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Evaluation of Multimedia Learning Environment Designed According to Different Attention Types via Eye Tracking Method

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Abstract

In this study, the effect of using multimedia learning environments design prepared according to different attention types (focused - split) by learners on recall performances was examined. For this purpose, the results were strengthened via using eye tracking data. The study group contains 99 university students. Two environments designed as educational multimedia according to split and focused attention. The study group was divided into two groups randomly. Then the data obtained from recall performance and eye tracking device were analyzed.

The learners obtained higher recall performance in multimedia prepared according to focused attention type. It was revealed that the learners using multimedia in split or focused attention type showed no difference in terms of fixation numbers obtained from eye tracking device. It is observed that the learners focus more on pictures than texts.

Keywords: Multimedia learning environment, focused attention, split attention, recall, eye tracking.

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Farklı Dikkat Türlerine Göre Tasarlanmış Çoklu Ortam Öğrenme Çevrelerinin Göz İzleme Yöntemi İle Değerlendirilmesi

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Öz

Bu çalışmada, öğrencilerin farklı dikkat türüne (odaklanmış - bölünmüş) göre hazırlanmış çoklu ortam öğretim tasarımlarını kullanmalarının geri getirme performanslarına etkisi incelenmiştir. Bu amaçla göz izleme (eye tracking) verilerinden faydalanılarak sonuçlar güçlendirilmiştir. Çalışma grubu, 99 üniversite öğrencisinden oluşmaktadır. Öğretimsel çoklu ortamlar olarak bölünmüş ve odaklanmış dikkat türüne göre tasarlanmış iki ortam araştırmacı tarafından geliştirilmiştir. Geri getirme performansı ve göz izleme cihazından elde edilen veriler analiz edilmiştir.

Öğrenenler, odaklanmış dikkat türünde hazırlanan çoklu ortam öğretim tasarımlarında daha yüksek geri getirme performansı göstermişlerdir. Sonuçlara göre; bölünmüş ve odaklanmış dikkat türündeki ortamlardaki odaklanma sayıları arasında anlamlı fark olmadığı ortaya çıkmıştır. Öğrenenlerin görsellere, metinlerden daha çok odaklandığı görülmüştür.

Anahtar kelimeler: Çoklu ortam öğrenme çevreleri, odaklanmış dikkat, bölünmüş dikkat, geri getirme, göz izleme.

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1. Introduction

Learners face with many stimuli in multimedia, and limited number of prominent information among these stimuli is transferred to memory whereas the remaining disappears (Baddeley, Eysenck and Anderson, 2009; Weinstein, Goetz and Alexander, 1988). In multimedia learning environments, a large number of studies specify the principals and their impacts required to draw attention and transfer information to memory (Florax and Ploetzner, 2009; Mayer, 2009; Schüler, Scheiter and Gerjets, 2013). These principals emphasize important situations such as the use of multi-sources, simultaneous use of sources and integration with each other (Moreno and Park, 2010; Plass, Moreno and Brünken, 2010; Plass, Heidig, Hayward, Homer and Um, 2013).

While learners are obtaining information from multi-source presentations, giving information as integrated provides learners with a better understanding. The information which is not presented in accordance with this principle causes split in learner's attention for two different tasks. For instance, it is thought that trying to read text ends up with split of attention into two different tasks during animation (Sorden, 2005). In addition, learners watching visual contents have to simultaneously combine the number of features such as perception-oriented style, form or direction with movement of objects going from one place to another on screen. It is stated that movements and changes in objects draw attention and prevent focusing on actual content (Hillstrom and Chai, 2006). Besides these, it is emphasized that preparation of effective presentations in multimedia positively affects learners' emotional and perceptional progresses such as motivation with prevention of cognitive load and accurate focusing and it is reflected on cognition and transfer performances with this effect (Agostinho, Tindall-Ford and Roodenrys, 2013; Moreno and Brünken, 2010; Moreno and Park, 2010; Plass, Heidig, Hayward, Homer and Um, 2013).

Eye tracking method is one of the innovations used to display the principles considered for the prevention of split attention effect in multimedia learning designs which have text and picture combination. Eye tracking method enables us to obtain more precise results from studies. In recent studies, it is emphasized that this method should be used to obtain findings based on more precise evidence (Liu, Lai and Chuang, 2011). It appears that the method is quite effective especially in multimedia learning environments where visual and verbal information is provided concurrently (Alkan, 2013; Molina, Redondo, Lacave, and Ortega, 2013; Yang, Chang, Chien, Chien, and Tseng, 2013). In many of the studies based on multimedia learning environment theory, data are predicated on only test results, and comments remain missing in terms of cognitive processes. Especially in the studies carried out about attention, lack of eye tracking data causes to get unclear results. The comments about design according to solely individual expression or test results are not enough to explain cognitive processes. Therefore, eye-tracking method is used in the studies aiming at examining multimedia learning environments (Bayram and Mutlu-Bayraktar, 2012; Liu, Lai and Chuang, 2011; Mason, Tornatora and Pluchino, 2013). For this purpose, results have been strengthened via this method within the scope of the study.

