

Original Research

Employing Eye Tracking in Quantifying and Qualifying Visual Attention of Web Site Viewers (Physical Education Faculties)

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ABSTRACT

In recent years, the web has emerged as an ideal media, that knowledge and information through which are effectively disseminated around the world. The purpose of this research is to study the websites of physical education and sports sciences with neuro marketing approach. The research method of this study was semi-empirical. The statistical population consisted of Ferdowsi University of Mashhad (FUM) students and other universities and educational institutions active in Mashhad that signed the consent form to participate in the study. Among selected individuals, 28 people were as research samples. In this research, Be Gaze software has been used to convert eye tracker data into quantitative data and to test the hypotheses of research we used repeated measure analysis and SPSS 21. The analysis showed that there was a significant difference between all areas in time of fixation at them; it also had significant differences between all areas in number of fixation, except the right menu and the header menu. FUM student did not affect the number and duration fixation of people at the affected areas, and FUM students were not biased toward their college. In relation to gender, the data showed that gender did not have a significant difference in the number of fixation, but gender was significantly different on the duration of fixation at all areas. In general, based on the areas of interest (AOI), FUM reach ranked among the other universities in a variety of factor and, in general, was better and more fully evaluated.

Keywords: Website, Top Universities, Faculty of physical education, Eye tracker, visual attention, Iran

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Introduction

The invention of the Web by Tim Berners-Lee (1989) and its unique hyper textual and hyperlinking features has created a vast information revolution that requires a thorough study of its various aspects to better understand it (1). Scientists define the World Wide Web as a resource that can provide information about anything, anyone, and anywhere (2). A website is a structured set of data and one of the most important interfaces between humans and computers (3). The data in this set is

information about products, services and the status of the organization which are displayed in the form of texts, graphics, photographs, and videos (4). Websites enable information retrieval at any time (5). Today, millions of people use websites to find information; they also want to get what they want quickly, so web designers have to spend a lot of time designing sites that are highly efficient and meet the needs of individuals (6).

In the meantime, in the transition from the physical to the virtual world, universities have been influenced by modern information and communication technologies and have taken the first steps to make their services accessible and user-friendly (7). The Web, as the most important communication tool in universities, has been widely used in formal and informal scientific communication since its inception (2) to provide information to a wide range of users (8). Websites play an important role in improving the academic, scientific and educational competencies of universities (9). As a platform for educational institutions, websites are tools that not only interact with their stakeholders but also help the users create a mental image of the institution (10). They are also considered as a way to attract students, researchers and investors and to promote the social image of educational institutions worldwide (11). As a result, understanding the needs of users of academic websites is very important and needs research. Hassan, Morris & Proberts (2012) and Mustafa & Al-Zou'bi (2008) stated that users of educational and academic websites pay more attention to two important points: finding the information they want and easy and timely access to it (12, 13). In this regard, a number of scholars have investigated and evaluated university websites in their research, including Abid Ismail, and Kuppusamy (2018), Tahani and Steve (2016), Katiliute and Daunoriene (2015) (14-16). Ahmi and Mohammad (2015) also evaluated 20 faculties in another study using Achecker software (17). Sengel and Öncü (2010) went further in their research and examined the role of gender in the use and evaluation of websites in a case study (5). Zahed Arash et al. (2013) and Khodadadi et al. (1395) are among the researchers who have researched this area in Iran (18, 19). By reviewing the existing literature, it was found that all of the studies have evaluated the websites based on webometrics (including the four metrics of web size indices, visibility, enriched files, and Google Scholar), questionnaires and software. However, these methods are not capable of providing the necessary and sufficient information regarding human-computer interaction. Today, one of the most important issues in evaluating websites and webpages is human-computer interaction; and the most pressing issues for users when interacting with computers is choosing the right option that will bring them to their intended destination. This problem is more pronounced in user interfaces such as websites where users are faced with a wide range of options to choose from (20). Today, many methods and techniques, including state-of-the-art technologies, have been devised and used to investigate how human-computer interaction happens. One of the tools that can help researchers in this field is using neuroscience tools such as eye tracking devices. The eye tracking method enables qualitative and quantitative research and data collection. Using this method qualitatively can be a good guide for website design considerations. This allows users to identify problems with the user interface and provide logical explanations for them. An eye detector is a device that shows the area the person is looking at (21), and provides information on gazes and saccades that are the basis of visual search. It also provides information about the viewing angle, scan path and saccade latency. In simpler terms, this technique involves the process of measuring eye activity. This allows the device to determine exactly where your eye focus is or how much your eye moves from point to point. This information can provide data about attention, focus and many other things (22). In support of the above, we can refer to the research by Weichbroth et al. (2016). They conclude that eye-tracking analysis is capable of providing valuable information regarding the design of information services and enhancing the usability of services to guide designers (23). Also, Velásquez (2013), who has worked on integrating eye-tracking techniques with web mining to identify key site targets, found that the eye-tracking technique is very useful, accurate, and capable of providing very accurate information about where one looks, what attracts them, and what they look for (24). Law (2019), who has been evaluating hotel websites using eye tracking, believes that the information obtained through this method is of much higher quality and can provide valuable information to hotel managers (25). Further research has been done using eye tracking to measure other features of web sites, such as the research by Wang et al. (2014) as well as Almaghbal (2013) (2, 26).

