Examination of students processes of searching information in education informatics network via eye tracking

Fatma Gizem Karaoglan Yilmaz*, Bartin University, Bartin 74100, Turkey
Ramazan Yilmaz, Bartin University, Bartin 74100, Turkey
Hatice Yildiz Durak, Bartin University, Bartin 74100, Turkey
Hafize Keser, Ankara University, Ankara 06100, Turkey

Abstract

The extensification activities of Education Informatics Network use in Turkey are in progress. The use and preferability of this education portal by teachers and students depend on various factors. One of these factors is usability. The purpose of this research is to make the usability analysis of the Education Informatics Network from the perspective of secondary school students. The participants of the study consist of 10 students who are from secondary school where the Movement of Enhancing Opportunities and Improving Technology is carried out. The data of the study were obtained from the eye-tracking method in the completion process of the authentic tasks given to the students and from the survey that was used to determine the demographic information. The results of the study show that the students completed the authentic task with success and they are able to reach the search results accurately and rapidly.

Keywords: Education informatics network, FATIH project, usability, eye tracking, information search behavior, secondary school students, human–computer interaction, interface design.

* ADDRESS FOR CORRESPONDENCE: **Fatma Gizem Karaoglan Yilmaz**, Bartin University, Bartin 74100, Turkey.
E-mail address: gkaraoglanyilmaz@gmail.com / Tel.: +90 03785011066

1. Introduction

The successful realisation of technology integration into a lecture by a teacher depends on various factors. One of these factors is the related to an enhancement in the diversity of digital content, sources and materials for teachers and students, improvement of the quality and increments in access. The processes of creating e-content, e-sources and e-materials constitute an important part of the projects that are carried out by various countries in order to realise technology integration in education (Keser, Karaoglan Yilmaz & Yilmaz, 2015; Sezer, Karaoglan Yilmaz & Yilmaz, 2013). In a similar way, one of the projects that are introduced by the Ministry of Education in Turkey in order to successfully integrate technology in education and to increase the quality and productivity of the education is the Movement of Enhancing Opportunities and Improving Technology Project (FATIH) project. One of the main components of this project is Education Informatics Network which is an online social education platform developed in the scope of 'providing and managing e-content'. Education Informatics Network is continued to be developed in order to provide access to reliable and effective content for teachers and students in school and home, briefly independently from time and space, where and when it is required (MEB, 2017).

Education Informatics Network aims to support effective material use via information technologies, to ensure integration of technology into education and to provide interactive e-content appropriate to grade levels. In addition, Education Informatics Network is a social learning platform that is designed with the purposes such as facilitating the transition period from teacher-centred education to student-centred education and raising individuals who can filter, search and interpret sources not by rote learning and who can produce knowledge from information (MEB, 2017). In order to reach all these aims, Education Informatics Network's acquisition of employable interface and infrastructure is one of the pre-factors.

Usability, or in other words, ease of use, is one of the cornerstones of the human–computer interacted studies and related to users' behaviours such as surfing on a website, searching for an information and interaction with the website (Dillon & McKnight, 1995). According to Dumas and Redish (1994), usability is the ability of individuals who use a tool or an environment to complete tasks very rapidly and easily. An important dimension of usability consists of interface design (Nielsen, 2012). When the web tools and environments which are used for educational purposes are considered, appropriateness of the interface design of the tools and environments to learners' habits and needs is necessary in order to realise effective, productive and attractive teaching applications.

In order to mention the effectiveness, productiveness and attractiveness of the web tools and environments, these tools should have interfaces that increase students' learning performances while reducing the possible mistakes to a minimum and enable learners to use their time appropriately while using these tools and environments (Rosson & Carroll, 2002). In these environments, learners should be able to see how they will reach their aims and how they can fulfil given tasks (Ballard, 2010). In this way, learners will be able to reach the materials and contents they need in learning environments where their self-learning is supported by reducing learners' cognitive loads. Learners can complete their tasks in the learning environments and maximise their performance in the learning process (Alper & Deryakulu, 2010; Ballard, 2010; Jonassen, 1999; 2004; Kilic Cakmak, 2007). The low usability of web tools and environments, inadequate interface design, inability to reach content and materials, getting lost and having surfing problems in learning environments might give rise to problems such as decrease in learning performance (Guyer & Guyer, 2009; Nielsen, 1993; Dix, Finlay, Abowd & Beale, 2004). Therefore, it is important to examine the usability of web tools and environments that are used for the educational purposes.