Individual differences have importance as an item that is emphasized at every stage of educational process. Individualized learning environments can be developed via analyzing learner's characteristics (Mason, Tornatora and Pluchino, 2013). In the development of effective multimedia learning environments considering design principles and learner’s characteristics, more distinct findings are obtained through eye tracking methods. This method presenting

important findings for analysis of cognitive processes such as attention, focusing and perception has importance in terms of proper application of design principals in learning environments. Comments regarding the designs performed according to only individual expression or test results are not sufficient in terms of expressing cognitive processes. For this reason, eye tracking method is utilized in many studies aiming at the evaluation of multimedia learning environments (Bayram and Mutlu-Bayraktar, 2012; Liu, Lai and Chuang, 2011).

In a wide range of studies, it was revealed that the presentation containing couple information type was more effective in learning environments than the presentations introducing information types (visual-audio) separately (Florax and Ploetzner, 2009; Mayer and Moreno, 2002; Van Genuchten, Scheiter and Schüler, 2012). In addition, giving this information near to each other without separation prevents split of attention (Crooks et al., 2012; Schmidt-Weigand and Scheiter, 2011; Sweller, 2004). Unlike previous studies, this study intends to reveal whether the effects of multimedia in question show any differences for the learners who are different with regards to attention and memory capacity with the support of eye tracking data. The outcome of the study will present important findings for the development of multimedia learning environments which reduces attention split effect, prevents extremeness and enables learners to differ in cognitive abilities to use attention and memories effectively. Within the scope of the study, following hypothesis were investigated with heat map and area of interest data.

1. Multimedia prepared according to split or focused attention has effect on recall performances.
2. Fixation numbers of learners shows significant difference according to use of multimedia in split or focused attention type
3. Fixation numbers of learners to pictures or texts shows significant difference.

Literature Review

While learners follow information from multiple sources, integrated presentation of the information allows learners to understand better. The information not presented in accordance with this principle may split learner's attention between two different tasks. For example, it is thought that reading a text during the presentation of animation will result in the split of attention into two different tasks (Sorden, 2005). Moreover, learners watching visual contents are forced to simultaneously combine plenty of features such as perception-oriented shape, form and direction in addition to motion of objects moving from one place to another in the screen. It is stated that movements and changes in objects attract attention and prevent focusing on main content (Hillstrom and Chai, 2006). In addition to these, it is emphasized that preparing effective presentations in multimedia positively affects prevention of cognitive load, proper concentration and emotional and perceptual processes of learners like motivation, and this effect is reflected on comprehension and transfer performances (Moreno and Park, 2010; Plass, Moreno and Brünken, 2010; Plass, Heidig, Hayward, Homer and Um, 2013).

In the presentations where text and images are used together, it seems that giving text as an explanation at the bottom of image is sufficient, but it is thought that when text is integrated to image, more effective results will ensue. In this situation, text and image are simultaneously taken up into information processing period. In the presentations where animation and expression are used together, simultaneous presentation and semantic cohesion between them

should be considered (Mayer, 2009; Širanović, 2007). The first study about split attention was carried out by Tarmizi and Sweller (1988) for geometry education. In the study, the samples were explained over two geometrical figures. Problem-solving strategy performances were compared with the samples where information about geometrical figures were directly presented via integration on figures and the samples where information was incrementally given under geometrical figure. In the second environment where image and texts were presented separately, it was revealed that attention of learners was split between image and text, and they needed to put more effort in situations due to cognitive load when compared with the other environment. On the basis of the cognitive load theory, text should be physically placed close to image during the presentation of a diagram with a text to prevent split of learner's attention on image and text and provide effective learning. When a diagram and explanatory texts are presented, the effects on learning during managing split attention are not known. This study aims to explain how learners can manage their cognitive loads via physical manipulation of materials. Physical manipulation means to manipulate diagram and related text to link them in digital materials in order to reduce split attention effect. Two experiments were carried out with the participation of fifty two university students. In Experiment 1 including 34 students, it was investigated whether they would show better performance via reducing split attention effect achieved through moving text objects on the screen and managing their own cognitive loads when compared to with other environments that included separated objects. In Experiment 2 including 18 students, verbal protocols of thinking aloud were obtained to reveal the learning processes of the students. The results supported split attention effect in digital environment. Moreover, the situations where students were self-directed did not give better performance than split attention situations. Transporting text boxes to the related diagrams is an extra task for the students and thus learning status is nearly the same with the situations where split attention occurs. In thinking aloud analyses, it is emphasized that students need more explanatory education and guidance to manage split attention situations better (Agostinho, Tindall-Ford and Roodenrys, 2013).

