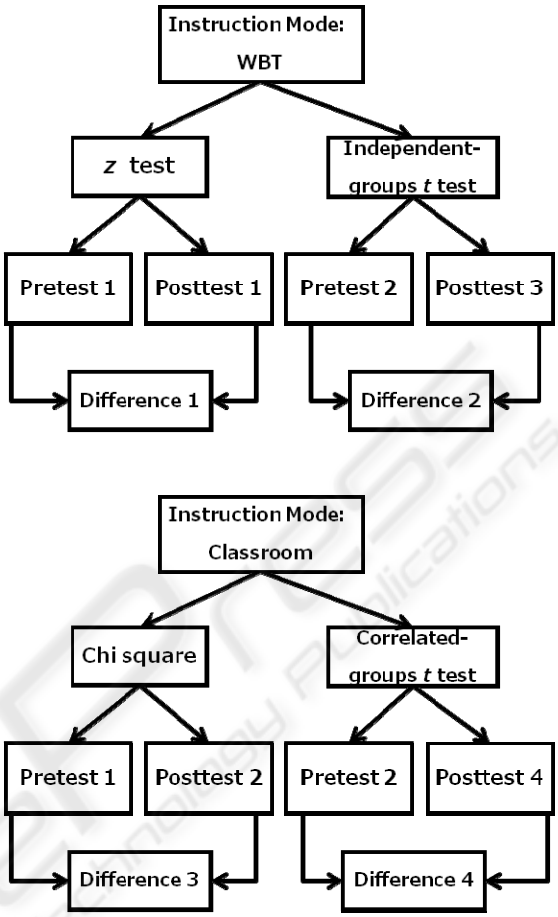

Figure 1: Graphical representation of the methodology.

Table 1: Use of change scores.

Measure	Used to Evaluate
Difference 1	Effectiveness of WBT on *z* test
Difference 2	Effectiveness of WBT on independent-groups *t* test
Difference 3	Effectiveness of classroom instruction on Chi square goodness of fit
Difference 4	Effectiveness of classroom instruction on correlated-groups *t* test
Difference 1 – Difference 3 and Difference 2 – Difference 4	Effectiveness of WBT vs. classroom instruction

efficacy for self- regulated learning. The scale included 11 items that measures students' perceived capability to use a variety of self-regulated learning strategies. Students' responses were recorded according to a 7-point scale ranging from not well at all for a rating of 0, not too well for 3, pretty well for 5, and very well for 7. Students' SRL was calculated by adding the score of 11 items for each students and then taking an average of that score, as has been done in other studies (Carroll & Garavalia, 2002; Inzlicht, McKay, & Aronson, 2006). As discussed in the literature review, the SRL scale has been validated by Usher and Pajares (2006).

6 RESULTS

Of the 19 students enrolled in the course, 14 (57% male, 43% female) usable responses were obtained. Students who participated in the study but didn't complete both pairs of pre-tests and post tests were excluded from the data analysis. The majority of the students (50%) were of age group 25-34 years old followed by age group of 45 and over. 36% of the participants were full time students while 64% were part time students.

6.1 Hypothesis 1

Is a WBT effective in helping students understand the concepts in statistics?

A paired-samples *t* test was calculated to compare the mean pre-test score before the exposure to learning through WBT-1 to the mean post-test score after the WBT-1 learning. The mean on the pre-test was 24% (*sd* =11.87), and the mean on the post-test was 67% (*sd* = 23.60). A significant increase from pre-test to post-test was found (t (8) = 5.768, $p < .001$).

A paired samples t test was calculated to compare the mean pre-test score before the exposure to the learning through WBT-2 to the mean post-test score after the WBT-2 learning. The mean on the pre-test was 10% (*sd* =20.69), and the mean on the post-test was 65% (*sd* = 18.57). A significant increase from pre-test to post-test was found (t (8) = 6.805, $p < .001$).

6.2 Hypothesis 2

Is there any difference between students' change in knowledge after WBT learning and classroom learning?

A paired-samples *t* test was calculated to compare the mean change in knowledge after learning through WBT-1 to the mean change in knowledge after classroom instruction on Chi square. The mean change in knowledge after learning through WBT-1 was 46% (*sd* =21.26), and the mean change in knowledge after classroom instruction was 77% (*sd* = 19.80). A significant difference was found (t (7) = -3.037, $p < .05$). Students learned more after classroom instruction than using the WBT-1.

A paired-samples *t* test was calculated to compare the mean of change in knowledge after learning through WBT-2 to the mean change in knowledge after classroom instruction. The mean change in knowledge after learning through WBT-2 was 45% (*sd* =31.38), and the mean change in knowledge after classroom instruction was 65% (*sd* = 20.18). A significant difference was found (t (10) = -2.541, $p < .05$). Students learned more after classroom instruction than using the WBT-2.

6.3 Hypothesis 3

Is there any correlation between students' SRL and their WBT performance?

A Pearson correlation coefficient was calculated for the relationship between students' SRL and their WBT-1 performance. A moderate correlation that was not significant was found (r (7) = .441, $p > .05$). Students' SRL was not strongly related to their WBT-1 performance.

