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The effects of the authentic learning approach with a course management system (moodle) on students' mathematics success and online authentic learning self-efficacy

Hüseyin Uzunboylu[1], Murat Tezer[2] and Ezgi Pelin Yildiz[3*]

[1]Higher Education Planning Supervision Accreditation and Coordination Board (YODAK) Nicosia, Cyprus.
[2]Faculty of Science and Literature-Mathematics, Near East University, Nicosia, Cyprus.
[3]Department of Computer Programming, Kafkas University Kazım Karabekir Vocational School of Technical Sciences, Kars, Turkey.

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This study was conducted to determine the effects of the "Moodle LMS which was based on authentic learning approach" and "online learning which was based on authentic learning approach environments" on "mathematics achievement" and "online authentic learning self-efficacy" levels of students in a basic mathematics course. In accordance with the purpose of this study, an experimental design with pre-test and post-test control group was used as the research design. Within the framework of the experimental model, two experimental and one control group were formed with random assignments and were included in different learning environments. Two data collection tools (Mathematics Achievement Test and Online Authentic Learning Self-Efficacy Scale) were developed. As a result, it was seen that there was a significant difference between the mathematics achievement test scores and between the online authentic learning self-efficacy scores when the experimental and control groups were tested later. They had all been doing a Basic Mathematics course in three different learning environments. The significant difference within the context of the two variables was in favour of the working group of the study's students who had their education in a blended learning environment (both traditional face to face and online learning) which was based on the authentic learning approach on Moodle LMS.

Key words: Distributed learning environments, human-computer interface, improving classroom teaching, interactive learning environments, post-secondary education.

INTRODUCTION

The use of internet in education has led to several innovations and developments. In the beginning, these innovations and developments helped to expedite and increase communication, particularly the interaction between student-student and student-teacher, and also brought about the dissemination of educational services.

*Corresponding author. E-mail: yildizezgipelin@gmail.com.

Along with face to face education, supported by instructional technologies, gaining widespread day-to-day use, traditional educational methods with online education materials or combining and enriching completely online education is called blended education (Baz, 2016). With the Covid-19 pandemic, which affects many countries in the world and face-to-face education was interrupted a long time ago and the distant education system was introduced. Thus, distance education applied at different levels entered into our lives when most of the stakeholders (such as teachers, students, instructors, managers) were foreigners (Dikmen and Bahceci, 2020; Yamamoto and Telli, 2020).

The most important factors in a face to face learning environment are solving immediately the problems encountered during the education process and also the development of behaviours when the problem is solved by being helped immediately. There are limitations to the different conditions of learners' face to face learning, such as not being able to adapt to the obligations of the activities of face to face learning students who have the responsibilities of family and work, the decrease in the performance dependent on attendance because there is no opportunity to have the lesson again, the hardships in planning the lesson to respond to the needs and the details of what kind of activities will be done in face-to-face learning, depriving the students of their autonomous learning ability (Swan, 2017; Kaya, 2002; Usun, 2006). Despite all these limitations, face to face learning has never lost its prevalence and reputation in the teaching and learning process (Yapıcı and Akbayın, 2012). In addition to these learning environments, today, there are also implementations such as distance education programmes and activities and methods of e-learning combined with face-to-face learning.

With the developments of the digital era, blended education has begun to be used instead of traditional education and online teaching methods (Lin et al., 2017). Blended education, which is one of the implementations of learning using internet services, includes both a face to face and an online combination of materials (Kwak et al., 2013). Within this context blended education, which has many advantages and opportunities, is preferred because it meets the class objectives, it is easy to evaluate at the end of designed courses, it allows for effective time management in class, it develops computer literacy between teachers and learners, it provides flexible schedules for the classes, as well as infinite sources of materials for teachers and learners, twenty-four hour access to the lesson materials, supported classroom activities with the use of www. sources and the opportunities to attend the lesson whenever and wherever the students want (Tierney, 2020). It encourages both cooperative and independent working between learners, provides additional learning materials, a decrease in the unnecessary responsibilities of teachers, an increase in the quality of communication and interaction between teacher-learner and learner-learner, the observation of the attendance and development process of the students, quick feedback, interactive programs, corrective actions by the institutes of education and teachers or instructors (Hijazi et al., 2006; Hubackova and Semradova, 2016).

Online learning, which involves only the internet services, comes out as one of the implementations of distance learning within this context; distance education must not be ignored as it has many advantages for online learning, such as being independent of space and time, there is an interactive and quick feedback, it provides more sources as well as the opportunity to study again, supported by multimedia materials and helping the student to search. Today online education must be used not only as a way to have information which depends on distance technologies but also to have an alternative chance to strengthen the information learned and to analyse the scientific information (Khoroshko et al., 2018). Online learning platforms are strong tools for providing important developments in terms of performance and supporting the student to gain learning skills (Rozano and Romero, 2016).

Online learning environments are classified under four titles (Park and Jo, 2017; Weller, 2007). These titles are Learning Management System, Learning Content Management System, Course Management System and Virtual Learning Environment. Learning Management System includes management of courses, presenting learning materials, sharing and discussing of these materials, having homework, exams and feedback from teachers or instructors, recording and reporting the system records. With these functions, Learning Management System is a system that provides access of information to the users and the means to share them and a supporting online system for independent work and also cooperation (Al-Busaidi and Al-Shihi, 2010). Platforms such as Moodle, Blackboard, Sakai, Docebo, A Tutor have been used widely in many schools, especially in higher education in universities, as the base of course management systems and have been a great support to teaching (Caputi and Ganrido, 2015). In the study in which Baimurzayev and Tekedere (2019) analyzed the availability of the cloud-based Moodle Learning Management System, it is stated that the website of the Cloud-Based Moodle is well available.

According to Onal et al. (2006), one of the most common open source software in LMIS is Moodle. When considered generally, the biggest advantage of Moodle is open source software and also the need for a single access for users. Therefore, the users get used to only one user interface. Today, especially in online courses, with an easy registration and the account information gained by this registration, this provides an easy way to use the Moodle platform. In broader terms, the users of this platform can access the online courses easily anytime and anywhere they want in the world. Also,

course design and management in Moodle include enriched multimedia materials, several communicative and cooperative activities (forum, chat, wiki, etc.) guidance and communication interaction of teachers together with feedback, evaluation, controlled learning by statistics of observation and support.

When Moodle is considered from a theory perspective, it is grounded in the social constructivist theory (Downes, 2006; Robinson et al., 2017). According to this theory, led by Vygotsky, learning and cognitive development are social and cooperative activities, happening in meaningful contexts and they cannot be thought of as disconnected from the real world's developments. It is focused on the relationship between the students' experiences both in school and out of school (Senemoğlu, 2011). Social constructivist theory is grounded in what kind of environment is needed to help the learners to learn better instead of what or how the teachers will teach when the environments are designed (Fer, 2009). The learners, whose interests and background information are considered, study in small cooperative groups in the social constructivist environments and therefore they learn from each other. The teachers or instructors take the role of guides in providing the information in these environments.

Today, one of the other approaches which is said to be effective for student success is the Authentic Learning Approach (Lombardi, 2007; Lucua and Marin, 2014). Maxwell et al. (2003) defined the authentic learning approach as "content based learning which provides the usage of information in real world environment and implementations". Authentic learning includes the constructivist theory and, thus, the authentic learning process guides the learners to have information and skills about what and how to learn in the real world environments. From this point of view, the learner, who realises what and how to learn, makes learning as their objective even if they are under the guidance and observation of the teachers (Watters and Ginns, 2000). Also, the learners will gain the qualification of using the information they learned in the real world, out of school, and lifelong skills.

Today, the authentic learning approach is in a situation that is combined with technology and integrated in multimedia implementations (Güngören and Horzum, 2014). Multimedia is seen as a sort of technology supported environment and the learning in this environment is also defined as multimedia environment learning. Within this context, authenticity and authentic learning concepts have important roles. The focus of technology-supported environments on problem and learning ensures that learning environments close to real-world learning are supported. Increasing the focus and learning of the learners, and developing their skills of transfer; it is possible to benefit from authentic, real, close to real multimedia learning environments (Grabinger and Dunlop, 2003).

When the literature is considered, it is seen that the authentic learning approach was used in the design of several courses in educational institutes. Mathematics courses have also their place in the courses which can be carried out with an authentic approach and its activities. When the mathematics course is considered with the connection to real life, it is emphasised that, in the frame of the authentic learning and teaching approach, experiences in daily life, examples of daily life must be dependent on the contexts of learning (Schreglmann and Karakuş, 2017). When the related literature is considered, the motivation and the success of the students, lifelong learning and other contributions of education were seen to have limitations in education institutes or universities, which include higher education, in both mathematics courses and other content of the courses and their studies. This situation was seen as a deficiency and, to make up for this deficiency, it was decided in this study that, in the basic mathematics courses which will be given to the university students, the following should be included; starting out from the real world, its situation and problems, the learners' thoughts on these authentic situations; designing activities for authentic learning which will make the students gain the qualification for lifelong learning and its opportunities in both daily life and in other parts of life.

In this study, "traditional face-to-face learning which was based on the authentic learning approach", "blended learning" (both traditional face-to-face and online learning which was based on the authentic learning approach on Moodle LMS) and "online learning which was based on the authentic learning approaches" were included as three learning environments. It was to be determined whether there was a significant difference between the mathematics success mean scores and the "online authentic learning self-efficacy" mean scores of the students who had mathematics course instruction in these three different learning environments. When the literature was considered, these three learning environments have advantages in the education process. Within these contexts, there was an attempt to find which one of them had more effect on the success of a basic mathematics course and online authentic self-efficacy.

Today's technologies have affected and changed the teaching and learning processes related to mathematics as in all other fields. In this context, it is pointed out that teachers need to use technological tools or environments in order to increase the interest of learners and help them understand mathematics. With this study, it is aimed to gain all these learning skills to the learners with the communication technologies tools and multimedia elements used information in the course. The research is thought to contribute to the field in this context.

The purpose of this study

The essential aim of this study is to specify the effects of

Table 1. Experimental research model.

Group	Pre-test	Experimental process	Post test
Experimental Group I	T1, T2	Based blended learn.	T1, T2
Experimental Group II	T1, T2	Based online learn.	T1, T2
Control	T1, T2	Based traditional learn.	T1,T2

T1: Math achievement test**, T2:** The scale of online authentic learning self-efficacy.

Table 2. Comparison of the pre-test online authentic learning self-efficacy Scale Mean rank scores of the experimental and control groups.

Groups	N	Mean rank	df	X^2	p	Significant difference
Control	60	88.42				
Experiment I	60	89.76	2	0.285	0.867	No significant difference between groups
Experiment II	60	93.33				

the "Moodle LMS which was based on the authentic learning approach" and "online learning which was based on the authentic learning approach environments" both on the success and “online authentic learning self-efficacy" levels of the students in a basic mathematics course. With the objectives defined above, the following question was put forward:

(i) Is there any significant difference between the post-test mathematics achievements mean scores, experimental groups I and II and of the control group students who had their basic mathematics course in blended, online and traditional face-to-face, learning environments respectively?

METHODOLOGY

Research design

In accordance with the purpose of this study, an experimental design with pre-test and post-test control group was used as the research design. Randomised design with pre-test and post-test control group is one of the most common research designs in education and psychology. Initially, subjects are assigned to groups randomly. Later, the subjects’ measurements with dependent variables were taken before the implementation. The experimental process, whose effect was tested during the implementation process, was not applied to the control group while it was applied to the experimental groups. Finally, the measurements in the dependent variables of the subjects in the groups were taken again by using the same tools or peer form (Buyukozturk, 2018; Ferguson and Takone, 1989). When the concept of the research design of this study was considered, the groups were formed in the concept of random design with pre-test and post-test control groups and learning environments as follows (Table 1).

The independent variables of the research

The education of mathematics was adapted with the authentic learning approach, blended education supported with Moodle LMS, online learning based on Moodle LMS, face to face education.

The dependent variables of the research

The dependent variable is success in mathematics, online authentic learning self-efficacy.

Participants of the study

The subject group of this study consisted of one hundred and eighty students who were in the first class and were doing a basic mathematics course in the Vocational School of Health at a private University in North Cyprus in the 2016-2017 autumn semester. Ninety-three of the students were males and eighty-seven of them were females in the subject groups. The students were assigned to experimental Groups I, II and control groups randomly and in an equal manner (sixty students in a group). The findings about evaluation of the experimental groups and control group students meant rank scores in a pre-test online authentic learning self-efficacy are given in Table 2. As the p value, according to the Kruskal-Wallis H test is 0.867>0.05, this means that there was no significant difference in Experimental Groups I, II and the control group students’ online authentic learning self-efficacy pre-test’s mean rank scores. Also, as the p value according to the Kruskal-Wallis H test is 0.174>0.05, this means that there was no significant difference in Experimental Groups I, II and Control group students’ mathematics achievement test mean rank scores (Table 3). It was determined that there were no significant differences between the pre-test mathematics achievement test and the authentic learning self-efficacy mean rank scores (p>0.05) of the experimental groups and the control group. So, the assignment of individuals to the experimental groups and the control group were made objectively and/or randomly.

Data collection tool

Mathematics achievement test

Considering the objectives and knowledge of the basic mathematics course’s subjects, the forty question achievement test was developed by the instructors of this course. In the development

Table 3. Comparison of the pre-test mathematics achievement mean rank scores of the experimental and control groups.

Groups	N	Mean rank	df	X^2	p	Significant difference
Control	60	99.84				
Experiment I	60	82.17	2	3.494	0.174	No significant difference between groups
Experiment II	60	89.49				

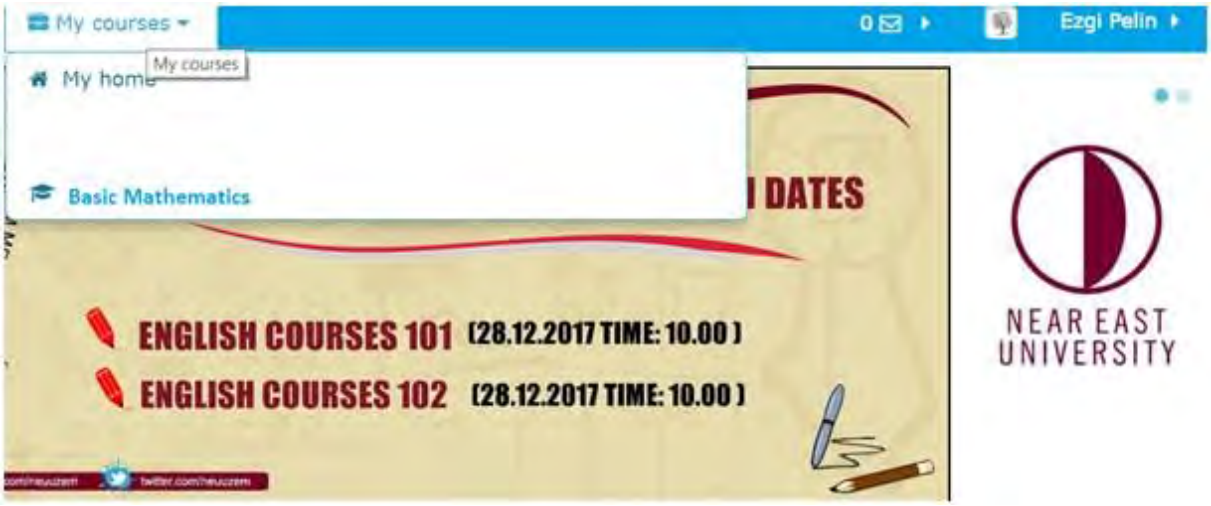

Figure 1. Home Page of the basic mathematics course.

stage, the instructors prepared the scenario and the questions, which the students would encounter in real life environments and which were suitable for the authentic learning approach. Except for this, the rest of the questions were developed according to the subjects in the syllabus for the university entrance examination. The originality of the questions was considered in the development stage. The developed questions were revised in accordance with the opinions of experts to determine whether they measured the objects and behaviours in the concept of the basic mathematics course. At the end of the item analysis, 0.30 and over 0.30 discrimination index of the item (r) was taken for achievement of the test and the two questions which were under 0.19 were removed from the test and the achievement test with thirty-eight multiple choice questions was developed. At the end of the item analysis, there were corrections to six questions whose item difficulty index was 0.20 – 0.29 and these questions were prepared for future use. With the collected data, the alpha reliability coefficient of the achievement test was calculated as .96. This result was evaluated to be quite sufficient for the reliability of the test. The results of the alpha reliability coefficient such as .70 and over are considered to be enough for a psychological test (Büyüköztürk, 2013).

The scale of the online authentic learning self-efficacy

The scale of the online authentic learning self-efficacy used in this research was developed by Tezer et al. (2018). The scale has nine factors (problem-solving skills and bonding, supra-cognitive skills and persistence in learning, interaction with real-world environments and interaction in the online environment, interaction and learning experiences with the real world, social bonding in online collaborative learning environments, structured support for internalising effective knowledge, multiple evaluation and feedback, collaborative work skills and product development). The scale was developed with a 5-point Likert type scale such that 5 points represented “absolutely agree” and 1 point represented “totally disagree”. This scale’s internal consistency coefficient calculated with Cronbach Alpha was determined as 0.97. According to many researchers, when the reliability coefficient is closer to 1, the reliability increases (Huang, 2002; Sekaran, 2013). Fraenkel and Wallen (2006) determined that, when the reliability coefficient is lower than 60, it is weak, when it is between .60 and .70, it is within acceptable limitations and when it is over 0.80 it is good.

The implementations and environment of the study

First, in the development stage of the environment, in order to provide the use of Moodle LMS on the internet, the Distance Education Centre’s (DEC) university web address, which has a ready-made Moodle setup, was open for students (to have a new basic mathematics course- SMO 105) (Figure 1). After the course was opened, the necessary information for registration of the students, who would have the course in blended and online environments, was opened by the instructors. The registered number of students was one hundred and twenty: sixty of them had the course in the blended education environment; sixty of them had the course in the online education environment. The other group, who had traditional (face to face) education, did not have registration on the Moodle LMS system, although the authentic learning approach was used in the basic mathematics course education as with the other groups. The date rates in the Moodle system were used for the start and expiry date of the course. The course notes and interactive videos about the course were added

Figure 2. SMO 105 Code Basic Mathematics Facebook Group.

according to these dates.

Panapto is a course registration software (lecture capture) that is used in universities, and also is an assistive platform to form the content of the course in a combined course management system with LMS (blackboard, Moodle, etc.). The access to the course activities (online), interactive videos and course notes determined in the screen shoots were provided from the students' phones to a DEC system supported by Moodle, and provided their participation particularly for mobile learning, "Photon Flash Player and Browser" was also used. Photon flash player and browser was developed for android devices and is an internet browser. Unlike other internet browsers, it allows the use of Flash contents in android devices without downloading any extra add-on.

Within the study concept, "BigBlueButton" online conference environment, which is in the Moodle platform, was used to communicate with the students simultaneously (synchronously), and in addition, to provide course notes and interactive videos, as well as providing live course support. With these environments, the students had the opportunity to ask the instructors about the lessons or the example questions that they did not understand, and they were supported also with collaborative learning activities so that they could communicate with each other. The forum about the course for student activities is included via a module to the learning environment. With this module, the students were given the chance to get to know and socialise with each other (Çevik, 2008; Donaldson et al., 2017; Elmas et al., 2008). Within the research concept, a forum in Moodle page was provided so that the students had a voice in the course management.

Within the study concept, with the help of a social networking website (Facebook) group as SMO Basic Mathematics Course DEC group, a continuous communication was provided. The announcements, information and instructions about the course or the use of the learning environment supported by Moodle LMS are given on this page (Figure 2). Within the scope of the study, a group was established on Facebook for better communication with students and lecturers. The membership was provided for groups I and II students.

Interactive lesson videos for authentic learning

Interactive lesson videos were prepared, scenarios based on authentic learning and using animations, images, texts and audio from multimedia components. The students, who were in the experimental groups, watched these videos online; they had the opportunity to watch them again with the recordings on the system (Figure 3).

Data analysis

The evaluation of the data collected in this research and tabulation were done with Statistical Package for Social Science (SPSS) version 23. To answer sub-objectives, the data obtained were analysed with the percentage (%), mean ($\bar{X}$), frequency (f) and standard deviation (Sd.). The comparisons of the grades of the students before and after the education were done via Kruskal Wallis-H and Mann-Whitney U non-parametric tests in the experimental and control groups separately. It was accepted that there was not a normal distribution in the data with $p<0.5$ value within the Kolmogorov-Smirnov test concept. In the explanation of the differences in data, the general average was considered. In all statistical analysis, the significance level was accepted as .05. The distribution and the frequency of the findings of the students' opinions about Moodle LMS, which is an online educational environment, were presented with the help of frequency and percentage distribution tables.

FINDINGS

The findings about the evaluation of the experimental groups and the control group students' mathematics achievement test results in post-test are in Table 4. According to the Kruskal-Wallis H test conducted in Table 4, the p value is .004 < .05 and that means there was a significant difference between the post-test mathematics achievement test mean ranks of Experiment I, II and the Control groups. In order to specify which groups were significantly different, the researchers used the Mann-Whitney U test. Tables related with the Mann-Whitney U test (Tables 5 to 7) are given below.