In the study where the effects of split attention and extremism were investigated in the multimedia used in the scope of mobile learning, leaf morphology of a plant was presented with different combinations of media functions. Three different combinations including mobile devices, those texts embedded in images, mobile devices with texts and real objects without mobile device were randomly applied to 81 fifth grade students. Comprehension ability and learning capability were assessed for all situations. When the results are evaluated, it becomes clear that there is no significant difference between the performances of students in terms of comprehension and learning capability in the environments where images are integrated to texts and which involve only texts, but it has been found out that the performances of the students in these two environments are higher in terms of comprehension and learning capability than the students studying with real objects without mobile device (Liu, Lin, Tsai, and Paas, 2012).

Second language acquisition was considered by the researchers to explain the performance differences of the students in respect of learning tasks with different cognitive load hypothesis. In this study, where cognitive load was considered during the second language learning, the effects of split attention environment and integrated learning environment on cognitive loads, reading and learning words during second language learning process were investigated. 20 students with medium level of knowledge of foreign languages were randomly assigned to the

four different environments used in the study. The environments were as follows: split attention without the use of dictionary, split attention with the use of dictionary, integrated format without dictionary and integrated format with dictionary. In split attention environments, reading text was assigned as reading comprehension task and test questions were given below. In integrated format, comprehension questions were given in reading text physically. According to the results, integrated format enhanced reading comprehension of the students when compared to split attention environment. The students included in the environments with the access of online dictionary showed better performance in word test, but they spent more time in reading test than the students included in the environments without dictionary access. Moreover, the students in split attention environment looked for more words in dictionary than the students in integrated format (Al-Shehri and Gitsaki, 2010).

According to multimedia presentation type effect, an illustrated text should be presented auditory instead of visually to prevent split of attention. In two empirical studies (34 and 78 participants, respectively), memory strategy skills, working memory capacity effect and possible compensatory effects were tested on multimedia learning. The effects of skill-development on comprehension (Study 1) and transfer (Study 2) were revealed. Presentation type effect was verified for less qualified students, not for very talented ones in terms of memory strategy usage. Memory strategy skills and working memory capacity differently affected multimedia learning depending on task features and requests. This special case is composed of a set including six articles presenting eye tracking usage to analyze multimedia learning processes in detail. Most of the articles focused on the effects such as verbal/written text, different types of tips, different presentation rates, different design features and visual attention in animations. In these results, the effects on visual attentions during learning through video and complex graphs are mentioned. In addition, eye tracking is used not only as a process measure in itself in some articles but also used as input for verbal reports (e.g. retroactive improvement reports). In both cases, contributions were discussed by major researchers in this field in terms of multimedia learning perspective and eye tracking. They all together give a general perspective to eye tracking in a variety of possibilities opened for multimedia learning and teaching researches in the topic (Seufert, Schutze and Brunken, 2009).

A study about memory aims to investigate the effects of consecutive and simultaneous information presentation methods on visual search skill and working memory loads of students. As information processing in the brain is connected to visual short-term memory capacity, limited information processing capacities of the students can affect different working memory loads for consecutive and simultaneous presentations with visual search skill. Within the scope of the study, change detection test was performed to analyze the visual search skill and working memory load. According to the results, the presentation types with high knowledge density level showed significant differences between the visual search skills and the working memory loads for both types. There was a significant difference among the presentations with different knowledge density in terms of visual search skill due to limited visual short-term memory capacity. Attention performances of the students with high visual search skill and low working memory load is higher than that those with low visual search skill and high working memory load (Chang, Kinshuk, Chen and Yu, 2012).

2. Method

In the method of the research, quasi-experimental model and survey model was used as mixed model. Quasi-experimental designs are the models that do not include random assignment and groups are tried to be matched on certain variables in matched design (Büyüköztürk et al., 2011). Survey models are the researches that aim to describe past or present situation as it exists and are performed with larger samples according to other researches (Karasar, 2007; Büyüköztürk et al., 2011). In the survey model, descriptive data were collected via eye tracking measurements during the experiment.