When the usability evaluation framework is considered, it is indicated that a classification can be made according to the approach (user, expert and model) and type (processual and resultative). It is stated that different evaluation approaches can be used in terms of usability, based on these approaches and types (Cagiltay, 2018). When the literature is reviewed, it draws attention that eye-tracking method is used in realising usability analyses in recent years. The eye-tracking tool is a

technology that presents objective and qualitative data on to where and how long users look at somewhere and in this way provides an opportunity to explore users' information searching behaviours, the points that are focused on screen and surfing durations (Cagiltay, 2018).

In the study conducted by using the eye-tracking method, Wang, Yang, Liu, Cao and Ma (2014) reached the result that the complexity of an online shopping website and the task might reduce the impact of learners visual attention and behaviour. In the study conducted by Ozcelik, Kursun and Cagiltay (2006), the usability comparison of four different university web pages was carried out by using an eye-tracking method. As a result of the study, they determined that the presentation of information on the website and the given tasks affect behaviours of participants. In the eye-tracking study conducted by Sendurur and Yildirim (2015), the different web searching strategies were compared according to different task types. Findings showed that web searching results can be changed according to task types. Particularly, it was seen that the number of webpage visits differs according to the use of keywords and task type. Ekici, Arslan and Tuzun (2016) made a usability analysis of Education Informatics Network from the perspective of teachers. As a result of the research, it was stated that teachers may fail in downloading lecture presentation, accessing the blog and searchers made by images and in these dimensions Education Informatics Network confront usability problems. In a similar way, Pala, Arslan and Ozdinc (2017) made a usability analysis of Education Informatics Network web portal from the perspective of teachers. According to the research findings, it was revealed that the most common usability problem occurs in the video section or in the general design of the website.

When an education purpose website has usability, students can interact with the interface to complete their tasks in a natural or an intuitional way. Usability is a critical structure for websites. Therefore, it is important for a social learning platform that appeals to thousands of teachers and millions of students, such as Education Informatics Network, to have a usable structure. When the conducted research studies are examined, it is seen that the studies on the usability analyses of Education Informatics Network web portal have just started to be carried out recently. It is seen that these studies were applied on teachers. It is seen that the usability analyses of Education Informatics Network are required from the perspective of students. For this reason, the purpose of the study is to conduct the usability analyses of Education Informatics Network in terms of students by using an eye-tracking method.

2. Method

In the scope of the study, students were asked to use Education Informatics Network to perform the given authentic tasks. The Education Informatics Network usage behaviours that were performed by students while they were performing the tasks were recorded by an eye-tracking device. The data obtained in this process were analysed. In this context, this study is a case study that is conducted by using qualitative research techniques.

2.1. Participants

The participants of the study consist of students receiving education in a secondary school in the city centre of a province located in the Western Black Sea region of Turkey. Ten students from the sixth, seventh and eighth grades of the secondary school participated in the study. The participation of the study based on a voluntary basis and organised in a way to involve students from each grade level and branch. According to this, four students from the sixth grade which has two branches, two students from the seventh grade which has one branch and four students from the eighth grade which has two branches participated in the study. Nielsen (2012) indicates that five users are adequate in terms of determining usability problems in eye-tracking research, in the situation that diversity is provided, such as involving different user types. In addition, studies conducted by Alemdag and Cagiltay (2018) indicate that eye-tracking studies are usually conducted with university students, and studies are needed to be conducted for younger students. With this in mind, secondary school students were identified as participants in this study. When the demographic information is examined,