According to the Mann-Whitney U test, the p value in

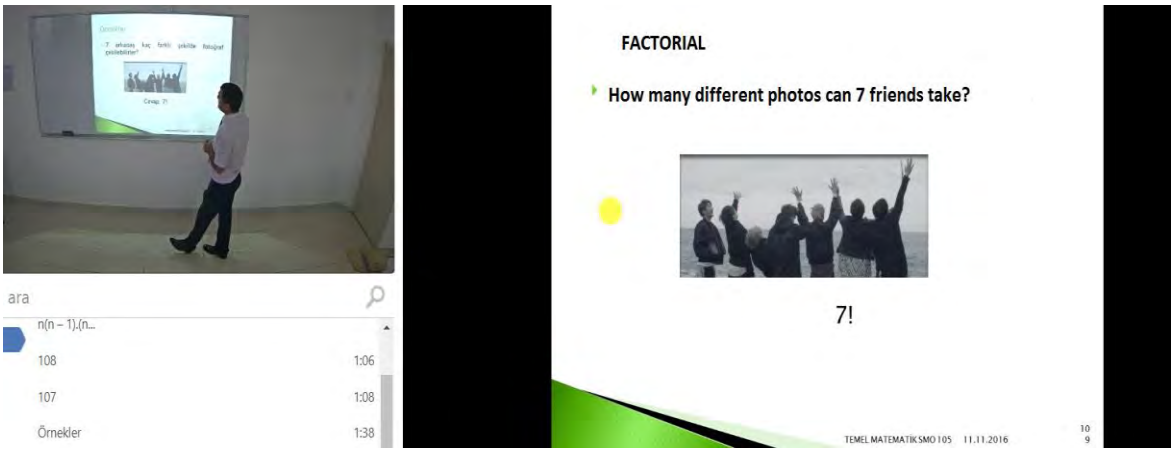

Figure 3. Teaching of subjects with multimedia content (such as images, texts and audio).

Table 4. Kruskal-Wallis H-test result for the post-test mathematics achievement test of the experimental groups and the control group.

Groups	N	Mean rank	df	X^2	P	Significant difference
Control	60	77.13				
Experiment I	60	107.65	2	10.914	0.004	p<0.05
Experiment II	60	86.72				

Table 5. Mann-Whitney U test result for the Post-test Mathematics achievement test of the Control Group and the Experimental Group I.

Groups	N	Mean rank	Sum of ranks	U	p	Significant difference
Control	60	50.53	3032	1202	0.002	p<0.05
Experiment I	60	70.47	4228			

Table 6. Mann-Whitney U test result for the Post-test Mathematics achievement test of the Control Group and Experimental Group II.

Groups	N	Mean rank	Sum of ranks	U	p	Significant difference
Control	60	57.10	3426	1596	0.281	p>0.005
Experiment II	60	63.90	3834			

Table 7. Mann-Whitney U test result for the post-test mathematics achievement test of Experimental Group I and Experimental Group II.

Groups	N	Mean rank	Sum of ranks	U	p	Significant difference
Experiment I	60	67.68	4061	1369	0.023	p<0.05
Experiment II	60	53.32	3199			

Table 5 is 0.002<0.05 and that means that there is a significant difference in the mathematics achievement test mean rank scores of the control group and the Experiment I group students' post-tests. The results showed a significant difference in favour of Experiment I students who had blended education. As the p value is 0.281>0.05 according to the Mann-Whitney U test in Table 6, it means that there is no significant difference between the mathematics achievement test mean rank scores of the control and the Experiment II group

Table 8. Wilcoxon Signed Rank Test results for the Pre-test and Post-test mathematics achievement test of the Experimental Groups and the Control Group.

Groups	Pre-test- post-test	N	Mean rank	Sum of ranks	z	p	Significant difference
Experimental Group I	Negative order	0	0	0	-6.737	0	p<0.05
	Positive order	60	30.5	1830			
	Ties	0					
Experimental Group II	Negative order	0	0	0	-6.737	0	p<0.05
	Positive order	60	30.5	1830			
	Ties	0					
Control Group	Negative order	4	4.88	19.5	-6.593	0	p<0.05
	Positive order	56	32.33	1810.5			
	Ties	0					

Table 9. Kruskal-Wallis H test results for the post-test online authentic learning self-efficacy of the experimental and control group's.