2.1. Study Group

Overall, 47 girls and 52 boys, total 99 students from Marmara University voluntarily participated in the study. All of the participants were undergraduate students who participated in the project management course in Computer Education and Instructional Technology Department. Students did not participate in earlier experiments in the Human Computer Interaction Laboratory. Their mean age is 20.8. They voluntarily participated the experiment for extra 5 points to their exam.

2.2. Multimedia Instructional Materials

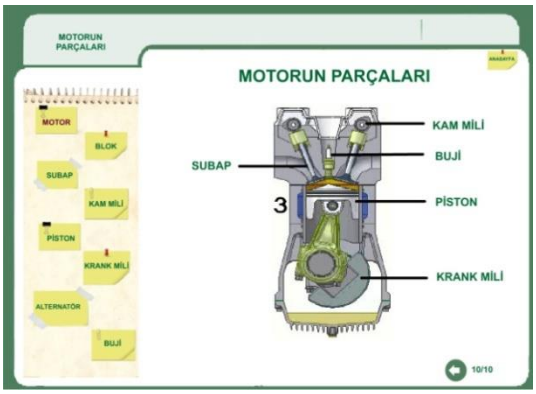
The multimedia used in this study was developed by the researchers. Three subject experts and the two instructional technologists examined the multimedia. The topic of motor was chosen as the content in multimedia. In this learning environment where the parts of a motor were explained with the support of images and videos, different designs were made in terms of attention status focusing on image and text. In both environments, attention status of learners was investigated during the presentation of same content with different designs including audio and images.

2.2.1. Focused Attention Multimedia Learning Environment

In this medium, the "motor" lesson contents were prepared as per the Multimedia Instructional Design Principles of Mayer (2009) with the aim of eliminating the presence of split attention causes. This instructional media has been designed as visual and audio kinds with the goal of focused attention, in order to enable the realization of recall. The presentation types have been diversified by supplementing visually presented information with audio explanations. With the aim of focusing attention, images were presented as separate from the video during the scenes of the video explanations. The information presented in images was thus presented with the objective of offering the explanation in audio and enabling focusing on the image and the explanation. The information presented in the images was supplemented with audio and presented in progression. The texts relevant to the images were presented in an integrated manner to the explained images. The material was designed to allow the self-pacing of the student.

The students were presented with operation instructions for perusing the material (See Figure 1).

Figure 1. Screenshot of a presentation from focused attention multimedia



2.2.2. Split Attention Multimedia Learning Environment

In this medium, the "motor" lesson contents were prepared in audio presentation according to the possibility of the occurrence of split attention effect. Images and texts were added into the scenes containing information presented in the videos. The audio information was prepared to present different sections than those presented as texts. The text descriptions of the images were presented spatially distanced from the images themselves. The application's preparation allowed the student's self-pacing. The students were presented with operation instructions for perusing the material (See Figure 2).

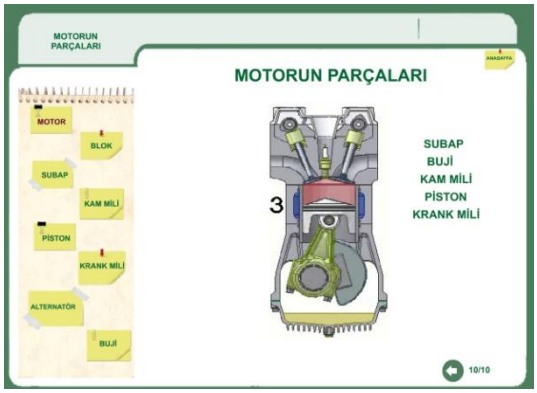


Figure 2. Screenshot of a presentation from split attention multimedia.

2.3. Data collection materials

2.3.1. Eye Tracking Measures

Eye tracking data can provide valuable information about the attention processes of the learners. The participants studied these materials and they were tested individually at the Marmara University Human Computer Interaction Laboratory.

In this study, SMI Experiment and Begaze 2.4 programs were used for measuring eye-movement data. After calibration, the participants were presented with multimedia learning environments.

The fixation numbers and heat map data were analyzed for the findings. Fixation: Fixing eye, looking at object or areas generally with 2-degree distribution threshold and minimum 100-200 ms duration. Heat map: The screens are rated with colors on heat maps according to gaze duration and number (Jacob and Karn, 2003).

2.3.2. Pre-Test

Before the experiment, the students were applied pre-test to determine their level of knowledge. This test consisted of open-ended questions about the parts of the motor. The students were tested before the experiment to understand whether their preliminary information about motor is similar to each other.

