Learning Analytics and the Community of Inquiry: Indicators to Analyze and Visualize Online-Based Learning

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Abstract. Background: The Community of Inquiry (CoI) describes success factors for online-based learning. Objectives: To develop approaches for automatic analysis of CoI to be visualized within student and teacher dashboards. Methods: Extending indicators from social network analysis and linguistics; evaluation within a case study. Results: The project is just starting. Conclusion: Results will help to better understand and improve cooperative online-based learning in higher education.

Keywords. teaching, education, pedagogy, health informatics

1. Introduction

Online-based learning environments in higher education offer great flexibility to students, but are challenging in fostering such cooperative learning [1]. The Community of Inquiry (CoI) [2] with its social presence, cognitive presence, and teaching presence is an established framework to foster cooperative learning in online learning environments.

Learning analytics is "the measurement, collection, analysis, and reporting of data about students and their contexts for purposes of understanding and optimizing learning" [3]. Learning Analytics research provides first approaches to retrospectively analyze the level of CoI in a course and to use this information to better support learning in online-based learning environments [4,5]. However, an automated and real-time analysis and visualization of the CoI in a given course that would allow immediate action by the instructor is not yet available. Our idea is to build and evaluate CoI dashboards [6] based on learning analytics. Our research questions thus are:

1. Is it possible to develop a comprehensive, automated representation and visualization of the CoI and its three dimensions for individual online-based courses by combining and extending approaches from learning analytics?
2. Does the visualization of the CoI in a teacher dashboard, combined with actionable advice, has any impact on teaching?
3. Does the visualization of the CoI in a student dashboard, combined with actionable advice, has an impact on self-regulation or learning outcome?

The project is funded by the Austrian Science Fund - FWF. The project has just started. In this poster, we want to present and discuss our methodological approach.

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2. Methods

To automatically measure social presence in an online course, we will select and extend indicators from social network analysis such as degree centrality, betweenness centrality, information centrality, connectedness, or density [4], using the software Gephi. To analyze cognitive presence, we will extend indicators such as word count, numbers of named entities, and lexical diversity [5], using the Linguistic Inquiry and Word Count Tool. To analyze teaching presence, we will test indicators from social network analysis. As the gold standard for all indicators, we will use the validated COI student survey.

We will then develop a coherent visualization of the CoI results for all three presences in a student and a teacher dashboard, including actionable advice, based on a user-centered design approach. We will perform subsequent validation studies to assess their acceptability and perceived impact on teaching and learning in online-based settings.

3. Results

The empirical work of the project will take place within the online Master program Health Information Management, University UMIT, Austria. This master program is strongly built on a socio-constructivist instructional design framework [7]. We have full technical access to the LMS data (via Moodle) of all HIM modules. Ethical approval for a feasibility study on learning analytics for a smaller group of students was already granted by the Research Committee for Scientific Ethical Questions" at UMIT.

4. Discussion

The project provides the following innovations: First, a framework for automated real-time analysis and visualization of CoI in online-based courses. Second, a prototype of CoI dashboards providing actionable advice. Third, evidence on the perceived impact of such dashboards. The results will help to better understand and improve cooperative online-based learning in higher education.

5. References

[1] R. Ferguson, Learning analytics: drivers, developments and challenges, *Int. J. Technol. Enhanc. Learn.* **4** (2012) 304. doi:10.1504/IJTEL.2012.051816.

[2] D.R. Garrison, Online community of inquiry review: Social, cognitive, and teaching presence issues, *J. Asynchronous Learn. Networks*. **11** (2007) 61–72.

[3] P. Long, and G. Siemens, Penetrating the Fog - Analytics in Learning and Education, (2011). doi:10.1145/2330601.2330605.

[4] P. Shea, S. Hayes, J. Vickers, M. Gozza-Cohen, S. Uzuner, R. Mehta, A. Valchova, and P. