Utilizing Eye-Tracking Technology to Promote Students’ Meta-Cognitive Awareness of Visual STEM Literacy

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Theoretical Framework & Scholaristic Contributions

We utilize a socio-cognitive framework, seeing learning as social or interpersonal activity being appropriated to the intrapersonal or intramental plane. Inspired in part by instructional models such as reciprocal teaching, multimodal social semiotic approaches, and distributed cognition, we seek to design learning environments with cognitive tools for meta-cognitive awareness of visual perception and interpretation. In this effort, we aim to adapt research on meta-cognition and metarepresentational competence. We believe that available media and data outlets expand the notion of text. Further research and development should be conducted to deepen our understanding of 'new media literacies' and inform STEM curriculum design. We believe this continued eye tracking and infographic work will have import in fields of STEM education, data literacy, user interface technologies, critical media studies and beyond.

Analysis and Future Directions

• The eye tracking exercise provided a reference point for discussion regarding effective presentation of data, visual appeal, and the students’ scientific data, and visual literacies as they created their own IGs. This pilot study was intended as a learning experience for students to think about their own visual process; not a scientific research experiment.

• The next InfoX camp will occur in July 2016. We have recruited staff of the Cognitive Development Laboratory to aid in systematically designing the next eye tracking experience to focus on particular and varied forms of information represented tools, the visual appeal of data, consider how students respond to redundancy amongst images, and include pupillometry measures as indicators of cognitive effort associated with processing data.

• We hope this work continues to promote student visual meta-cognition and contributes to a deeper understanding of new media and data literacies.

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References & Acknowledgements


Introduction and Purpose

During a ten day summer camp (Infographic Expression, or InfoX) designed to promote student visual, scientific, and data literacy through infographics our team implemented a curricular component involving viewing infographics (IGs) while being recorded by an eye-tracking machine. Students viewed quantitative data collected by the eye-trackers and reflected on their own and peers’ process of visual engagement. This activity enabled students to increase their metacognitive awareness of their prevailing perceptual and interpretive processes, supporting their performance during the rest of the camp and ultimate creation of their own science news IGs.

Research Context and Design

• The overall objectives of the InfoX summer camp were to engage high school students in a meaningful process of analyzing visual representations of scientific data and to support student understanding of how they process mixed media information by having them identify a topic of personal interest and author a science news infographic.

• The eye-tracking exercise was intended to provide students exposure to scientific procedure, an experience in a cognitive development laboratory to analyze their own embodied engagement with diverse visual representations, and produce a large data set that students could reflect upon to deepen their understanding of their own visual perception.

• We selected a series of six student-generated IGs and coded each into four areas of interests (AOIs). Seven InfoX students participated in two IG trials as the eye-tracking machine recorded their gaze patterns, saccades, and duration of focus in each AOI. These trials occurred on day two of the camp to highlight student prior knowledge before explicit IG instruction.

Data Output for Trial 1

Data Output for Trial 2

Analysis of Trial 1 and Areas of Interest (AOI)

The day after the eye tracking exercise students presented the two infographics they had seen to the rest of the class and explained how they believed they had viewed the IG and processed the information. Then, through a series of raw output spreadsheets and data representations from the eye-tracker, instructors illustrated where students’ gaze actually went, our design process for assigning AOIs, how students responded to questions, and duration of focus on each AOI in milliseconds. Students were surprised by some of these results and spent time reflecting on trends in the data. Students then had a second opportunity to explain where they looked and how they engaged the visual information in light of having seen the actual results. Collectively, the class offered feedback for each of the experimental infographics and reflected on how they had processed visual representations differently.

Trial 1 Sample Questions:

1. Which snake is the deadliest for mice? Where did you find this data?

2. Where does the Blue Krait inhabit? Where did you find this data?

3. Which snake bite is associated with diarrhea? Where did you find this data?

Trial 2 Sample Questions:

1. ‘Subject 2’ observed that their strategy was to view the whole IG first, before proceeding to each AOI. This student observed the blue line re-tracing where her gaze appeared. In a separate room (away from the IG), she is instructed to write down everything she learned from the IG.

2. ‘Subject 1’ observed that their strategy was to view the IG in AOI 1, then AOI 2, 3, and 4. They conclude this after 7.4 seconds. In this AOI, the eye-tracking machine recorded their gaze patterns, saccades, and duration of focus. These trials occurred on day two of the camp to highlight student prior knowledge before explicit IG instruction.

3. ‘Subject 4’ observed that their strategy was to view the IG in AOI 1, then AOI 2, 3, and 4. They conclude this after 7.4 seconds. In this AOI, the eye-tracking machine recorded their gaze patterns, saccades, and duration of focus. These trials occurred on day two of the camp to highlight student prior knowledge before explicit IG instruction.

AOI 1

AOI 2

AOI 3

AOI 4

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