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A study of education on power transformers in a virtual world

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Abstract

The aim of this paper is to expose impacts of teaching through SL in the topic of internal structures of power transformers for undergraduate students in department of electricity and energy at Usak University. We begin with introducing the subject taught with traditional methods and through Second Life. We then analyze the findings with Mann-Whitney U and Wilcoxon Signed Ranks tests using SPSS software. We draw the conclusion by indicating that SL made an effective contribution to the students' knowledge acquisition while the contribution of traditionally teaching methods in increasing success of the students cannot be ignored.

Selection and/or peer-review under responsibility of Academic World Education and Research Center.
Keywords: Virtual World, Second Life, Online Education, Power Transformers;

1. Introduction

Power transformers have a very important role in transmission and distribution of electrical energy. Using of these apparatus requires very qualified employees in case of maintenance or failure of the energy system. In learning phase of the employees, there are difficulties as traditional education systems are based on theoretical knowledge. On the other hand, training phase of the employers has some troubles in which learner cannot see inner parts of equipment of the energy system such as windings, core, connections, and oil and so on while transformers are in-service. In addition, educational costs of students who will become the employers are expensive because of necessary educational materials.

Rapid expansion in the use of technologies in teaching and learning has led to new disciplines and pedagogical approaches. Distance education is one of the new forms of education that virtual worlds can probably find the most accurate place through educational settings. In higher education, distance learners potentially have opportunities to learn in new ways, at their own pace and without any time or place restrictions. Students are able to interact with one another by becoming involved in culturally and geographically diverse groups. It is possible to see various examples of virtual world applications from a wide range of fields such as education, medicine, art and design technology and so forth. In this study, the drawbacks mentioned in the first paragraph have been overcome using the power of 3D virtual worlds' technologies. They present new possibilities for supporting formal and informal knowledge acquisition for online learning activities (Zhang, de Pablos & Zhu, 2012; Mathews, Andrews & Luck, 2012; Bredl, Gross, Hunniger & Fleischer, 2011). In these worlds educators can apply student-centered teaching

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pedagogies that support active, constructivist learning activities (Kluge & Riley, 2008). In our previous studies, we have addressed to literature reviews of the related articles (Aydogan, Aras & Karakas, 2010; Aydogan, Karakas, Aras & Ozudogru, 2011).

This study proposes teaching and training selected students in the Electricity and Energy Department in the topic of internal structures of power transformers in Usak University, Turkey using SL. It is considered that this world which increases quality of the education will reduce cost of the education. There are two groups of the students which consist five students each. The control group has been taught in conventional ways and the experimental group has been taught and trained through SL that is designed and implemented. Pretest and posttest have been administered to each group's students and results have been evaluated.

The second section of this paper involves the review and detailed information about SL. In the third section, a power transformer has been designed and implemented on SL, and then the control group has been trained in the topic of internal structures of the power transformers on SL. In analysis and findings section, pretest and posttest have been administered to each group's students and findings have been investigated and evaluated. The last section involves discussion and conclusions.

2. Review of Second Life

SL was publicly released by Linden Labs, which was founded by former CEO Philip Rosedale inspired by Snow Crash - a novel by Neal Stephenson - in San Francisco in 2003 and is inhabited by millions of users - called "residents" - all over the world. SL is described in its website as it is "a place to connect people, a place to shop, a place to work, a place to love, a place to explore, a place to be different, to be yourself" (http://secondlife.com). People are using SL to communicate, to establish businesses, to sell goods or services and buy virtual property, to organize events, for live performance, for movie making, even for charity. The main reasons for using SL are: exploring the environment, sharing experiences with others, meeting people and making friends around the world and engaging in commercial activities (Graves, 2008). The prominent characteristic features of SL are: it is a user-generated environment, residents can develop shared content collaboratively upon common interest, and it has economic transaction possibilities built in, for marketing based on Linden Dollars that leads to real world income. In addition, encouragement for interactivity, connectivity of the system, easy access to various materials, and different resources are main factors for engagement in SL. The above information implies that the primary aim of SL is to afford an environment in which the users can interact with each other. However, SL also hosts many educational events including in-world classes, academic conferences, seminars, demonstrations, exhibitions and a great number of educational institutions such as universities, colleges, libraries from around the world, have islands as virtual learning and teaching platforms. There are many virtual worlds for educational purposes; however, the most promising and popular environment is Second Life (SL) in reference to Reis et al. and Tsiatsos et al. (Reis, Escudeiro & Escudeiro, 2010; Tsiatsos, Konstantinidis, Ioannidis & Tseloudi, 2009). SL has been outstanding virtual world for educational purposes in UK universities for the latter half of the 2000s and hundreds of universities all over the world pay attention to the engaging teaching and learning activities in SL (Kirriemuir, 2010; Zhu, Wang & Jia, 2007). To give an example, Gardner et al. (2008, cited in ReLIVE08) developed the MIRTLE project to create a mixed-reality environment for teaching and learning in the University of Exeter. The key hypothesis of the project was "avatar representations of teachers and students can help create a sense of shared presence, engendering a greater sense of community and improving student engagement in online lessons". In other words, the presence of avatars enhances engagement and learning. Since the majority of distance students may feel socially and pedagogically isolated not only from each other but also from institutions (Brown, 1996) , Gardner et al. believe that this project particularly helped distance learners to feel a sense of social presence which is explained by Schroeder (2002) as the feeling of 'being there.' They aimed for this project was to bring together the physical and virtual worlds to foster a sense of community between remote and local students along with instructors. As a consequence, they sought to eliminate the isolation of distance students feeling themselves as really being there that may inspire them and ultimately enhance their learning process. In the next section, we explain design, implementation and training phase of the study.