Groups	N	Mean rank	df	X^2	p	Significant difference
Control	60	80.27				
Experiment I	60	106.65	2	8.866	0.012	p<0.05
Experiment II	60	84.58				

students' post-test. In this situation, it was shown that there was no significant difference between the mathematics achievement test mean scores of the control group who had traditional education and the Experiment II group students who had online education. As the p value is 0.023<0.05 according to the Mann-Whitney U test in Table 7, this means that there is a significant difference between the Experiment I and II group students' mathematics achievement test mean rank scores in post-test. The results were significantly different in favour of Experiment I group students who had blended education. The findings about the difference in evaluation between the mathematics achievement test mean scores of the experimental and the control group students pre-test and post-test are given in Table 8.

Wilcoxon signed rank test was used as the statistical test with the aim of presenting the differences between the pre-test and post-test mathematics achievement test mean rank scores of the experimental group and the control group students. The related test was used to show whether there was a difference between the data of the same sources with two rates measurement results (Büyüköztürk, 2013). According to Table 8, in addition to positive and negative ranks and the sum of ranks reporting depending on the Wilcoxon signed rank test, the values which were useful for us were the z value and its significance level. The z values were found to be -6.737, 6.737 and -6.593, and they were under the critical significance level which is .05. Within this context, it was found that there was a significant difference between the mathematics achievement test mean rank scores of the experimental group and the control group students' pre-tests and post-tests. In order to calculate the effect size, r = Z / √N formula was used. The results were as follows;

Experimental Group I, r = Z / √N (r= -6.737 / √180), r = -0.51
Experimental Group II, r = Z / √N (r= -6.737 / √180), r = -0.51
Control group, r = Z / √N (r= -6.593 / √180), r = -0.50

The effect was that the size in the results was bigger than 0.50, therefore it proved that there is a large effect between the pre-tests and post-tests mathematics achievement test mean rank scores of the experimental groups and the control group students. The findings of the analysis of the experimental group and the control group students' online authentic learning self-efficacy post-test's mean rank scores are given in Table 9. As the p value, according to the Kruskal-Wallis H test, is 0.012<0.05, this means that there is a significant difference between the experimental groups I and II and the control group students' online authentic learning self-efficacy post-test's mean rank scores. According to the findings of this test, there was a significant difference and the Mann-Whitney U test was used to show in which group there was a difference. The test results can be seen in Tables 10 to 12).

Table 10. Mann-Whitney U test results for the post-test online authentic learning self-efficacy of the control group and Experimental I.

Groups	N	Mean rank	Df	U	P	Significant difference
Control	60	51.25	3075	1245	0.004	p<0.05
Experiment I	60	69.75	4185			

Table 11. Mann-Whitney U test results for the post-test online authentic learning self-efficacy of the control group and Experimental II.

Groups	N	Mean rank	Df	X^2	p	Significant difference
Control	60	59.52	3571	1741	0.756	p>0.05
Experiment II	60	61.48	3689			

Table 12. Mann-Whitney U test results for the post-test online authentic learning self-efficacy of the Experimental I and Experimental II Groups.

Groups	N	Mean rank	Df	X^2	p	Significant difference
Experiment I	60	67.40	4044	1386	0.030	p<0.05
Experiment II	60	53.60	3216			

The p value, according to the Mann-Whitney U test, is 0.004<0.05 and that means there was a significant difference between the experimental group I and the control group students' online authentic learning self-efficacy post-test mean rank scores. The results showed significant difference is in favour of the experimental group I students who had blended education. The p value according to the Mann-Whitney U test is 0.756>0.05, this can be interpreted that there was no significant difference between the experimental group II and the control group students' online authentic learning self-efficacy post-test mean rank scores. This finding showed that there was no significant difference between the control group who had traditional education and the experimental Group II students who had online authentic learning self-efficacy post-test grades. The p value according to the Mann-Whitney U test is 0.030<0.05 and this means that there was a significant difference between the experimental Group I and experimental group II group students' online authentic learning self-efficacy post-test mean rank scores; the results showed that the significant difference was in favour of the experimental Group I students who had blended education. The findings about the analysis of the difference between experimental and control group students' online authentic learning self-efficacy pre-test and post-test are given in Table 13.

