Eye-Tracking in Formal Education. Understanding Map Reading Skills and Their Development

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Abstract:

Maps intricately weave into the fabric of our lives, extending beyond daily navigation to serve as cultural artifacts. Their historical and contemporary relevance transcends mere navigation, evolving into a medium through which human beings communicate and understand their environment. This evolution has encouraged various disciplines to examine maps, inspiring formal education to teach map reading skills and prompting cartographic research to focus on the dynamic relationship between maps and their users.

In recent decades, the emphasis on exploring user interaction with maps has increasingly incorporated eye-tracking (ET) as a core research method, particularly as eye-tracking technology has become more accessible (Holmqvist and Andersson, 2017). This methodological shift aligns with the broader trend of delving into the complexities of user interaction with maps. ET is distinguished by its objectivity, recording eye movements to offer insights into psychological processes like attention and cognitive load (Molina et al., 2024). Integrating ET with other methods, such as observation, think-aloud protocols, keyboard analysis, and questionnaires, enriches our understanding of user-map interactions, revealing patterns like the natural inclination of the eyes to start at the top left of a layout and traverse towards the bottom right (Anthamatten, 2021; Fairbairn and Hepburn, 2023).

There are a range of review studies that have explored scholarship using ET (Kiefer et al., 2017; Krassanakis and Cybulski, 2019; 2021 and Fairbairn and Hepburn, 2023). While these studies focus mainly on map users in general, similar studies dedicated to students and map skills in formal education have yet to be carried out. Map Skills (in German, *Kartenkompetenz*) refer to the ability to appropriately handle maps (Hemmer et al., 2010). This encompasses three fundamental skills, namely map reading, map evaluation and map production. While there is extensive praxiological knowledge on map skills, competency-based education requires theoretically grounded and empirically validated models for map skill acquisition and development. Hemmer et al. (2010) developed, based on PISA reading literacy model, the
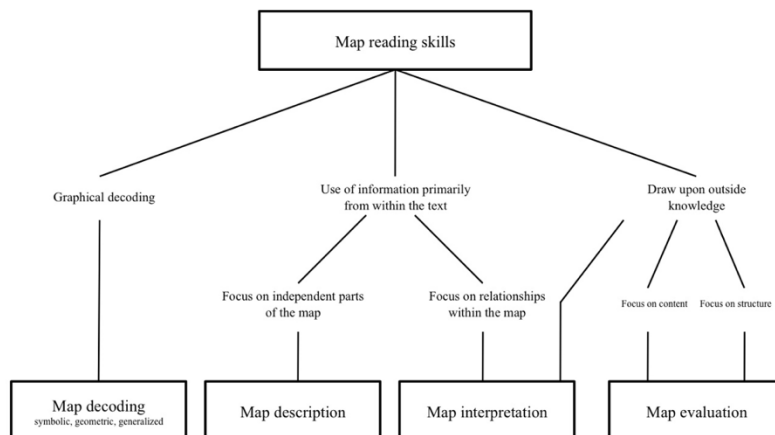
Figure 1 Map Reading Skills (Bagoly-Simó & Binimelis 2022, p. 213)

Map Reading Skills Model (Fig. 1) that distinguishes between four competencies. This paper spotlights map reading skills, which include graphic decoding (symbolic, geometric, generalization) and using primary information by describing individual phenomena and spatial structures of the map. For the purposes of the study, map evaluation remains unconsidered.

Mapping review served to explore how ET facilitates research on students of different ages (from primary to upper-secondary education) tackling map-related tasks. This mapping review started from existing meta-studies and built up a sample of papers tackling formal education, map reading skills, and ET published since 2017. Thereby, a range of strategies were used. First, we consulted the literature cited in the existing studies. Second, we conducted an extensive archival search of the journals quoted in the meta-studies, as they constituted a key platform for discussing ET and maps. Third, we carried out a database search in Education and Geography to identify further publications. Finally, while processing each paper, we added additional papers based on the references (Miake-Lye et al., 2016). Computer-assisted content analysis helped to define categories. At this stage, we are still processing the current sample of 52 papers.

The presentation will introduce the main findings and recommendations for further conceptual and empirical work on ET and maps in formal education.

Acknowledgments

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