Generally, examining the features, performance and status of websites from a variety of perspectives can help universities resolve existing problems and improve academic websites. Such benefits have

prompted universities around the world to compete in making websites more attractive and in improving the status of their institution (27). To this end, given the increasing growth of websites at international and national levels, as well as the lack of research in this field domestically, a review and evaluation of the websites of the Ministry of Science and Research seemed necessary. Findings of such studies can provide valuable insights for the chancellors of universities and college deans in the country. In this regard, the present study aims to evaluate the usability of the websites of physical education faculties affiliated to the Ministry of Science and Research, with the help of the eye tracking device and from the websites' users' viewpoints, in a more accurate and scientific way.

Material and Methods

Research Methodology

A quasi-experimental and applied research method was used in this study.

Participants

The statistical population of the study consisted of students of Ferdowsi University and other universities and educational institutes in Mashhad who voluntarily responded to the call for research. They also met the criteria for the participants including the age range of 20-35 years and having normal eye sight. From the elected individuals, 28 were chosen as the sample of this study.

Experiment procedure

Each participant was asked to sit on a chair in front of a computer monitor, 70 cm away, to have their eyes tracked. The height of the monitor was adjusted to the height of the participants so that one would not have to rotate and move their heads to see all parts of the monitor. For each individual, the three-point calibration process was performed separately to completely eliminate the discrepancy between the point the person is looking at and the point the device is pointing to. Next, all participants were allowed to look at each university website for 1 minute, during which time all eye movements were recorded using an eye tracker. The order of presentation of the sites to participants was also calculated using R software. The sites were shown to the individuals according to the software's order so that the probability of the order of showing the sites would be the same for all the participants. The Areas of interests (AOI) of this study included the school logo, the right menu, the top menu, and the news section.

Statistical analysis

Using BeGaze software, the data obtained from the eye tracker was changed into quantitative data, then descriptive statistics were used to calculate the mean, standard deviation, frequency percentage, and some other factors. Repeated measures ANOVA and post hoc tests were used for data analysis by means of the 24th version of SPSS software.

Results

Table 1 shows the descriptive characteristics of the participants in this study.

Table1. Demographic information of participants

Group	Numbers	Age	
		mean	S.td
Student of Ferdowsi Universities	14	25.46	1.195
Student of other Universities	14	24.14	0.876
Female	17	24.74	1.046
Male	11	24.91	1.02

Chart 1 shows the number of gazes of male and female participants in the study areas. According to this chart, the highest number of gazes is for the news and the fewest for the college logo.