40% (f = 4) are female students and 60% (f = 6) are male students. The age range of students changes between 11 and 14. According to the survey applied to the students, it was stated that 70% (f = 7) have computers in the home and 50% (f = 5) of them have Internet connection in the home. When the length of the computer using years was examined; it was found that 10% (f = 1) use a computer for 1 year, 30% (f = 3) for 2 years, 20% (f = 2) for 3 years and 40% (f = 4) for 4 years and more. When the length of Internet using years was examined, it was found that 10% (f = 1) use Internet for 1 year, 50% (f = 5) for 2 years, 10% (f = 1) for 3 years and 30% (f = 3) for 4 years and more. When the daily Internet usage durations were examined, it was found that 10% (f = 1) do not use the Internet every day, 80% (f = 8) use Internet between 1 and 3 hours 2% and 10% (f = 1) use Internet between 4 and 6 hours.

2.2. Collection of the data

In the scope of the study, the survey and eye-tracking reports that were developed to obtain demographic data of the students were used as the data collection tool. The survey consists of two parts. In the first section, there are questions that were prepared to determine the demographic characteristics of the students such as age and gender. In the second part of the study, there is a question on the authentic tasks that were used in the analysis process of Education Informatics Network. In order to enable students to use Education Informatics Network effectively, 11 authentic tasks were prepared. Before the tasks were determined, the most used sections in Education Informatics Network were accepted as criterion and tasks were chosen among the operations that can be made on Education Informatics Network. In order to ensure the use of different menus on the website, it was emphasised that the tasks were independent of each other. The prepared tasks were given in Table 1.

Table 1. Authentic tasks

Order	Tasks
1	Enter the address: eba.gov.tr with student information
2	List 'Social Studies Course' subjects by selecting your own grade level among your current courses in Education Informatics Network Course.
3	Open the video that you find by using the keyword 'Cyber Traps' in Education Informatics Network Video section.
4	Download the image to your computer that you find by using the keyword 'Bartın' in Education Informatics Network Visual section.
5	Download one of the English voice records to your computer that you find by using the keyword 'English' in Education Informatics Network Audio section.
6	Download the textbook which belongs to your grade level to the computer that you find by using the keyword 'Sciences' in Education Informatics Network Book section.
7	Download the issue of Science for Children journal titled 'Viruses are Everywhere' to your computer that you find by using the keyword 'Science for Children' in Education Informatics Network Journal section.
8	Download the PowerPoint presentation titled 'Life of Ataturk' to your computer that you find by using the keyword 'Ataturk' in Education Informatics Network Document section.
9	List the Education Informatics Network Documentary Contests.
10	List the Education Informatics Network Applications according to the 'Number of Likes'.

The study was conducted via a portable eye-tracking device in the relevant secondary school. The students filled the first part of the survey before they start performing the authentic tasks. Afterwards, students executed the tasks respectively on a voluntary basis. At the beginning of the research process, an orientation was provided for students that explain the aim of the research. Subsequently, calibration operation was applied on each student in order to enable the eye-tracking device to collect data. The eye-tracking device was used in a room that belongs to the school administration where the location is respectively quieter and have better conditions for the application. The eye-tracking device and the laptop that contains the software of the device were used in the aforementioned room in the process of the study. Through the sensors on the device, it is

possible to examine the students' durations of completing the authentic tasks, perspective areas and heat maps in Education Informatics Network.

2.3. Analysis of the data

The data obtained from the demographic information section were analysed and interpreted by reporting in a form of frequency and percentage. The expected duration of completing the tasks by the students and the activities performed by the users were shown with tables and graphs. In addition, the data obtained from the eye-tracking device were examined by using the Gaze Viewer software program and the results were reported in a graphical way.

3. Findings

In the scope of the study, the situations of students to complete the authentic tasks in Education Informatics Network portal were presented in Table 2.

