

Examination of the Impact of Using an Interactive Electronic Textbook on the Affective Learning of Prospective Mathematics Teachers

Sakine Öngöz¹

Adnan Baki²

Abstract

This semi-experimental study aims to examine the impact of a learning environment that uses interactive electronic textbook on the affective learning of prospective mathematics teachers. The study group consisted of 64 prospective teachers attending the Mathematics Teaching program at Karadeniz Technical University, Turkey. For 14 weeks, experimental group received the Development and Learning course in a blended learning environment, in which an interactive e-textbook was used inside and outside the classroom. In this period, only face to face education was conducted with the control group in the classroom environment. A course attitude scale and a blended learning environment satisfaction scale were employed for the purpose of data collection. In addition, observations were conducted with both of the groups during the application. The analysis of the findings indicated that there was a significant increase between pre- and post-course attitude scores of experimental group students, the students were satisfied with the learning environment formed, and the electronic text book increased interest in the course.

Key Words: Interactive electronic textbook, prospective mathematics teachers, blended learning model, affective learning

1. Introduction

The electronic book (e-book) first started to appear in the market in the 1990s (Gregory, 2008). Shiratuddin et al. (2003) state that, at first, ASCII standard texts emerged with printed books being transferred into electronic media and were called e-books. Later, the e-book definition was broadened to include multimedia and multiple texts linked to one another through bridges, and accordingly many different definitions exist in the literature regarding e-book. In the simplest term, e-book can be defined as “*the contents of a book made available in an electronic form*” (Hawkins, 2000). According to another definition, it is a; “*portable hardware and software system that can display large quantities of readable textual information to the user and lets the user navigate through this information*”

¹ Dr., Karadeniz Technical University, Fatih Faculty of Education, Department of Computer Education & Instructional Technology, ssensoy@ktu.edu.tr

² Prof. Dr., Karadeniz Technical University, Fatih Faculty of Education, Department of Secondary School Science and Mathematics Education, abaki@ktu.edu.tr

(Borchers, 2010). Examining the development process of e-books from past to present, it is seen that e-books have experienced a constant change and renewal in parallel with advances in computer and internet technologies. The e-book sector starting with the transfer of printed books into an electronic medium has entered an evolutionary stage that creates educational e-books equipped with visual and interactive components (Soules, 2008). E-books are useful tools for increasing the interaction between students, and between teacher and students. E-books are regarded as resources likely to generate effective outputs as part of the current learning-teaching process when appropriate environments are designed and technical problems are prevented (Shiratuddin et al., 2003). Chen (1998) suggests that e-books have a feature which enables them to be used in accordance with many different learning approaches. As a result, the number of e-books designed for a particular topic or course increases daily. These e-textbooks are very useful tools for teachers, for publishers and for students (Brusilovsky et al., 2004). Teachers can easily transfer structured course contents to the students; publishers can offer books at lower cost that can be updated more easily; and students can access learning resources online at any time or location. Jung and Lim (2009) states that, due to the introduction of e-books into schools, the discrimination between rich and poor, and rural and urban areas will be eliminated; effective learning can be provided; enterprising and self-confident individuals can be raised; a financial contribution can be made to the education; and most importantly student-centered education can be realized. McFall (2005) mentions that primary resource for teachers and students is still the printed book but these resources are not really sufficient in terms of achieving the desired outcomes of education. He and argues that e-textbooks containing multimedia makes important contributions to the quality of students' learning. Noam (1999) focuses on the same issuer and indicates that printed books, which he calls "yesterday's technology", will inevitably disappear in the face of facilities provided by today's electronic media. Güney (2007) comments that, as course material, e-books have the potential of replacing printed books and high level of interest in e-books supports that idea.

Allison (2003) classifies electronic textbooks in three groups: simple, compound and advanced. The Gutenberg Project created by Michael Hart can be accepted as the starting point of simple text format e-textbooks. The purpose of this project launched in 1971 within the body of University of Illinois was to create a library with a capacity of 10,000 e-books with free access. Over the course of time, the number of persons using this library has rapidly increased, and this virtual environment became a resource serving people throughout the world. In the library to be found on <http://www.promo.net/pg/>, it is possible to access the electronic texts of thousand of books, particularly world classics with expired copyright via file transfer protocol (FTP). Compound e-textbooks consist of many components such as sound, picture, graphics, video and animation which address different senses. Advanced level e-textbooks are electronic books which are interactive and graphical or in which a search can be made. Unlike the other two types, the reader is almost pulled into the e-book and interaction is the prominent feature. According to Jung and Lim (2009), the concept of the electronic textbook is constantly renewed based on technology and educational understanding of the age. These textbooks contain applications such as video,

animation and even virtual reality. Apart from these features, e-textbooks have the facility for internal searches and on the internet. E-textbooks have gained a new dimension due to these technologies developments and they have become completely student-centered and show parallelism with targets to be achieved in today's educational programs.