2.3.3. Recall Performance Test

After the developed multimedia applications were performed, the recall test was applied to all the students in order to determine the effects of materials on learners' recall performances. The recall test consisted of 5 open ended questions about the parts of the motor. The questions included the tasks on bringing the concepts back. Meanwhile, they were expected to remember the names of the motor parts on the image presented visually. Every concept of the answers was 20 point. The recall test was administered to measure to what extent the learners recalled factual information that was explicitly stated or could be implicitly drawn from the materials. The test results were evaluated by two researchers.

2.3.4. Experiment Process

During experiment, 99 students in the study were taken into application individually. Learners were grouped according to the applied multimedia applications type they were taken into experiment process in HCI laboratory in the Department of Computer Education and Instructional Technology of Marmara University. Students were tested with open ended questions before the experiment to understand whether their preliminary information about motor are similar to each other. 6 students showing differences in terms of preliminary information were excluded. The average score of the students before the experiment was 12.03. This score shows that prior knowledge of all the student groups is low.

The experiment was previously recorded as screen recording with 'SMI Experiment' program in test computer mounted with eye tracking device. This process was

performed only once during the research and each participant was studied via this experiment. The experiment was started after calibration of eye. Then, the eye movements of the students studying focused and split multimedia environments were recorded with the eye tracking devices found in HCI laboratory.

Students to be taken into the experiment were taken to the laboratory individually. Randomly 48 students studied in focused attention multimedia environments according to their groups in HCI laboratory and then answered the performance test about the issue. 51 students studied in split attention multimedia environment according to their groups in HCI laboratory and then answered the performance test having recall tasks about the issue.

2.4. Data Analysis

In the study, while the recall scores and the fixation numbers were defined as dependent variables, the multimedia environment types were defined as independent variables. 47 people who were chosen randomly were able to analyze the data and the results were used. In the program, some data were excluded from the analysis without any bias due to the periodic record error occurring beyond the control of the researchers.

In the light of the research questions, some statistical tests were applied via SPSS 21.0 program (IBM Corp., Armonk, NY). Independent Sample t-Test was used to investigate whether there is difference between the average of the two different groups, One Sample t-Test is used to investigate whether there is difference between two averages of the one group, Mann-Whitney U Test is used to investigate whether the difference between the two groups' averages show normal distribution and 2x3 Factorial Variance analysis is used to investigate whether there is difference between the average of more than two (Buyukozturk, 2006). The records which were recorded via Experiment 2.4 program and showed eye and mouse movements were analyzed via Be Gaze 2.4 program. Fixation, duration and heat map values were examined in the analyses.

3. Findings

One of the research questions in the study investigates whether recall performances of learners showed significant difference according to use of split or focused attention type multimedia environment. The results of Independent Samples t-Test about this question were presented in Table 1.

Table 1. The Results of Independent Sample t-Test about The Recall Performance Scores Of Learners

Multimedia	N	M	sd	t	df	p
Focused Attention	48	74.60	18.013	-8.894	97	0.000
Split Attention	51	41.63	18.879			

When test results were examined, it was observed that recall performance of learners using split or focused attention type multimedia environments showed significant difference ($p<0.05$, $t(97)=-8.894$, Table 1). It is seen that recall performances of the group which was applied by focused attention type multimedia learning designs, one of the multimedia environments designed according to attention types are higher ($M=74.60$) than of the group which was applied by split attention type multimedia learning designs ($M=41.63$, See Table 1).

It was investigated whether fixation number of learners showed significant difference according to use of split or focused attention type multimedia environment. The analyses were performed on total 47 students whose fixation numbers were kept in eye tracking records from study group.

Shapiro-Wilk test was applied to understand whether data was normally distributed and it was seen that data about fixation numbers of learners using split or focused attention type multimedia environments did not have normal distribution ($p<0.05$). In accordance with this result, non-parametric Mann-Whitney test was used to compare average of learners. When test results were examined, it was observed that fixation numbers of learners using split or focused attention type multimedia environments did not show significant difference ($p>0.05$, $z=-1.766$, Table 2).

Table 2. Mann-Whitney U Test results about fixation numbers of learners using Focused or Split multimedia environments

Multimedia	N	M	z	p
Focused Attention	23	7637.017	-1.766	0.077
Split Attention	24	7343.562		

It is aimed to investigate difference between the numbers of fixation on texts or pictures in environments. For this purpose, One Sample t-Test was applied and the results were presented in Table 3.