Table 2. Status of students completing or not completing tasks

	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	Success (%)
S1	+	+	+	+	+	+	+	+	+	+	100
S2	+	+	+	+	+	+	+	+	+	+	100
S3	+	+	+	+	+	+	+	+	+	+	100
S4	+	+	+	+	+	+	+	+	+	+	100
S5	+	+	+	+	+	+	+	+	+	+	100
S6	+	+	+	+	+	+	+	+	+	+	100
S7	+	+	+	+	+	+	+	+	+	+	100
S8	+	+	+	+	+	+	+	+	+	+	100
S9	+	+	+	+	+	+	+	+	+	+	100
S10	+	+	+	+	+	+	+	+	+	+	100
Success (%)	100	100	100	100	100	100	100	100	100	100	

S = student; T = task; + = successful; − = unsuccessful.

When Table 2 is examined, it can be seen that students completed the authentic tasks relevant to Education Informatics Network portal with success. There are no tasks that students fail. In Table 3, students' durations of completing the tasks were shown.

Table 3. Duration of completion of tasks by students (in seconds)

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	Mean
T1	34	69	38	24	46	35	34	37	32	26	37.5
T2	16	12	23	12	14	13	16	18	13	14	15.1
T3	59	38	37	18	42	18	28	26	25	24	31.5
T4	23	23	28	23	35	17	19	51	23	25	26.7
T5	22	18	22	25	29	14	28	22	18	25	22.3
T6	22	26	22	18	28	22	63	43	23	14	28.1
T7	26	21	24	25	38	20	30	29	30	26	26.9
T8	26	49	30	24	32	27	29	33	51	32	33.3
T9	14	10	21	8	24	9	17	20	9	10	14.2
T10	8	5	20	6	6	5	13	9	7	11	9
Total	250	271	265	183	294	180	277	288	231	207	244.6

S = student; T = task; + = successful; − = unsuccessful.

As it can be seen in Table 3, the completion rate of the tasks successfully by the students is 100%. In terms of the eye-tracking research, the data rate of 70% and over is accepted as sufficient for usability