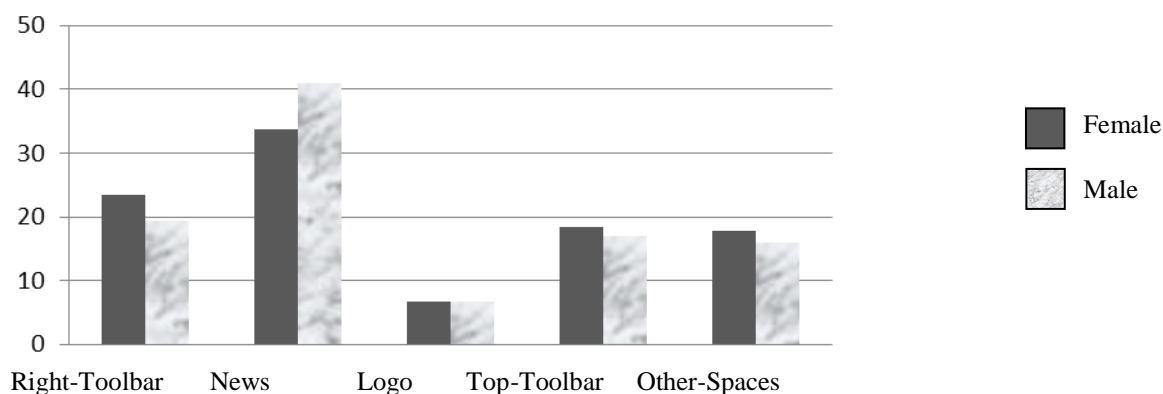


Chart1. Average number of gazes per region of interest by gender

Chart 2 shows the duration of gazes of male and female participants in the study areas. According to this chart, the highest amount of gaze time is for the news and the least for the college logo.

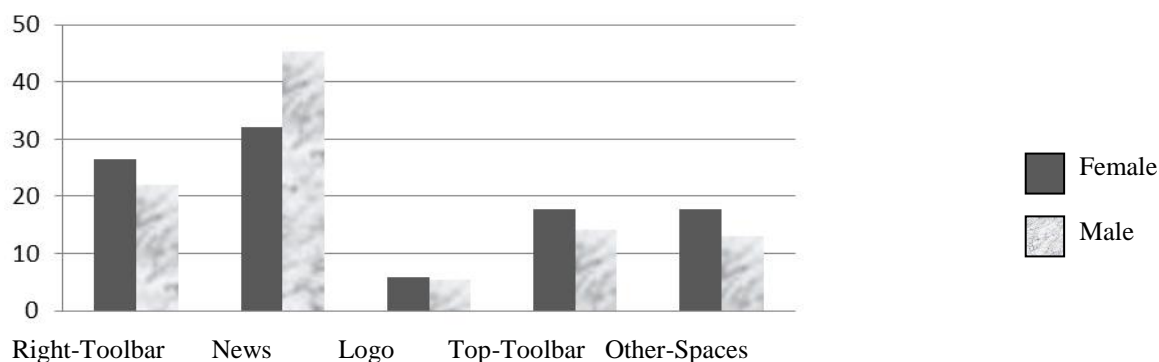


Chart 2. Average duration of gazing at the desired areas in terms of gender

In order to decide whether to use parametric or non-parametric statistics, certain assumptions should be examined. The first and most important statistical assumption is to determine the normality of the data distribution. For this purpose, Kolmogorov-Smirnov test was used. Considering the purpose of the study, repeated measures ANOVA was used to test the research hypotheses and to examine the mean differences in the number of gazes. Because the level of significance was less than 0.05 ($\alpha = 0.001$), Muchley's test = 0.229, Chi-square= 37.970, the Greenhouse-Geisser test was used to see whether the results were significant or not. The results were found to be significant and this confirmed that there were significant differences in the number of gazes between the four areas. Then, Bonferroni post hoc test was used to see if there are any differences between the means. The results indicated that there were significant differences between all the areas of interest except between the right menu and top menu (Table 2).