Table 3. One Sample t-Test results about picture or text fixation numbers of learners in environments One Sample t-Test results about picture or text fixation numbers of learners in environments

Multimedia Sources	N	M	sd	t	df	p

Picture	44	2962.066	2591.570	7.667	44	0.000
Text	44	2443.771	1296.369	12.646		

When One Sample t-Test results about picture or text fixation numbers of learners are examined, significant difference is observed in support of picture between number of fixation on pictures or texts ($p<0.05$). It is seen that learners focus on pictures ($M=2962.066$) more than texts ($M=1296.369$) regardless of the use of split or focused attention type environments (See Table 3).

Eye tracking data was analyzed to determine the areas on which learners focused more in multimedia designed according to focused attention. On the screen which names of motor parts were presented as integrated into picture and video, it was aimed that students focused on both of them without any split of attention between text and picture. When eye tracking data was evaluated, it was seen that students mainly focused on pictures, then on texts and menu buttons (See Figure 3).

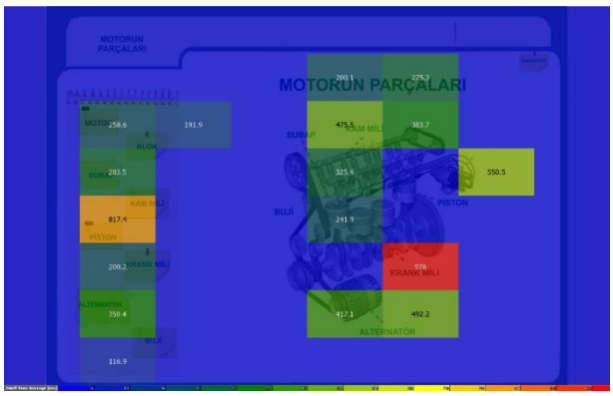


Figure 3. Fixation numbers belonging to the screen which texts were integrated to pictures in focused attention multimedia

On another focused multimedia screen that audio expression and video were used, it was aimed to make fixation on actually described part in the video via images. So that it was aimed to prevent split of focuses of learners on other objects in the video. When eye tracking data of this screen is evaluated, it is found that learners focus more on the object described in the video. Then, they focus on name of the object and menu buttons (See Figure 4).

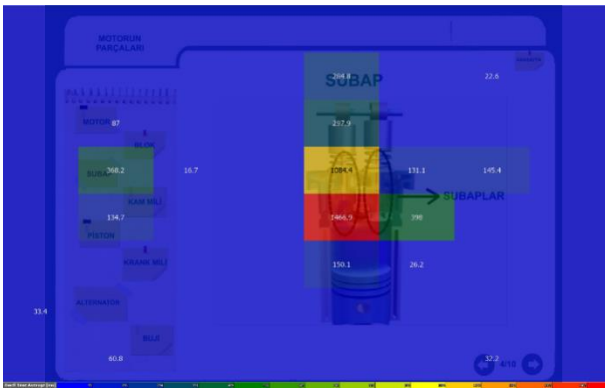


Figure 4. Fixation numbers belonging to the screens which described object is marked in focused attention multimedia

Eye tracking data was analyzed to determine the areas that learners focused more in multimedia designed according to split attention. When eye tracking data obtained for the screen used for video, text and audio expression is evaluated in multimedia learning environments which emergence of split attention effect is possible and motor and its parts are described, it is seen that learners focus more on texts and fixation numbers are more in texts than in picture or video. It is seen that learners' attentions are split between picture and video and use of texts as well as audio expression makes focusing difficult. This situation affected learner performance as a result of emergence of effect of extremeness (See Figure 5).

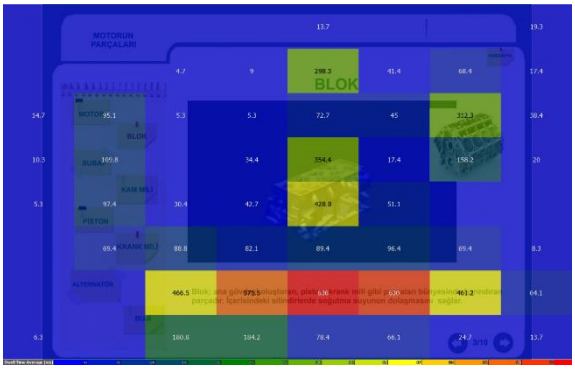


Figure 5. Fixation numbers belonging to the screen which video, text and audio expressions are present in split attention multimedia

When eye tracking data belonging to the screens that names of motor parts in picture or video are presented without integration into pictures is evaluated in multimedia learning environments which emergence of split attention effect is possible, it is seen that attentions of learners are split between picture and text. It is found that they focus more on texts then on picture and buttons according to fixation numbers (See Figure 6).