(O'Brien, 2009). It is seen that the duration of performing all of the tasks is 244.6 seconds. It is seen that among the tasks, T10 is the task that was completed within the shortest time (9 seconds) and T1 was completed within the longest time (37.5 seconds). When the average task completion durations are considered, the student who completed in the shortest time is the student S6 (180 seconds) and the student who completed in the longest time is the student S5 (294 seconds). The heat maps that belong to the student S4 (24 seconds) who completed the first authentic task in the shortest time and student S2 (69 seconds) who completed the task in the longest time were presented in Figures 1 and 2 comparatively.
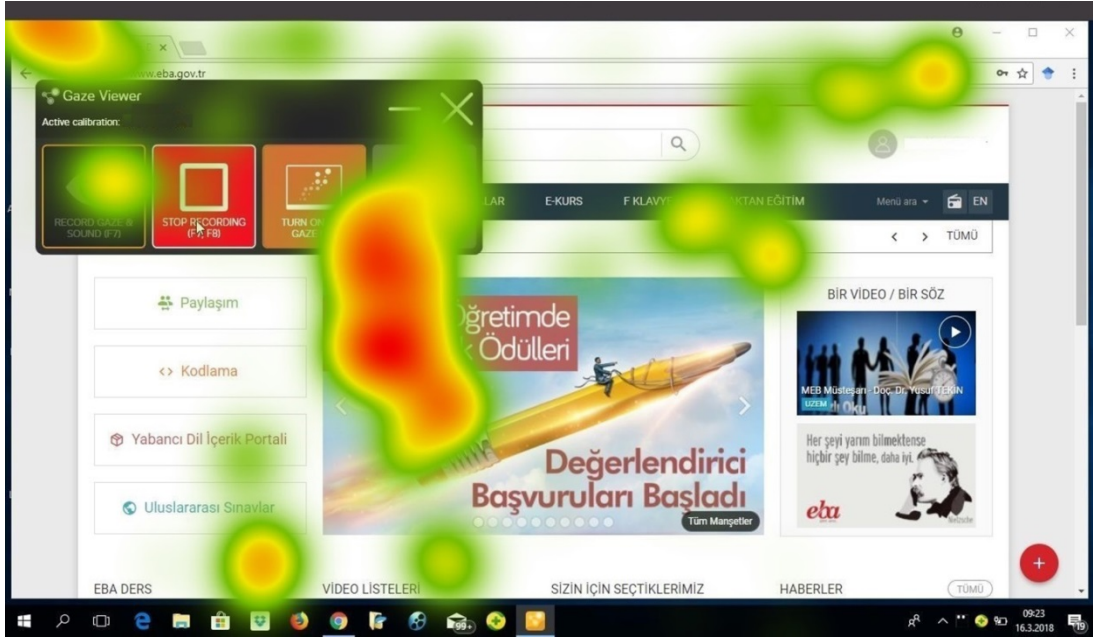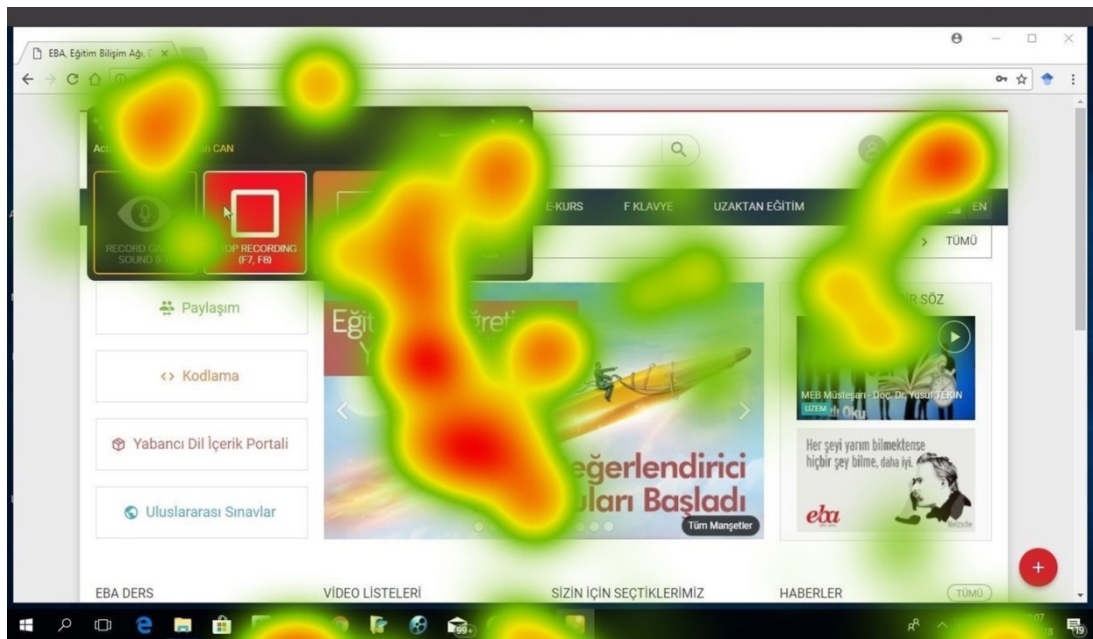

Figure 1. Student 4 heat map for Task 1

Figure 2. Student 2 heat map for Task 1

When the heat maps which are related to Task 1 were compared, it was understood that the student who complete the Task 1 more slowly, also focuses on the different points of the screen for a long time in Task 2. This focus may arise from the fact that different items draw the attention of the student as it also demonstrates that students put a cognitive effort by focusing on different points for a long time for completing the task. This also gives rise to a longer completion duration.

4. Discussion, results and suggestions

The findings of this study that was carried out with the purpose of conducting usability analyses of the Education Informatics Network eye-tracking method from the perspective of students show that the students, who are the participants of this study, are able to complete the aforementioned tasks conveniently. According to the research findings, the usability of Education Informatics Network is in a good state in terms of the tasks of entering the website, searching for courses and course subjects, searching for videos and images, accessing voice records, displaying course books, accessing the required issue among the journals, accessing the required presentation by using keywords, listing documentation contests and listing the Education Informatics Network applications according to the order of being liked.