Table 2. Follow-up test results related to the number of gazes to interest areas

Factors Involved		Average Difference	Standard Deviation	Confidence Level	Confidence Interval in 95% Level	
					Lower band	Upper band
Right Menu	News	-14.45	2.55	0.001	-21.71	-7.18
	Logo	14.50	1.37	0.001	10.59	18.42

	Top Toolbar	3.12	1.97	0.752	-2.49	8.73
News	Right-Menu	14.45	2.55	0.001	7.18	21.71
	Logo	28.95	2.34	0.001	22.27	35.64
	Top Toolbar	17.57	3.15	0.001	8.63	26.54
Logo	Right-Menu	-14.45	1.37	0.001	-18.42	-10.59
	News	-28.95	2.34	0.001	-35.64	-22.27
	Top Toolbar	-11.38	1.28	0.001	-15.05	-7.71
Top Toolbar	Right-Menu	3.121	1.97	0.752	-8.73	2.49
	News	-17.57	3.15	0.001	-26.54	-8.60
	Logo	11.38	1.28	0.001	7.17	15.05

The mean differences of duration of gazes between the four regions were examined. Since the level of significance for the Muchley's test was less than 0.05 (significance level = 0.001, Muchley's test = 0.113, chi-square = 55.981), the Greenhouse- Geisser test was used the result of which was significant and confirmed that there were significant differences in the duration of gaze between the four areas. Table 3 illustrates these differences.

Table 3. Follow-up test results related to the duration of gazing at interest areas

Factors Involved		Average Difference	Standard Deviation	Confidence Level	Confidence Interval in 95% Level	
					Lower band	Upper band
Right Menu	News	-12.67	3.43	0.006	-22.43	-2.90
	Logo	19.07	1.59	0.001	14.54	23.59
	Top Toolbar	7.47	2.14	0.010	1.38	13.56
News	Right-Menu	12.67	3.43	0.006	2.90	22.43
	Logo	31.74	2.99	0.001	23.22	40.26
	Top Toolbar	20.14	3.84	0.001	9.19	-31.09
Logo	Right-Menu	-95.35	1.59	0.001	-23.59	-14.54
	News	-31.74	2.99	0.001	-40.26	-23.22
	Top Toolbar	-11.59	1.24	0.001	-15.13	-8.05
Top Toolbar	Right-Menu	-7.47	2.14	0.010	-13.56	-1.38
	News	-20.14	3.84	0.001	-31.09	-9.19
	Logo	11.56	1.24	0.001	8.05	15.13

Also, one-way ANOVA was used to examine the effect of gender on the number and duration of gazes at the target areas. The results showed no significant difference with regard to the number of

gazes and gender while in relation to the gaze duration and gender (with 0.05 error level) only the news area had a significant difference (Table 4).

Table 4. Results of one-way analysis of variance for duration of gazes in different regions

		Sum of Squares	Degree of Freedom	Average of Squares	F	Significance Level
Right Menu	Inter-group	118.45	1	118.45	2.17	0.15
	Intra-group	1418.72	26	54.56		
	Total	1537.17	27			
News	Inter-group	1188.69	1	1188.69	7.19	0.01
	Intra-group	4295.78	26	165.22		
	Total	5484.48	27			
Logo	Inter-group	0.831	1	0.831	0.12	0.72
	Intra-group	167.87	26	6.45		
	Total	168.70	27			
Top Toolbar	Inter-group	24.36	1	24.36	0.38	0.54
	Intra-group	1662.07	26	63.92		
	Total	1686.44	27			

Finally, the mean comparison test was used to rank the areas of interest on the college sites in terms of number and duration of gazes.

