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Usage Possibilities of the Eye Tracking Device in Testing Comics Illustrations in the Physical Text

Eye tracking method has been known for long. In recent years, due to the technical development, the possibilities for its use have improved significantly. It is used not only in the advertising and marketing sector, but also in medicine and research. This research method has been applied in educational research. Among others, it gives a picture of the preferences of an investigated subject without influencing the results by misleading or random responses, which occur very often especially when adolescents participate in research.

Eye Tracking

We assume Emile Javal to be a founder of the eye tracking research method, even though the originality of this idea is controversial, in any case, he was the first who published it in 1879. *A French professor named Emile Javal realized that during reading the eye frequently stops moving. While he probably was not the first one to notice he most likely was the first one to publish that he noticed. That was in 1879. Later, he and his colleagues performed several observations of eye movements* [Scherffig, 2005].

Eye tracking beginnings were difficult and technically imperfect. In the first simple experiments the subject was observed by an observer [Scherffig, 2005], later, the devices, which were not practical at all, were invented and thanks to their location on the head of an examined person they also were distracting and thus could influence the results of research. *Early eye trackers were head mounted or forced subjects into fixed head positions both of which affect the natural situation for the test subjects* [Manhartsberger, Zellhofer, 2005].

Present time and technological development bring the possibility of using the eye tracker to us, which actually is a non-invasive device as well as it does not distract the studied object. In practice, you probably would not recognize it from the ordinary computer, but it is equipped with a special infrared camera that records not only the eye movements but also the time of fixing eyes on some spot. *Eye tracking is a non-invasive method that can measure many important parameters associated with brain activity in solving various*

educational issues. E.g. it is possible to identify the examined person´s eye fixation as well as the fixation time (total and average), saccadic speed and reaction of the eyes on the stimulus (saccade latency) [Błasiak et al., 2013].

When using the eye tracker in research, there are two essential terms, fixation and saccades. Fixation, as its name says, represents the points on which the sight is stopped, usually for no longer than half a second [Manhartsberger, Zellhofer, 2005]. Eye tracker device records the order of these points. *Most information from the eye is made available during a fixation. The main goal of a fixation is to identify the fixated object.* [Manhartsberger, Zellhofer, 2005] Saccades are transitions, or rather jumps between these points.

The Research Made in Krakow

Department of Physics at the Pedagogical University in Krakow under the guidance of prof. Błasiak conducted an experiment in July 2012 that was aimed at finding strategies students choose in order to solve various difficult physical tasks. A group of 35 randomly selected pupils from the grammar school in Krakow were subjected to the study. Pupils were expected to solve six tasks while they were being monitored by eye tracker device from the company of Tobi, model T 60. Particularly the second experiment realized by this group caught our attention as the pupils with the best and worst marks were singled out of the sample. The eye tracker device scanned the eye stops on different parts of the instructions for the task. In the figure from this study we can see the heat maps (heat spots), which means a colour scale representing the pupils´ eyes activities in solving the tasks (squares represent the response selected by pupils) [Błasiak, 2013].

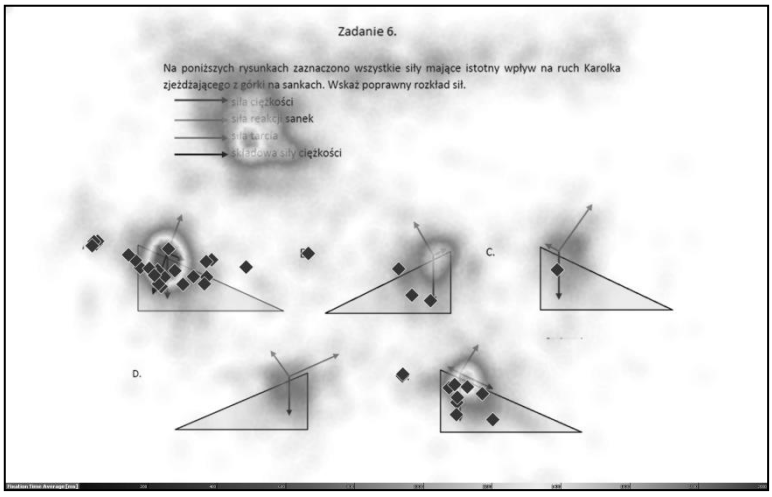

Fig. 1. Heat maps indicating the fixation time of eyes and squares mark the responses of students [Błasiak, 2013]