A Pearson correlation coefficient was calculated for the relationship between students' SRL and their WBT-2 performance. A moderate correlation that was not significant was found (r (9) = .027, $p > .05$). Students' SRL was not strongly related to their WBT-2 performance.

6.4 Hypothesis 4

Are students' SRL independent of their learning style?

Only 11 of the 14 students completed the Kiersey Temperament Sorter, with 8 of the 11 falling into the Guardian temperament. Because of this clustering, an ANOVA comparing students' SRL by temperament type was not possible. For reporting purposes the SRL scores were divided into three categories: high (SRL > 4), medium (SRL =4) and low (SRL < 4). Table 2 shows the cross tabulation between SRL level and students' Keirsey temperament.

Table 2: Count of SRL by Temperament.

		Temperament			
		Guardian	Rational	Idealist	**Total**
SRL	Med.	1	0	0	**1**
	High	8	1	1	**10**
	Total	**9**	**1**	**1**	**11**

6.5 WBT Satisfaction

How satisfied are students with their change in knowledge using WBTs?

11 out of 14 participants responded to the satisfaction questionnaire. 45% of the students were 'somewhat satisfied' with WBTs while 36% were neutral about it. Two participants were dissatisfied with the tutorial. Satisfied students liked the content/information presented in the WBT while the dissatisfied students reported lack of interactive features and necessity of more illustrative examples. A total of 60% of the respondents said they would be 'likely' to study similar tutorials. None of the students reviewed any other resources on the topic taught using WBT-1 and WBT-2.

7 LIMITATIONS

No web-tracking software was used so the time spent studying the tutorial was not measured. However, the students were asked in the feedback questionnaire about how much time they spent studying the tutorial. A survey method was used to determine the students' satisfaction about their change in knowledge after learning through the web-based tutorial. A major limitation of the survey method is that it relies on a self-report method of data collection. In addition, factors like poor memory, intentional deception, or misunderstanding of the question may all contribute to inaccuracies in the data. Some of the responses for the tutorial satisfaction questionnaire were inconsistent. The pre-test and post-tests questions were not face validated. The small sample size in this study is an obstruction to the issue of generalizing the findings to larger populations. And hence the results of this study cannot be generalized.

8 CONCLUSIONS

The result for the first hypothesis, which investigated the effectiveness of WBTs for understanding statistics concepts, showed that there was a significant increase in students' change in knowledge using WBT learning. This result is consistent with the literature that shows WBTs are just as effective a learning medium as classroom instruction (Buzzell, Chamberlain, & Pintauro, 2002; Daeid, 2001; Donovan & Nakhleh , 2007; Fernandez, 1999; Michel, 2001; Nedic & Machotka, 2006; Wilson & Harris, 2002). More specifically, it confirms that WBTs were effective for learning statistics concepts, similar to studies by Aberson, Berger, Emerson, and Romero (1997, 2007), and Bliwise (2005). However, our results were influenced by the uncontrollable confound of students reading the textbook chapter before the WBT exposure. 64% (7/11) and 67% (8/12) students read/skimmed through the textbook chapter before they studied WBT-1 and WBT-2 respectively.

The outcome of the second hypothesis, which examined the learning differences between WBTs classroom instruction, showed that the classroom instruction was more effective than WBT instruction. This is probably due to the fact that the pair of topics taught through WBTs and classroom instructions were comparable. In both situations, the WBT topic was introduced first and then the related topic was taught using classroom instruction. This design might have prepared the students' mindset first through the WBT and repetition may have helped them understand the second topic in the classroom setting more easily. In view of this, future studies should investigate the change in knowledge by reversing this sequence. However, coupled with the results of the first hypothesis, it is safe to say that this research validates the use of WBTs as a supplemental method of instruction. By moving some of the instruction out of the classroom, it could free classroom time for the practical applications of those concepts.

The consequence of the correlation test between SRL and WBT performance was interesting. In the present study, the majority of the students were of age 25-34 and above 45. Generally, this group is considered as experienced students and hence exhibited high SRL score. However, their WBT performance didn't indicate a proportional increase, demonstrating no correlation between SRL and WBT performance. This may be attributed to no face validation of the test questions or possible reluctance or lack of motivation to learn using WBT as the participants were from an on-campus class. Some students reported that they didn't study the tutorial (27% and 33% students did not study WBT-1 and WBT-2 respectively), which may indicate

their lack of motivation to learn using WBT and respond to related post-tests as compared to their class work. In future replication of such study, due consideration may be given to add students' post-test score to their final course grade in order to motivate students so as to improve the response rate. Some students reported that the WBTs lacked interactive features. In view of this, in the future replication of such a study, it would be helpful to determine what interactive features are desirable and then design the WBTs accordingly.

The sample size in the present study was small and the participants were graduate students who exhibited high SRL score. Undergraduate students are more likely to stick to their high school learning strategies which are not sufficient for the college learning. It would be interesting to replicate this study with undergraduate students enrolled in on campus and online classes and give WBT learning treatment to both groups.

Student satisfaction with the WBTs was mild due to their desire for more interactive features and illustrative examples. This speaks to the high level of expectations on the part of the students for online materials. Thus, this research has shown that WBTs do have value and can be used as a supplement to classroom teaching, but they should be designed to include interaction.

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