In the study carried out by Pala et al. (2017) that conducted the usability analysis of Education Informatics Network, it is seen that all teachers completed the tasks of Tasks 1, 6 and 7, respectively, which are entering Education Informatics Network, searching in images and access to the required issue of a journal. It is seen that these findings on students coincide with the findings of this study conducted on students. On the other hand, in the study of Pala et al. (2017), it was seen that Task 4, which is the task of starting a video from the e-content section is the task that participants face difficulties the most. In other respects, the findings of this study conducted on students show that students are able to reach the required video easily. From this perspective, it is seen that there are differences between the student and teacher findings. In the study carried out by Ekici et al. (2016), in which the usability analysis of Education Informatics Network was conducted, it was seen that teachers confront difficulties in terms of the tasks of accessing Education Informatics Network Blog and help links, accessing and downloading the required image. On the other hand, in this study, it is seen that students can reach presentations and images conveniently. The possible reasons for the differences among the study findings could be the differences between study participants (teachers and students). It is thought that another reason could arise from the schematic interventions made according to the constant updates of Education Informatics Network portal.

This study was conducted in a secondary school where FATIH Project was started to be implemented, the interactive whiteboards were installed and where teachers and students use Education Informatics Network portal in lectures with randomly chosen students. It is also seen that the relevant students also have an experience in using computers and Internet. Based on these situations, the usability of Education Informatics Network could be mounted on relevant tasks. From this point of view, it can be also stated that students' performances to benefit from the environment increase due to an increase in their experiences of using Education Informatics Network environment. Therefore, it is important to encourage and guide students to use this environment. In order to generalise these results on students, the usability findings of students can be compared according to individual differences from cognitive, affective, social and physiological aspects. However, Alemdag and Cagiltay (2018) point out that multimedia learning principles, multimedia content, individual differences, metacognition and emotions are among the factors that influence eye-tracking measures. Also, in Mazman and Altun (2013) study, they state that eye movements may be a determiner of individual differences in spatial abilities. Future studies can examine the differences among the groups of students according to their metacognitive thinking skills. In these groups, verbal metacognitive support and metacognitive support via pedagogical agents can be used to investigate the changes in eye-tracking speeds and splashes. Within the scope of this study, only the availability of EBA as a portal has been examined. Future research can also analyse the availability of multimedia content on

the EBA portal. In this way, the contents of the portal can be made more effective and useful. Donmez and Cagiltay (2018) have done design and development of eye-tracker-based eye training games. In this study, students worked with low vision and the individual differences of the students are considered. Learning environments can be designed and evaluated by considering different individual characteristics (especially distractibility, autism and hyperactivity). With eye tracking, individuals with disabilities can be trained to use information communication technologies with these individuals, since they can only use computers with eye movements without using their hands.

References

Alemdag, E. & Cagiltay, K. (2018). A systematic review of eye tracking research on multimedia learning. *Computers & Education, 125*(2018), 413–428.

Alper, A. & Deryakulu, D. (2010). Web ortamli probleme dayali ogrenmede bilissel esneklik duzeyinin ogrenci basarisi ve tutumlari uzerindeki etkisi. *Egitim ve Bilim, 33*(148), 49–63.

Ballard, J. K. (2010). *Web site usability: a case study of student perceptions of educational web sites* (Doctoral Dissertation). University of Minnesota, Minnesota.

Cagiltay, K. (2018). *Teoriden pratige insan—bilgisayar etkilesimi ve kullanılabilirlik muhendisligi*. Ankara, Turkey: Seckin Yayinevi.

Dillon, A. & McKnight, C. (1995). Never mind the theory, feel the data: observations on the methodological problems of user interface design. In *Designing user interfaces for hypermedia* (pp. 117–125). Berlin; Heidelberg: Springer.

Dix, A., Finlay, J., Abowd, G. D. & Beale, R. (2004). *Human-computer interaction* (3rd ed.). Pearson Prentice Hall.