Detailed analysis showed that the best pupils spent about twice longer time on the instructions for the task (area of interest) than the students with worse marks [Błasiak,

2013]. We put it into the context of other trials aimed at pictures, which showed that students with better results concentrate more on the text than on the pictures [e.g. Hannus, Hyönä, 1999].

Testing of prof. Błasiak and his colleagues was not focused on comparing images and texts, as it dealt with a compact task in which pictures took part. And so pupils had to notice both components to solve the task. However, we advocate that such use of the eye tracking device could bring important results in our research.

Reasons Why the Eye Tracking Method Can Be Used for Testing the Illustrated Text

Using the eye tracking device has already been used in a number of studies that examined not only the pictures themselves, but also their position in relation to the text, most often placed on the websites etc. However, these studies were commercially oriented and it would be a mistake to believe that the image itself can generally cover the whole range of different types of pictures. For didactic purposes it is necessary to examine specific types of educational illustrations, diagrams, graphs, and the like in a specific environment of graphic processing of the textbook. We incline to classification of illustrations as it is provided by Tokár. In the traditional sense we can divide book illustrations into two groups, scientific and artistic ones [Tokár, 2002]. We deal with the scientific illustrations in details, as we could include the illustrations in textbooks of physics into this group. The definition says: *Scientific illustrations are such displaying and illustrating signs that are bind on a substantive text (scientific, educational) in a factual way: they rigorously reproduce it, objectively and graphically explain, document, or complement it, enhance its content and expand its referential function or model the reality* [Tokár, 2002].

Proposal for Testing

We assume that the testing with the eye tracking device would bring many interesting outcomes in the review of the textbooks in general and would help us in evaluating the proposed physical text that is enriched with special type of the book illustration. It is the illustration in comics' style which repeats the same heroes (continuity of images) and each image or group of images has a storyline or content that is directly related to a given curriculum and follows the text. These illustrations not only fulfil an aesthetic function, but also are educational and explanatory material. In fact, they explain the specific physical concepts, phenomena that are, in our point of view, difficult to understand.

By means of the eye tracker, we would like to examine whether and to what extent students were attracted to pictures and if they used them as a source of information at some point. This parameter might refer to a level of visual literacy of the examined students. *International research confirms the existence of a visual literacy: there are people who cannot "read" images, understand visual information, just as there are people who cannot read and write* [Tokár, 2002]. We presume that such people will be interested in the picture just for the first moment and later, they will not deal with it, they will not intentionally seek the information necessary to answer the tasks assigned to them.

As a subject of our research, we also should determine the differences between students who had already been educated in physics and who had not. Completed researches showed that people with previous experience focused more on the text and their concentricity was targeted, in comparison with laymen's random searching. *At a first glance on the graphs, we can see differences in overall appearance between the groups. For example, in the novice graph the overall appearance is fuzzy compared to the expert graph.*

Our interpretation is that novices frequently alternate between the five areas ... For the experts the lines are more clearly distinguished, suggesting that there is a dominating focus... [Lindström et al., 2009]. It also seems that the illustrations help particularly low ability students to understand [Hannus, Hyönä, 1999].

Conclusion

The main reason for the choice of eye tracking as a research method for studying the illustrations in the educational text is the objectivity of the results. Examining the didactic importance of illustration in textbooks cannot exclude the factor of motivation. Though we do not want to deal with the motivation in details, as such it influences an attention and reception of information by recipients. *Most often we also divert our attention to that point so that we can focus our concentration (if only for a very brief moment) on the object or region of interest* [Duchowski, 2007]. Exactly this area of our perception could be lit by the eye tracking device and thus contribute to improving the quality of educational texts, especially in the field of physics.

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