The Wilcoxon signed rank test was used as the statistical test with the aim of presenting the difference between the pre-test and post-test Online Authentic Learning Self-Efficacy mean rank scores of the experimental group and the control group students. The z values were found to be -6.628, 6.781 and -6.780, and they were under the critical significance level 0.05. In this regard, it was found that there was a significant difference between the pre-test and post-test Online Authentic Learning Self-Efficacy mean rank scores of the experimental group and control group students. The calculated effect sizes were as follows;

Experimental Group I, $r = Z / \sqrt{N}$ ($r = -6.628 / \sqrt{180}$), $r = -0.50$
Experimental Group II, $r = Z / \sqrt{N}$ ($r = -6.781 / \sqrt{180}$), $r = -0.51$
Control group, $r = Z / \sqrt{N}$ ($r = -6.780 / \sqrt{180}$), $r = -0.51$

As the effect size calculated was bigger than 0.50; therefore it proved that there is a large effect size between the pre-tests and post-tests online authentic learning self-efficacy mean rank scores of the experimental groups and the control group students.

DISCUSSION

In this study of two dependent variables (mathematics achievement and online authentic learning self-efficacy), the significant difference was in favour of the students (experimental group I) who had had the course in blended education supported by Moodle LMS in the education of a basic mathematics course adapted authentic learning approach. The results that came out according to these statements show that the research results were both similar and different from the literature.

However, for this study, the results of the mathematics

Table 13. Wilcoxon signed rank test results for the pre-test and post-test online authentic learning self-efficacy of experimental groups and control group students.

Groups	Pre-test-post-test	N	Mean rank	df	z	p	Significant difference
Experiment I	Negative order	1	33.50	33.50	6.628	0.000	p<0.05
	Positive order	58	29.94	1736.50			
	Ties	1					
Experiment II	Negative order	0	0.00	0.00	6.781	0.000	p<0.05
	Positive order	59	30.00	1770.00			
	Ties	1					
Control pre-test post-test	Negative order	0	0.00	.00	6.780	0.000	p<0.05
	Positive order	59	30.00	1770.00			
	Ties	1					

achievement test result were in favour of blended education learning environments. If the literature is considered, there are many advantages to a blended education environment; these include having both the strong and weak sides of web based and class based learning (Osguthorpe and Graham, 2003), availability of technology support (Oliver, 2015), effective time management in class, flexible schedules, infinite sources of materials for teachers and learners, 24 h access to the lesson materials, supported classroom activities with the use of www sources, opportunities to attend the lesson whenever and wherever the students want, the cooperative and independent work between the learners, providing additional learning materials, decrease in the unnecessary responsibilities of the teachers, increase in the quality of communication and interaction between teacher-learner and learner-learner, observation of the attendance and development process of the students, quick feedback, interactive programs, corrective actions (Hijazi et al., 2006) by education institutes and teachers or instructors are possible. In this context, several educational institutions, which designed courses depending on blended education, had successful results (Olapiriyakul and Scher, 2006). In fact, blended education, which was given for the basic mathematics course achieved successful results in the context of this study. In addition to blended education, having a basic mathematics course education adapted with the authentic learning approach and face to face courses which are appropriate for presenting this approach, integrating technology combined with multimedia environments via Moodle LMS and within the concept, the concept of "authentic multimedia learning environments" was accepted. These benefitted from the Moodle LMS modules (forum, survey, homework, modules), the "BigBlueButton" tool support which is in the DEC system and is used in Moodle LMS's teacher-learner and learner-learner; the Facebook group page serving the same purpose (SMO basic mathematics course DEC group), the videos prepared online with authentic learning were the aim of this study and they were structured as the factors which supported this success.

Conclusion

Within the scope of evaluating the self-efficacy of the online authentic learning and mathematics achievement results before and after the education of the students in the experimental groups and the control group of the study; it was found that the post-test mathematics *achievement* test scores and online authentic learning self-efficacy scores of the students who had their basic mathematics education supported by different learning methods (blended, online learning and traditional) are higher compared to the pre-test mathematics achievement scores and online authentic learning scores*. This was interpreted as a result of the "authentic learning approach" adapted to each group.*

Recommendations

The results of the study show that supporting the basic mathematics course with the authentic learning approach has a positive effect. With this result, it can be suggested that the implementations and evaluations of the authentic learning approach theory must be given more place in the development of academic skills in different course concepts. Also, this study has proved that a basic mathematics course using the online authentic learning approach has a positive effect on online authentic learning self-efficacy of the students. Therefore, it is suggested that the implementation and evaluation of the authentic learning approach must be included more often in different course concepts for developing students'

online authentic learning self-efficacy.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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