Reviewing the educational sciences studies in Turkey, there are hardly any studies related to use of e-books, e-book design for educational purposes, use of specially designed e-books as part of learning environments and the evaluation of the results obtained. Currently no interactive e-book designed as a resource for courses taught in faculties of education. Furthermore, no study has been undertaken to examine the impact of these types of materials on prospective teachers. Taking all these points into consideration, it is thought that this study will fill an important gap in the literature and bring a different perspective to researchers in relation to the issue of how a learning environment which is an alternative to the traditional understanding of face to face education can be constituted in teacher training in Turkey. This study aims to describe the impact of a learning environment that uses an e-textbook inside and outside of the classroom on the affective learning of prospective teachers. Within the scope of main problem: "What is the impact of an electronic textbook on the affective learning of prospective mathematics teachers?" answers to following questions are sought:

- a. Does the use of an e-textbook change the attitudes of prospective teachers towards the course?
- b. Are prospective teachers satisfied with the learning environment created using an e-textbook?
- c. Does the impact of an e-textbook increase the interest of prospective teachers in the course?

2. Method

An experimental method was employed in the study. Among the different types of these methods, the full experimental method is the one with highest scientific value. However, the semi-structured method is preferred by educational researchers. This is because student classes are determined by the administration of the institution beforehand in accordance with the central education policy and therefore, researchers are not able to randomly select students for the experimental and control group (Çepni, 2007). Within the scope of this study, two groups were formed one using and the other not using the e-textbook and changes in their affective learning were compared. For the reason given above the groups were not chosen via random assignment, students that had been placed in related programs following the university entrance exam comprised the sample. In the literature, many studies examined how e-books change the student behaviors chose to compare one group using and the other not using electronic materials (Maynard and Cheyne, 2005; Mikk and Luik, 2005; Güney, 2007; Korat, 2010; Porter, 2010)

The present study was conducted with 64 students attending a Secondary Science and Mathematics Education Mathematics Teaching Program in the Education Faculty, Karadeniz Technical University, Turkey. The study was conducted over 14 weeks with 33 students in the experimental group and 31 in the control group. There was no difference between the previous professional knowledge courses taken by all the 64 students in and the same instructor delivered the lectures to both of the groups. Courses of control groups were conducted in a traditional classroom environment. Ismail and Zainab (2007) indicate that proficiency in the access to and use of technology directly influences the status of using e-books. Based on this idea, a “Survey for Determining Status of Using Computer” was administered to both groups in order to determine whether there was any difference between the members of the experimental and control group in terms of their skills in using computers and the internet and whether this would affect the results of the study. The data obtained from the survey demonstrate that there was no significant difference between the two groups. Furthermore, students in both groups had similar preferences regarding computer and internet usage and similar opinions about use of these technologies in the classes (Öngöz, 2011).

In classroom environment of the experimental group an interactive e-textbook “Cognitive Development and Learning Theories” developed by Öngöz (2011) was used. This material was prepared according to Electronic Book On-Screen Interface (EBONI) e-text book design principles and, following an 8 week pilot study, it was updated and brought into use in the web environment. The e-textbook contains many visual, auidial and interactive elements and has an interface appropriate for personal use. At the beginning of the application, the experimental group students were informed about the use of e-textbook. The instructor used the e-textbook to support the in-class lectures and utilized the textual and visual elements. Using an e-textbook in the classroom creates a structure in which instructor is the active but students are passive. In order to mitigate the negative impacts of this situation, students can access the e-textbook with their user names and passwords outside the class, as well. Components of the blended learning environment used in the application are shown in Figure 1.

