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COMPARATIVE ANALYSES BASED ON WSI VIEW PATHS RECORDED DURING MULTIPLE PRACTICAL EXAMS IN ORAL PATHOLOGY

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Introduction/ Background

Data collected about the ways students view Whole Slide Images (WSIs) during their practical exams can be used for many interesting analyses. Tracking such viewing behavior over years enables multiple comparisons and leads to drawing more general conclusions about observed viewing patterns.

Aims

First goal of this work was to collect data about how students view WSIs attached to questions during practical exams in oral pathology conducted over several years. What is important, we were collecting this data for all or for most students participating in the exams. Second objective was to analyze the data using specially prepared methods. This way we could gain interesting insights into students' viewing behavior. Finally, by analyzing data from a few exams we wanted to compare the observed viewing patterns across multiple years, and find general conclusions which hold true for multiple exams.

Methods

A scalable software-based view path tracking method with centralized database was used to collect data describing how students pan and zoom across WSIs attached to exam questions. The tracking software was active during multiple practical exams in oral pathology conducted in the recent years at Poznan University of Medical Sciences in Poznan, Poland. Data about over 100,000 view fields has been gathered, and we used it in various analyses, including visualizations and numerical calculations. The latter were based on computation of per-view-path metrics, like number of view fields, viewing time, average zoom level, focus on a region of interest, dispersion. Generated overview images and calculated numbers were compared and aggregated for different students, questions, student classes, and exam years. On each level, we split the data into groups of students who answered a question correctly, and those who gave an incorrect answer. We looked for correlations between the calculated metrics and answer correctness, and even attempted to predict students' answers based on the metrics, using machine learning approaches.

Results

The view path tracking implementation has successfully collected data about WSI areas viewed by students during multiple practical exams in oral pathology, and we were able to use this data for multiple analyses. Produced visualizations (static images and animations) provided clear overviews of how individual students viewed WSIs, and which areas of the slides were most often viewed when answering correctly or incorrectly. Calculated metrics enabled more objective comparisons, and aggregation of obtained numbers resulted in finding more general patterns. We found that students who gave incorrect answers tended to view the WSIs for longer time, go through more areas, often more dispersed across a slide, and focus less on the expected region of interest. Analysis of data split by student classes taught by different assistants helped in assessing personal impact of a teacher on his or her students' results. Finally, thanks to the view path tracking data collected over multiple years, we were able to compare results of the analyses from different exams, to see whether the

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observations hold true for multiple groups of students and for a longer period of time. This way we found certain consistencies and patterns reoccurring over years, which makes such findings particularly meaningful. Yearly analysis also helped in assessing didactic value of used slides and identifying slides which potentially require more attention during oral pathology classes.