Figure 6. Fixation numbers belonging to the screen which texts are separately presented from video in split attention multimedia.

In the next research question of the study, eye tracking data was analyzed to determine heat map during use of multimedia in focused attention type by learners. On the image in focused attention multimedia, it was aimed that learners focused on both the text and picture without attention split on the screens which texts containing names of motor parts were integrated into the picture. When heat maps are evaluated according to eye tracking data, it is seen that learners focus more on pictures then on texts and menu buttons (See Figure 7).

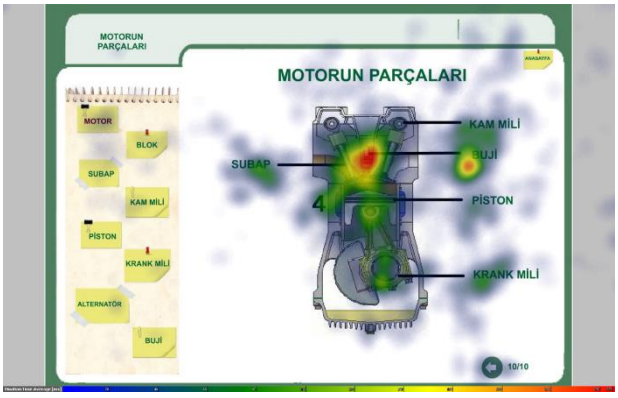


Figure 7. Heap maps belonging to the screens which texts are integrated into pictures in focused attention multimedia.

In focused attention multimedia, it was tried to perform focusing via marking on actually described part in video. Therefore, it was aimed to prevent attentions of learners to split into other objects in video. When the heat maps about the eye tracking data belonging to this screen are examined, it is seen that learners focus more on the object marked in the video. Then, they focus on name of the object and menu buttons (See Figure 8).

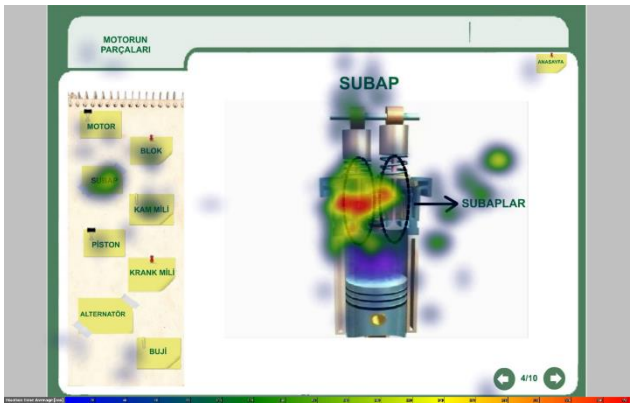


Figure 8. Heat map belonging to the screen which the object is marked in focused attention multimedia

Eye tracking data was analyzed to determine heat maps in the progress of use of multimedia by students in split attention type. When heat map about eye tracking data obtained for the screen that video, text and audio expression were used was examined in multimedia learning environments which emergence of split attention effect is possible, it is seen that learners focus more on texts than on picture or video. It is seen that learners' attentions are split between picture and video and use of texts as well as audio expression makes focusing difficult. This situation affected learner performance as a result of emergence of effect of extremeness (Figure 9).

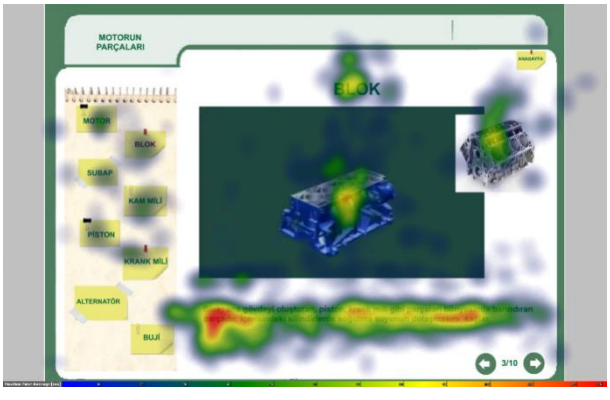


Figure 9. Heat map belonging to the screen that video, picture and audio expressions are present in split attention multimedia.

When heat map belonging the screens that are presented as names of motor parts in picture or video are not integrated into pictures is evaluated in multimedia learning environments which emergence of split attention effect is possible, it is seen that attentions of learners are split between picture and text. It is found that learners focus more on texts, then on picture and buttons (See Figure 10).