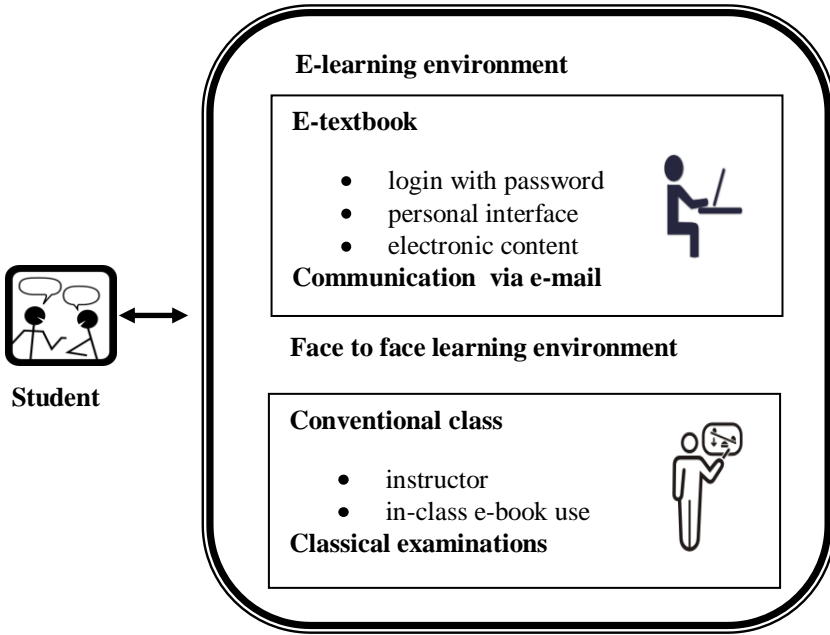


Figure 1. Structure of the blended learning environment arranged for experimental group

This learning environment formed in the experimental group shows a parallel with the blended learning model. In fact, blended learning is not a new approach in the past it has included elements such as the teacher, classroom environment, laboratory and books, has gained a new appearance by incorporating many more and interactive elements as a result of the advanced information and communication technologies. Graham (2005) states that traditional face to face education and technology-aided educational understandings were highly separate systems in the past, however, today they are used together and will be more intertwined in the future. Valiathan (2010) considers that blended learning now combines a collection of different sources from different environments such as collaboration software, web-based courses and information management applications and incorporates them into *face-to-face, e-learning and self-paced learning*".

2.1. Data collection tools

The "Development and Learning Course Attitude Scale" developed by Öngöz (2011) was used to collect data within the scope of the study. Validity and reliability studies were carried out on this 22 question 4 point Likert type scale. The Cronbach- α value of this three-factor scale is 0.942. The "Blended learning environment student satisfaction scale" containing 12 items was used in order to determine the satisfaction of students in the experimental group with the learning environment that was created. This scale was

developed by Yılmaz (2009), who also conducted the validity and reliability studies of the scale. In addition to these instruments, during the application, unstructured observations were conducted with the individual members of the experimental group and control group.

3. Findings

The pre-course attitudes of students were determined in the 3rd week of the application while their post-course attitudes were determined just after the application. The findings concerning the pre and post-attitude scores are presented in Table 1.

Table 1. Pre and post-course attitude scores of students

<i>Student No</i>	<i>Experimental Group</i>		<i>Control Group</i>	
	<i>Pre- course attitude</i>	<i>Post- course attitude</i>	<i>Pre-course attitude</i>	<i>Post-course attitude</i>
1	2.71	2.81	2.67	3.14
2	3.29	2.65	2.81	2.76
3	2.71	3	2.71	2.71
4	3.43	3.14	2.9	2.62
5	3.14	3.14	3	3.05
6	3	2.95	3.05	3.15
7	3.14	3.43	2.71	2.29
8	3.48	3.29	3	3.57
9	2.9	3.43	2.71	2.81
10	3.33	2.9	3.05	3.38
11	2.48	4	3.38	3.52
12	3.38	3.33	3.19	3.24
13	3.1	3.19	2.24	2.57
14	2.57	2.86	3.05	2.9
15	3.1	3.48	3.43	2.9
16	3.24	3.29	3.14	3.05
17	2.95	2.95	2.95	3.05
18	3.52	3.52	3.05	2.33
19	3.14	3.38	3.29	2.95
20	3	3.43	2.9	3.25
21	2.81	2.95	3.1	2.9
22	3.14	2.86	2.81	3.52
23	2.71	2.38	3.52	4
24	3.67	3.76	2.33	2.76
25	2.62	2.67	3	2.67
26	2.9	3.62	3.29	2.71
27	1.33	1.86	2.62	3.05
28	2.86	3.33	3.1	3.14

Table 1 continued

29	3.19	3.71	2.52	2.9
30	2.48	2.43	2.9	3
31	2.57	2.71	3.5	3.11
32	4	4		
33	2.86	3.14		
Average	2.99/4.00	3.13 / 4.00	2.96 / 4.00	3.00 / 4.00

The findings reveal that the average values of pre-course attitudes of the students in the experimental and control group are close to one another; 2.99 for the experimental group and 2.96 for the control group. Looking at the average values of post-course attitude scores, it can be seen that this number is 3.13 for the experimental group and 3.00 for the control group. The results regarding whether a significant difference occurred between the groups in terms of attitude change are presented in Table 2.

