

Eye-tracking indicators relevant in education and their interpretations

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Alžběta KREJČÍ, *Department of Physics Education,
Faculty of Mathematics and Physics, Charles University, Prague, Czech Republic*

Abstract. Based on eye movements we identified thirty indicators of cognitive processes, that could be applied in education research and education itself. We sorted these and added possible interpretations. Five of the indicators were then applied to data to test their practical usability.

1 Motivation and goals

Eye-tracking allows us to track the movements of eyes, for example when students are reading on a PC screen. Its most important benefit for education is enabling a certain insight into cognitive processing of tested material. This method has been applied in science education before (e.g. [1]), mainly while studying problem solving or reading graphs. Our focus was reading of a specialized text. We wanted to create a list of useable indicators and their possible interpretations.

These could allow teachers to review student's strategies while studying, monitor which part of solving a problem was problematic for a class, or help students by enabling creation of intelligent and highly individualised textbooks (e.g. [2]).

2 Methods

Indicators potentially useful in education were determined by a literary research.

Some indicators were then applied to data from a previous research performed by Iva Jakubská [3] for a rough idea of whether or not they could be truly used in practice. We chose a qualitative approach.

2.1 Basic concepts

Eye-trackers allow us to monitor and record eye movements using different methods, in our case the reflection of infrared radiation on the cornea.

Eye movements while reading a text can be divided into two groups – fixations and saccades [4]. Fixations are events lasting around 300 ms during which the eye is still, saccades are the movements connecting fixations. Regressions are a type of saccades that goes against the normal direction of reading. Areas of interest are parts of the tested material selected before collecting data as potentially important or interesting when evaluated separately.

3 Results

The literary research examined nine different sources. We created a table of thirty indicators sorted by which type of eye-tracking data they use, be it fixations, saccades, areas of interest or something else (e.g. Fig. 1). We added corresponding interpretations. Testing selected indicators on actual data showed some indicators were reasonably useful; others will require further testing. For example, qualitative analysis of recordings showed one participant knew what information was necessary for solving a problem, however they couldn't solve the problem successfully, indicating the problem was using the information. It also showed they paid attention to reading the problem, meaning they weren't just "being lazy" with their answer.

4 Conclusion

Providing a comprehensive list of eye-tracking indicators and their interpretations could give teachers valuable information about their students work and results. It could also be used for reference in further research in science education.

References

- [1] Jarodzka, H., Holmqvist, K., & Gruber, H. (2017). Eye tracking in Educational Science: Theoretical frameworks and research agendas. *J. of Eye Movement Res.* 10(1). <https://doi.org/10.16910/jemr.10.1.3>
- [2] Ishimaru, S., Kuhn, J., Bukhari, S. S., Dengel, A., & Heisel, C. (2016). Towards an intelligent textbook: Eye

gaze based attention extraction on materials for learning and instruction in physics. UbiComp 2016 Adjunct - Proceedings of the 2016 ACM Int. Joint Conf. on Pervasive and Ubiquitous Computing. <https://doi.org/10.1145/2968219.2968566>

[3] Jakubská, I. (2018). Strategie žáků při řešení úloh z mechaniky zkoumané metodou oční kamery [Masters thesis]. Charles University, Faculty of Mathematics and Physics.

[4] Jošt, J. (2009). Oční pohyby, čtení a dyslexie. Fortuna. Prague.

Primary author: KREJČÍ, Alžběta

Presenter: KREJČÍ, Alžběta

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