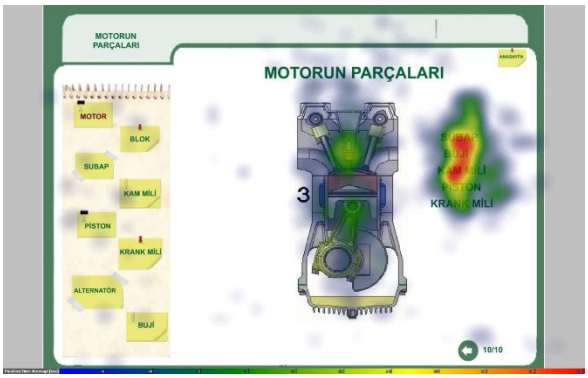


Figure 10. Heat map belonging to the screen that texts and pictures are separately presented in split attention multimedia

In focused attention multimedia, the part was marked in the video to increase focusing on motor part being described with the video. This marking was not performed in split attention multimedia. In this situation, focusing is dispersed on the video and it is not focused on the part being described (See Figure 11).

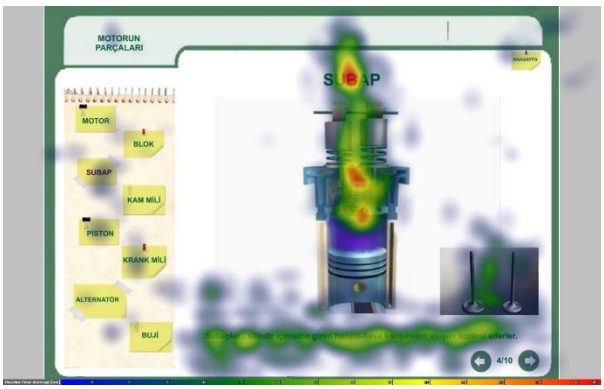


Figure 11. Heat map belonging to the screen that is presented without marking the object in split attention multimedia

4. Conclusion

Use of different sources such as picture, text and audio in learning environments enriches the education environments, especially online learning environments as tools assisting rapid development and spread of knowledge support learning. In developing online learning environments, interactive learning process is generated between content and learners. Environments used aim to provide the configuration of knowledge via keeping students active during learning process.

In e-learning environments, many studies revealed that learners showed higher learning performances in the environments with audio-based animations, also text and pictures were integrated together (van Genuchten, Scheiter and Schüler, 2012; Huff, Bauhoff and Schwan, 2012; Kühl, et al., 2011; Liu, et al., 2012; Lin, Hung and Chang, 2013; Plass, et al., 2013). On the other hand, simultaneous presentation and presence of semantic harmony between them should be considered when animation and expression are used together (Širanović, 2007; Mayer, 2009). In this study, it was similarly revealed that the restoration performances of the learners were higher in the environments with the presentation of integrated visual and verbal presentation type information than in the environments without this integration. On the other hand, the simultaneous presentation and presence of semantic harmony between them should be considered when animation and expression are used together (Mayer, 2009; Širanović, 2007).

Within the scope of the study, the difference created on recall performances of learners by multimedia learning designs prepared with different attention types was examined. When the results were evaluated, the scores of recall performances of learners show differences in focused and split attention multimedia. In multimedia designed according to the focused attention, learners showed higher performances. In furtherance of this result, many studies were conducted to provide permanent learning in multimedia (Agostinho, Tindall-Ford & Roodenrys, 2013; Akbulut, 2011; Kalyuga, 2009; Mayer & Moreno, 2010; Schüler, Scheiter & Gerjets, 2013). For effective design of these environments, it is aimed that learners' attentions focus on content without any split. Therefore, many principals are considered. In the light of the performed studies, the principals were also considered in the focused attention multimedia of this study.

According to eye tracking data obtained about the screens which picture, video and texts are presented together, one of the results is that learners focus more on video or pictures in focused attention multimedia. Focusing on video and pictures by learners was provided without split of attention. In the study performed by Yang, et al. (2013), the results showing that average fixation time and average data processing time are longer in areas with pictures show parallelism with the study. On the other hand, in the study carried out by Liu, Lai and Chuang (2011), they revealed that learners focused better on video in the environments where texts were presented narratively, rather than visually.

It was found that markings made to aim to draw attention to a certain point on images had contributions to recall performances of learners. In the study carried out by Chen, Wang, Chen and Chen (2014), it was seen that learners showed better performances with the use of visually emphasized presentations and visual markings. In two studies performed by Ozcelik et al., (2009, 2010), color coding method was used in learning environments prepared via using markings and its positive effects were presented among the results via eye tracking data.

Increase in learning with color coding was performed with accurate positioning of pictures and texts related to each other concurrently.

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