3. Design, implementation and training

A power transformer has been designed and implemented considering its important inner parts on SL. Figure 1 illustrates the transformer by all appearances including the tap changer, bushings, oil reservoir tank, cooling parts and so on. In Figure 2, the transformer can be seen top view with the buchholz protective relay. This relay generates alarm and trip as the transformer oil is exposed to heat and getting expanded.

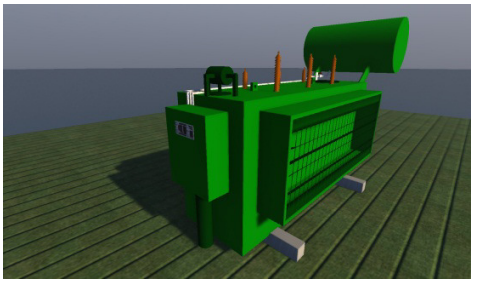

Figure 1. The transformer by all appearances.

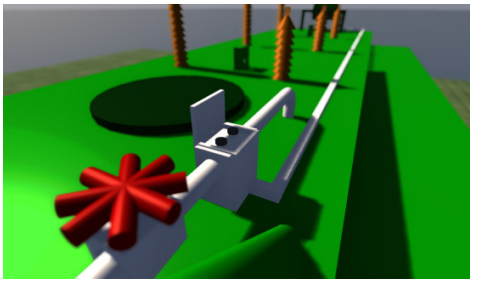

Figure 2. the transformer top view

Inside the transformer tank, there are magnetic core, primary and secondary windings and their connections. Transformer oil, necessary for cooling down and insulation, fills up the tank fully. These parts have been shown in Figure 3. Figure 4 illustrates the magnetic core parts. Magnetic flux is generated by primary winding current and travel through the magnetic core and is induced voltage in secondary winding quite simply.

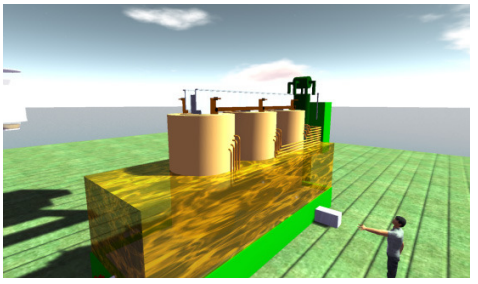

Figure 3. Inner parts of the transformer

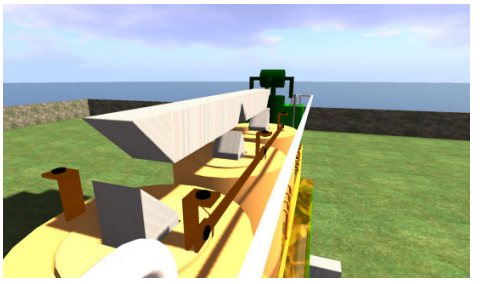

Figure 4. The core parts

After the design and implementation phase, the basic of the movements and changing the camera positions to the students of the experimental group on SL. The training phase is carried out by synchronously and/or asynchronously. The students can interact each part of the transformer and get more information about the clicking parts. Figure 5 illustrates interacting with the bushings. This is good solution for the asynchronous training. The students can reach the education materials without time and place restrictions. Both Turkish and English language can be used for the detailed information of the parts. In Figure 6, the teacher can duplicate the transformer for each of the students and answers to the student's questions.