Table 2. Intergroup comparison of attitude scores

	Group	<i>N</i>	\bar{X}	<i>Ss</i>	<i>t</i>	<i>p</i>
Pre-course attitude	Experimental	33	2.99	0.46	0.27	.785
	Control	31	2.96	0.31		
Post-course attitude	Experimental	33	3.13	0.46	1.32	.189
	Control	31	3.00	0.36		

As shown in table 2, there is no significant difference between the pre and post course attitudes of the students in the experimental and control groups as $p < 0.05$ could not be reached. The findings regarding the significance of the attitude change within the groups are given in Table 3.

Table 3. Intra-group comparison of attitude scores

	Attitude	<i>N</i>	\bar{X}	<i>Ss</i>	<i>t</i>	<i>p</i>
Experimental Group	Pre-course attitude	33	2.99	0.463	-2.16	.038
	Post-course attitude	33	3.13	0.465		
Control Group	Pre-course attitude	31	2.96	0.31	-0.53	.599
	Post-course attitude	31	3.00	0.36		

Table 3 demonstrates that there is a positive significant difference between pre and post course attitudes of the experimental group students for the Development and Learning course. Since $p < 0.05$ value was not achieved in the control group, there was no significant difference between pre and post course attitudes in the control group.

The scores obtained from the “Blended learning environment student satisfaction scale” administered to the students in the experimental group following the application are presented in Table 4.

Table 4. Scores obtained from “blended learning environment student satisfaction scale”

Student no	Score	Student no	Score	Student no	Score
1	3.67	12	4.17	23	3.33
2	2.75	13	3.08	24	4.00
3	4.33	14	3.83	25	2.17
4	3.58	15	4.17	26	3.17
5	3.50	16	3.50	27	2.42
6	3.58	17	3.75	28	3.27
7	3.00	18	3.58	29	3.50
8	3.83	19	3.42	30	2.67
9	4.17	20	2.83	31	2.83
10	4.08	21	3.17	32	3.75
11	2.00	22	3.50	33	3.50
Average: 3.40 / 5.00					

From Table 4, it can be seen average of the general satisfaction is 3.40. This corresponds to the “I agree” score range within the scale and there was no student that was ‘completely dissatisfied’ with the blended learning environment. The ratio of those “agreeing” and “absolutely agreeing” with positivity of the learning environment is 78.8%.

Unstructured observations, which were conducted with the students during the application, were transcribed and then attention was paid to the frequencies of the situations and events. The observation findings reveal that the students in the experimental group followed the course with interest during the application. The inclusion of sections of the e-textbook related to the topic in the class contributed to students’ having a more enjoyable class. It was observed that students in the experimental group were not bored and were not distracted during the classes, they followed the e-textbook with interest and they did not take many notes. Moreover, it was seen that when the instructors gave current examples and used animations in the e-textbook, interest of the students increased. The students in the control group were more easily distracted during the course compared to the students in the experimental group. They appeared to be less willing to answer questions, they had a great tendency to be bored, were occupied with things other unrelated to the lesson and they had higher levels of note taking. Although the control groups instructor’s lecture style was no different from the experimental group’s instructor, it was observed that students in the control group had more difficulties in focusing on the lesson compared to the members of the experimental group. The instructor did not have to ask for silence in the experimental group; however the instructor in the control group was obliged to make this request.

4. Discussion

It is considered very important that the difference between the pre-course and post-course attitude scores of students in the experimental group is significant. This appears to be

because, prospective teachers developing a positive attitude towards the professional knowledge courses would be willing to learn, accordingly their scores will be higher and they will perform their jobs more enthusiastically when they are appointed to a teaching post (Ekici, 2008).