Table 6. Ranking of sites in terms of duration and number gazes on the areas of interest

	Faculty \ Areas	Right Menu	News	Logo	Top Menu
	Time of duration	Beheshti	Second place	Fifth place	Second place
Ferdowsi		First place	Third place	Fourth place	Second place
Isfahan		Fifth place	Second place	First place	Third place
Tabriz		Fourth place	First place	Fifth place	Fifth place
Tehran		Third place	Fourth place	Third place	Fourth place
Number of duration	Beheshti	Third place	Fifth place	Third place	Second place
	Ferdowsi	Second place	Third place	Second place	Third place
	Isfahan	Fifth place	Second place	First place	Fourth place
	Tabriz	Fourth place	First place	Fifth place	Fifth place
	Tehran	First place	Fourth place	Fourth place	First place

Discussion and Conclusion

The purpose of this study was to evaluate and rank the websites of the departments of physical education at the top universities all around the country using an eye tracking device. The study sample consisted of 28 students (17 women and 11 men), 14 of whom were Ferdowsi University students and 14 from other universities.

The results of the present study showed that there were significant differences between the numbers of gazes in all areas of the study, except for the right menu area and the top bar which were looked at by participants equally. But, the difference between the news and the logo areas was very large: The news area took the most attention from the participants whereas the logo area took the least. In addition, with a very small difference, the right menu ranked second and the top bar ranked third.

Since people's attention is initially drawn involuntarily to an element because of the more visible features of that element (28), the reason for the greater number of gazes to the news area can be explained by its basic characteristics: It is in the middle of the page, is animated and contains important content. He knew this, because these factors (being in the middle of the page, its motion and information) are very influential factors in attracting people's attention. Research results from Faraday (2000), Grier (2004), Grier, Kortum, and Miller (2007), Djamasbi et al (2010), Roth et al (2013) and Steele (2018) all endorse this (28-33). Faraday (2000) stated in his research that factors such as motion, size, image, color, and position can determine where users first look on the web page (30). Greer (2004) also stated that gazing when presenting moving elements is more than gazing at fixed elements, and in 90.13% of cases the starting point for the gaze is the center of the screen (31).

Grier et al. (2007) and Steele (2018) have also stated in other studies that spatial location and motion are two important factors in attracting attention to the target area (28, 33). Djamasbi et al (2010) also stated that positioning is the most important factor in attracting viewers' attention, and elements positioned higher attract more attention than the ones positioned lower (29). Due to these reasons (it is colorful, is in the central position and moves), the news section on the websites of different faculties of the colleges has been ranked first and attracted the attention of the subjects, and on the other hand, since the logo was small and was positioned on the corner of the page it did not attract much attention. The number of gazes at the right menu was also higher than the upper bar, which is in line with the results of Seif and Squoi Zadeh (2013). In their research, they found that the number of drawings on the right menu was far greater than the left menu and the top bar, and emphasized the use of the right menu in domestic designs. Also Kalbach and Bosenick (2003) stated that since most users are right-handed, it is easier for them to work with right-hand menus because right-handed users tend to drag the cursor to the right of the screen when not using the mouse; the cursor is therefore closer to the right menus and navigation bars (34).

The results of the study showed that there was a significant difference between all the areas in terms of the duration of gazing and among the four study areas, the most gazing times were related to the news, and the least to the logo. The duration of gazing indicates the importance of the area in question. Bojko (2013) confirms the results of the present study. He stated in his paper that spending more time looking at an area is because of the greater effort to extract information and the importance of that area (35); also, Tzafilkou (2017) stated that the time of looking at an area correlates with its usefulness and the importance of the information it provides to people. In this study, among the four target areas, the news item was the most important, which is why both the number and duration of the gazes at this area were higher than others (36). Another thing to note is the significant difference between the right menu and the top bar which was not significantly different in terms of number of gazes but significantly different in terms of duration of gazes and also the average gaze duration. The average duration of gaze at the right menu was higher than that of the top bar and it can be said that the contents of the right menu were more attractive and important to people than those of the top bar.