Donmez, M. & Cagiltay, K. (2018). Development of eye movement games for students with low vision: single-subject design research. *Education and Information Technologies*. doi: 10.1007/s10639-018-9771-x

Dumas, J. S. & Redish, J. C. (1994). *A practical guide to usability testing.* Norwood: Ablex Publishing Corporation.

Ekici, M., Arslan, I. & Tuzun, H. (2016). Egitim bilisim agı (eba) web portali kullanilabilirliginin goz izleme yontemiyle degerlendirilmesi. In A. Isman, H. F. Odabasi, & B. Akkoyunlu (Eds.), *Egitim teknolojileri okumaları icinde* (pp. 273–297). Ankara, Turkey: TOJET.

Guyer, T. & Guyer, S. (2009). *Hiperortam ve gezinmenin modellenmesi ogretim amaclı web tasarimi uygulamalari*. Ankara, Turkey: Nobel Basımevi.

Jonassen, D. (1999). Designing constructivist learning environments. In C. M. Reigeluth (Ed.), *Instructional design theories and models: a new paradigm of instructional theory* (II) (pp. 215–239). Mahwah, NJ: Lawrence Erlbaum Associates.

Jonassen, D. H. (Ed.). (2004). *Handbook of research on educational communications and technology*. Taylor & Francis.

Keser, H., Karaoglan Yilmaz, F. G. & Yilmaz, R. (2015). TPACK competencies and technology Integration self-efficacy perceptions of pre-service teachers. *Elementary Education Online, 14*(4), 1193–1207.

Kilic Cakmak, E. (2007). Coklu ortamlarda dar bogaz: Asiri bilissel yuklenme. *Gazi Egitim Fakultesi Dergisi, 27*(2), 1–24.

Mazman, S. G. & Altun, A. (2013). Individual differences in spatial orientation performances: an eye tracking study. *World Journal on Educational Technology, 5*(2), 266–280.

Milli Egitim Bakanligi (MEB). (2017). *Egitim bilisim agı (EBA)*. Retrieved February 2, 2018, from http://www.eba.gov.tr/hakkimizda

Nielsen, J. (1993). *Usability engineering*. San Diego, CA: Academic Press.

Nielsen, J. (2012). *How many test users in a usability study?* Retrieved August 28, 2017, from http://www.useit.com/alertbox/number-of-test-users.html

O'Brien, S. (2009). Eye tracking in translation process research: methodological challenges and solutions. *Methodology, Technology and Innovation in Translation Process Research, 38*, 251–266.

Ozcelik, E., Kursun, E. & Cagiltay, K. (2006). Goz hareketlerini izleme yontemiyle universite web sayfalarinin incelenmesi. *Akademik Bilisim 2006 Bildiriler Kitabi, 9–11 Subat 2006*. Pamukkale Universitesi Denizli.

Yilmaz, F. G. K., Yilmaz, R., Durak, H. Y. & Keser, H. (2019). Examination of secondary school students processes of searching information in education informatics network via eye-tracking method. *World Journal on Educational Technology: Current Issues*. *11*(1), 065–073.

Pala, F. K., Arslan, H. & Ozdinc, F. (2017). Investigation the usability of education information network (ein) web site by eye tracking and authentic tasks. *Ihlara Egitim Arastirmalari Dergisi, 2*(1), 24–38.

Rosson, M. B. & Carroll, J. M. (2002). *Usability engineering: scenario-based development of human-computer interaction*. Morgan Kaufmann.

Sezer, B., Karaoglan Yilmaz, F. G. & Yilmaz, R. (2013). Integrating technology into classroom: the learner-centered instructional design. *International Journal on New Trends in Education and Their Implications, 4*(4), 134–144.

Sendurur, E. & Yildirim, Z. (2015). Students' web search strategies with different task types: an eye-tracking study. *International Journal of Human-Computer Interaction, 31*(2), 101–111.

Wang, Q., Yang, S., Liu, M., Cao, Z. & Ma, Q. (2014). An eye-tracking study of website complexity from cognitive load perspective. *Decision Support Systems, 62*, 1–10.