By using an e-textbook in the Development and Learning course that the experimental group attended for 14 weeks meant that the prospective teachers were offered an electronic learning environment meeting certain criteria. Computer and internet usage could have been provided inside and outside of the class in different ways during the course. For example, certain topics could have been given and the prospective teachers could have been asked to undertake research on the topics, report their findings and to share their knowledge with the class through presentations. In this case, prospective teachers would be using the internet, accessing the information by means of key words in the search engine, and using the information gained in the preparation of presentations. These kinds of applications are conducted in many courses in universities. The electronic aspect of the learning environment that was created for this study was an interactive e-textbook developed in accordance with student and expert opinions and in line with EBONI standards. It is thought that this material has a positive impact on the affective learning of the prospective teachers. It is possible that using a resource, which offers various alternatives in terms of visual and written information, directly covers the topic of interest, enables internet searches allows prospective teachers to form environments appropriate for their individual learning styles. Ekici (2008) comments that one of the most important reasons why prospective teachers' develop positive attitudes towards pedagogical knowledge courses or that their attitudes' show more positive change is that they can find learning opportunities in accordance with their learning styles. Prospective teachers realized that a mainly verbal course like Development and Learning could be conducted in a way other than just the lecturing of the instructor and with the use of printed materials and non-interactive resource materials. This positively impacted on their attitude towards the course. The findings from the observations clearly show that the students in the experimental group were more willing to participate in the lesson compared to the students in the control group.

The use of blended learning environments formed through combination of strong aspects of face to face education and e-learning increases day by day. Dziuban et al. (2010) indicate that there are many reasons behind this such as the ease of access to resources, pedagogical richness, interaction, and flexibility in space and time. On the other hand, designing a blended learning environment takes much longer than traditional class design (Johnson, 2002; Willett, 2002). At this point, the determination of satisfaction of the students studying within a blended learning environment created after intensive work is important in terms of the impact of the environment on learning and the researcher's self-assessment. In the literature, there are many studies which have investigated the satisfaction in relation to traditional, electronic and blended learning environments and making comparison between two or three of these types of learning. Reviewing these studies, it is mostly seen that student satisfaction or content is higher for traditional and/or blended

learning compared to courses conducted only via e-learning (Rivera and Rice 2002; Priluck 2004; Rovai and Jordan 2004; Usta, 2007; Orhan, 2008). Looking at the studies comparing satisfaction with traditional face to face learning and blended learning, it is seen that satisfaction with blended learning is at least as much as with traditional learning (or higher than it) (Cottrell and Robinson 2003; Melton et al., 2009).

The findings of the present study demonstrate that there is no student dissatisfied with the blended learning environment created using an e-textbook inside and outside class. It is seen that 78.8% of the students are satisfied or very satisfied with the blended learning environment. This finding is similar to the result obtained by Futch (2005). In that study, the students' ratio of being satisfied or very satisfied with the blended learning environment was found to be 78%. The interactive e-textbook elevated the course from being a boring event and had a positive impact on increasing student interest in the course because of the visual and interactive elements it provided. Furthermore, the e-textbook also enabled students to study outside class; therefore, it eliminated the limitation of learning only happening in the classroom. The fact that the lesson was not taught just in a web-based learning environment into which the e-book was integrated is considered to be something positive because students were not prevented from face to face interaction and discussion with their peers and the instructor. As a matter of fact, it was revealed through the observations that students followed the lesson and e-textbook used in the lesson in an engaged manner.

5. Conclusion and Suggestions

No significant difference was found when pre-course attitudes and post-course attitudes of students in the experimental and control group were compared. However, examining the change in pre course and post course attitudes within the groups, a significant difference was found in the experimental group, though no significant difference was found in the control group. Examining the satisfaction of the students in the experimental group with blended learning environment, it is seen that class average was 3.40. This corresponds to "I agree" on the scale and reveals that the students were generally satisfied with blended learning. Observation data indicate that students in the experimental group have a greater interest in the course compared to the students in the control group. Based on all the data, it was concluded that a learning environment using an interactive e-textbook had a positive impact on the affective learning of prospective mathematics teachers.

When we have a look over preferences in Turkey, it is impossible to say that e-books are the most popular supplements in educational environments. This means both students and teachers have lack of knowledge and experience on using e-books for instructional purposes. Thus, universities and Ministry of Education coordinated projects are estimated vitally important in terms of dissemination of the electronic course books. Studies devising, implementing and evaluating the results of e-books applications at different levels from primary to university education may be organized. The prospective e-books should present more than plain text in PDF, HTML or any other format because such non-interactive

media do not live up to expectations of students. E-books of proper features should contain plenty of interactive elements like pictures, videos, animations, games and analogies appealing to the level of students. By this way, it will get easier to design learning environments for individuals having different learning styles.