The effect of gender on the number of gazes in the target areas also showed that gender did not make a significant difference in the number of gazes in the target areas. Concerning the duration of gazing (with 0.05 error level), only in the news area a significant difference was seen between genders. The results of this study are in line with those of Rowat et al (2010) and (2013) (32, 37). In her research, she examined the relationship between the locations of web targets and how effective they were in

helping viewers find them in online stores, online newspapers, and web pages. It was found that in terms of location, placement, and staring at areas there are no significant differences among the different web sites between men and women. However, Tzafilkou et al. (2017) in another study analyzed gender-based behaviors on the end user and found that gender had an impact on performance, risk perception, perceived usefulness, learning willingness, ease of use, and self-efficacy, and It makes a significant difference (36). Also, a number of scholars such as Terzi (2011), Theo et al. (2015), Hertzal (2003) studied gender differences in search behaviors, perceptions, use of information technology, and self-efficacy, and found that there are differences between women and men (38-40). The reason for these diverse findings may be that in the present study we were using an eye tracking device to find a pattern of gaze in a short period of time, but the above-mentioned study used a questionnaire to collect data from the participants about the type of behavior they showed with websites, Thus, we did not get a significant difference in our results.

Generally it is recommended that the news section on various college sites must be animated, colored, and preferably in a central position. Even if it is possible, it should be positioned so that one can read and see the content related to the news section as soon as the web page is opened without moving the cursor. The right and top menus should preferably designed as sliders so that they can be read without having to click on them. The user should only move the cursor over them and open all submenus. Furthermore, regarding the logo layout and its type, it can be said that the best place for the logo is probably the right side and the top part. Moreover, a detailed design for logos can be more attractive for users because they will spend more time looking at them. The logo of Isfahan University, for example, had a detailed design which was unfamiliar for the individuals, and therefore was ranked first in terms of both the number and the duration of gazes.

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چکیده فارسی

استفاده از ردیاب چشمی بمنظور تعیین کمیت و کیفیت توجه بصری بینندگان وب سایت دانشکده های تربیت بدنی

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در سال های اخیر، وب سایت به عنوان یک رسانه ایده ال ظاهر شده است که از طریق آن دانش و اطلاعات به شکل موثری به گوشه و کنار جهان انتشار می یابد. هدف از اجرای این تحقیق بررسی و رتبه بندی وب سایت های دانشکده های علوم ورزشی دانشگاه های سطح یک ایران می باشد که با کمک دستگاه ردیاب چشمی انجام گرفت. روش تحقیق پژوهش نیمه تجربی بود. جامعه آماری تحقیق را دانشجویان دانشگاه فردوسی و سایر دانشگاه ها و موسسات آموزشی فعال در مشهد تشکیل دادند که ۲۸ نفر به عنوان نمونه تحقیق انتخاب شدند. از نرم افزار بی گیز برای تبدیل داده های دستگاه ردیاب چشمی به داده های کمی و به منظور آزمون فرضیه های تحقیق از آزمون آنالیز واریانس مکرر و نرم افزار اس.پی.اس.اس ۲۴ استفاده شد. تجزیه و تحلیل یافته ها نشان دادند که بین تمامی نواحی مورد نظر از لحاظ مدت زمان خیره شدن به آن ها تفاوت معنادار وجود داشت؛ همچنین بین تمامی نواحی مورد نظر از لحاظ تعداد خیره شدن ها نیز دارای تفاوت معناداری بودند. بجز منوی راست و منوی بالای صفحه. دانشجوی دانشگاه فردوسی بودن یا نبودن بر تعداد و مدت زمان خیره شدن افراد به نواحی مورد نظر تاثیری نداشت و دانشجویان فردوسی نسبت به دانشگاه خود دچار سوگیری نبودند. در بررسی انجام شده در ارتباط با جنسیت نیز داده ها حاکی از آن بود که جنسیت در تعداد خیره شدن ها دارای تفاوت معنادار نبود، اما جنسیت بر مدت زمان خیره شدن در تمامی نواحی مورد نظر تفاوت معنادار داشت. در ارزیابی کلی دانشگاه فردوسی در فاکتورهای مختلف توانست رتبه بهتری را به خود اختصاص دهد و در مجموع بهتر و کاملتر ارزیابی شد.

واژه های کلیدی: وب سایت، دانشگاه های سطح یک، دانشکده علوم ورزشی، ردیاب چشمی، توجه بصری، ایران