Figure 5. Interacting with the bushings

Figure 6. The training environment

4. Analysis and findings

SPSS 19 packets programs are used for data analysis in this study. Mann-Whitney U and Wilcoxon Signed Ranks test from non-parametric tests is used due to lack of the sample size. Findings are discussed individually for each research question in below.

1. Is there a significant difference between pretest achievement scores of the experimental group and pretest achievement scores of the control group?

Table 1. Comparison of Experimental and Control Groups Pretest Achievement Scores (Mann - Whitney U Test Results)

Groups	Tests	N	Mean Rank	Sum of Rank	U	p
Control	Pretest	5	4.60	23	8.000	.338
Experimental	Pretest	5	6.40	32		

Analyzing the results of the experimental and control group pretest did not differ significantly between mean scores in Table1 (U=8.000, p=0.338 > 0.05). This result shows that there isn't a significant difference between the knowledge levels of students in the experimental group and control group about the subject before narrative of the subject.

2. Is there a significant difference between pretest achievement scores of the control group and posttest achievement scores of the control group?

Table 2. Comparison of Control Group Pretest and Posttest Achievement Scores (Wilcoxon Signed Ranks Test Results)

Groups	Tests	N	Mean	Std. Deviation	Z	p
Control	Pretest	5	20	7.906	-2.041	.041
Control	Posttest	5	44	8.216		

By analyzing the results of pretest and posttest of control group, given training through conventional method appears to contribute an increase between control group pretest and posttest achievement scores in Table 2. Wilcoxon Signed Ranks test was made to determine whether this difference is significant between the averages. The results of this test show that this increase was statistically significant (Z=-2.041, p=0.041<0.05). Therefore, this suggests that given training through the conventional method increases the achievement of students in control group.

3. Is there a significant difference between pretest achievement scores of the experimental group and posttest achievement scores of the experimental group?

Table 3. Comparison of Experimental Group Pretest and Posttest Achievement Scores (Wilcoxon Signed Ranks Test Results)

Groups	Tests	N	Mean	Std. Deviation	Z	p
Experimental	Pretest	5	25	9.354	-2.041	.041
Experimental	Posttest	5	70	12.748		

By analyzing the results of pretest and posttest of experimental group that taught and trained through SL appears to contribute an increase between experimental group pretest and posttest achievement scores in Table 3. Wilcoxon Signed Ranks test was made to determine whether this difference is significant between the averages. The results of this test indicates that this increase was statistically significant (Z=-2.041, p=0.041<0.05). Therefore, this suggests that the given training through SL increases the achievement of students in experimental group.

4. Is there a significant difference between posttest achievement scores of the experimental group and posttest achievement scores of the control group?

Table 4. Comparison of Experimental and Control Groups Posttest Achievement Scores(Mann - Whitney U Test Results)

Groups	Tests	N	Mean Rank	Sum of Rank	U	p
Control	Posttest	5	3.30	16.50	1.500	.020
Experimental	Posttest	5	7.70	38.50		

By analyzing the results in Table 4 appears that the experimental group posttest achievement scores are higher than the control group posttest achievement scores. Mann - Withney U test was made to determine whether this difference is significant between the scores. The results of this test shows that this difference was statistically significant (U=1.500, p = 0.020 < 0.05). According to the results obtained, this suggests that that the given training

through SL is more effective than the given training through conventional method to increase the achievement of students.

5. Discussion and Conclusions

Students in the control and experimental groups have been trained in the topic of internal structures of power transformers through traditional ways and SL respectively. Success grades of the students in both groups have been obtained by using pretest and posttest. In the analyzing of the grades, non-parametric tests of the Mann Whitney and Wilcoxon Signed Ranks have been administered due to lack of the sample points.

In the results of Mann Whitney U test which was applied to compare pretests grades of both student groups, there was no statistically significant difference and it was interpreted as both groups were consistent in terms of the lecturing. In the results of Wilcoxon Signed Ranks test which was applied to compare pretests and posttests to the each group in themselves, statistically significant differences were found in favor of the posttests. These results show that each educational method improve the students successes statistically. In comparing with each groups' posttests, statistically significant difference was found in favor of the experimental group. As a result, it is possible to infer that both traditional educational methods and teaching through SL are effective in increasing the success of the students; it is also fair to say that teaching through SL is more effective in increasing the success of the students than teaching with traditional methods.

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