

## Integrating writing research results in academic writing instruction – the example of Thesis Writer

Academic writing poses manifold challenges to students, instructors, as well as to higher education institutions. Thesis Writer (TW) offers a domain-specific, technology-supported learning environment for scaffolding academic writing, combined with an online editor optimized for producing academic text (Authors, 2018). Implemented as SaaS, TW allows for fine granular tracking of user system interaction, text production, and text revision. In this paper we will describe two methods of data analysis and visualization recently implemented in TW.

*Visualization of individual user process data (time slider):* Studying writing processes with keyloggers is an established field (Leijten & Van Waes, 2013). Use of screen recording allows for user system interaction research (Tang, Liu, Muller, Lin, & Drews, 2006). TW unobtrusively combines these two aspects in the natural user setting by employing logfile analysis (Dumais, Jeffries, Russell, Tang, & Teevan, 2014). To analyze process data for small user numbers, a replay function was implemented with a time slider. Within a web browser, it replays the user's primary system function usage simultaneously with their text production. It is therefore possible to research how text production changes following usage of tutorial or linguistic support functions.

*Aggregated user data analysis & visualization:* An API from TW's database to the R statistics package aggregates and visualizes logfile data, which is displayable in TW. Additional to research purposes, data can be displayed to learners to support their learning processes (Vieira, Parsons, & Byrd, 2018). The dendrogram in Figure 1 displays cluster analysis results revealing usage pattern visualization of TW's phrasebook by 80 users who called the phrasebook 200 times. They mostly used the phrasebook at the beginning of the writing process (Calls per Time). Calls per Section displays in which sections of the rhetorical structure the phrasebook was used and how often.

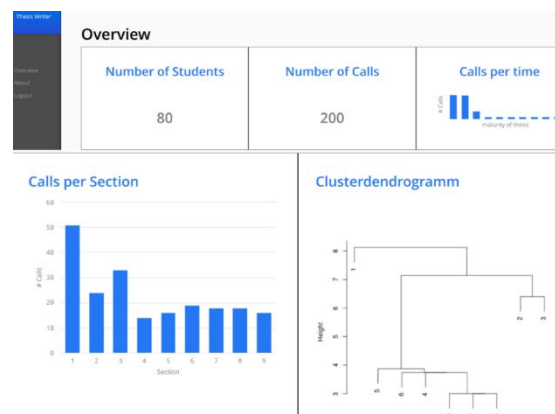


Figure 1

Academic writing is a complex task, and difficult to both learn and supervise. Rapid increases in the systems supporting this process have been seen (Allen, Jacovina, & McNamara, 2015), including TW. Many systems offer fine granular tracking and analysis of user-system interaction using logfiles. Additional to general research interest, we believe that both support more practical goals, by helping to understand the impact of pedagogical interventions for users, and by displaying data relevant to users to improve their learning process.

- Allen L. K., Jacovina M. E., McNamara D. S. (2015). "Computer-based writing instruction". In C. A. MacArthur, S. Graham, J. Fitzgerald (eds.), *Handbook of writing research* (pp. 316–329). New York: The Guildford Press.
- Authors. (2018). Removed for review.
- Dumais S., Jeffries R., Russell D. M., Tang D., Teevan J. (2014). "Understanding user behavior through log data and analysis". In J. S. Olson & W. A. Kellogg (eds.), *Ways of Knowing in HCI* (pp. 349–372). Springer, New York, NY.
- Leijten M., Van Waes L. (2013). "Keystroke logging in writing research: Using Inputlog to analyze and visualize writing processes" *Written Communication* 30(3): 358–392.
- Tang J. C., Liu S. B., Muller M., Lin J., Drews C. (2006). "Unobtrusive but invasive: using screen recording to collect field data on computer-mediated interaction". In *Proceedings of the 20th anniversary ACM conference on Computer supported cooperative work* (pp. 479–482). Banff: ACM.
- Vieira C., Parsons P., Byrd V. (2018). "Visual learning analytics of educational data: A systematic literature review and research agenda", *Computers & Education* 122: 119–135.