References

- Allison, K. J. (2003). Rhetoric and hypermedia in electronic textbooks, PhD Thesis, Texas Woman's University.
- Borchers, J. (2010). Electronic books: definition, genres, interaction design patterns, Retrieved September 22, 2010, from <http://hci.rwthachen.de/materials/publications/borchers1999c.pdf>
- Brusilovsky, P. Chavan, G., & Farzan, R. (2004). Social adaptive navigation support for open corpus electronic textbooks. *Adaptive Hypermedia and Adaptive Web-Based Systems*, 3137, 24–33.
- Chen, L. (1998). Design and development of a prototype electronic textbook for teacher education, PhD Thesis, University of Houston.
- Cottrell, D. M., & Robinson, R. A. (2003). Blending learning in an accounting course, *The Quarterly Review of Distance Education*, 4(3), 261–269.
- Çepni, S. (2001). *Araştırma ve proje çalışmalarına giriş*, Trabzon: Erol Ofset.
- Dziuban, C. D., Moskal, P. D., & Hartman, J. (2010). Higher education, blended learning, and the generations: knowledge is power: no-more, Retrieved September 30, 2010, from <http://www.sc.edu/cte/dziuban/doc/blendedlearning.pdf>
- Ekici, G. (2008). Öğretmen adaylarının öğretmenlik meslek bilgisi derslerine yönelik tutumları ile öğrenme biçimlerinin değerlendirilmesi, *Yüzüncü Yıl Üniversitesi Eğitim Fakültesi Dergisi*, 5(1), 111-132.
- Futch, L. S. (2005). A study of blended learning at a metropolitan research university, PhD Thesis, University of Central Florida.
- Graham, C. R. (2005). Blended learning systems: definition, current trends, and future directions, The handbook of blended learning global perspectives, San Francisco: Pfeiffer Publishing.
- Gregory, C. L. (2008). "But I want a real book" An investigation of undergraduates' usage and attitudes toward electronic books. *Reference and User Services Quarterly*, 47(3), 266-273.
- Güney, Z. (2007). Etkileşimli elektronik kitapla öğretimin öğrenci başarısına etkisi, PhD Thesis, Institute of Educational Sciences, Ankara University, Ankara.
- Hawkins, D.T. (2000). Electronic books: A major publishing revolution: Part 1: General considerations and issues, *Online* 24, 4, 14-28.
- Ismail, R. & Zainab, A.N. (2007). Factors related to e-books use amongst it students. *International Conference on Library and Information Science*, Kuala Lumpur.
- Johnson, J.J. (2002). Reflections on teaching a large enrollment course using a hybrid. *Teaching with Technology Today*, 8(6).

-
- Jung, S. M., & Lim, K.-B. (2009). Leading future education: development of digital textbooks in Korea. *12th UNESCO-APEID International Conference Quality Innovations for Teaching and Learning*, Bangkok.
- Korat, O. (2010). Reading electronic books as a support for vocabulary, story comprehension and word reading in kindergarten and first grade. *Computers & Education*, 55, 24–31.
- Maynard, S., & Cheyne, E. (2005). Can electronic textbooks help children to learn? *The Electronic Library*, 23(1), 103–115.
- McFall, R. (2005). Electronic textbooks that transform how textbooks are used. *The Electronic Library*, 23(1), 72–81.
- Melton, B., Graf, H. & Chopak-Foss, J. (2009). Achievement and satisfaction in blended learning versus traditional general health course designs, *International Journal for the Scholarship of Teaching and Learning*, 3(1).
- Mikk, J., & Luik, P. (2005). Do girls and boys need different electronic books? *Innovations in Education and Teaching International*, 42(2), 167–180.
- Noam, E.M. (1999). The dim future of the book. *The Journal of Policy, Regulation and Strategy for Telecommunications Information and Media*, 1(1).
- Orhan, F. (2008). Redesigning a course for blended learning environment, *Turkish Online Journal of Distance Education (TOJDE)*, 9(1), 3.
- Öngöz, S. (2011). Eğitim fakültelerinde okutulan gelişim ve öğrenme dersine yönelik hazırlanan bir elektronik kitabın değerlendirilmesi, Yayımlanmamış doktora tezi, Karadeniz Teknik Üniversitesi, Eğitim Bilimleri Enstitüsü, Trabzon.
-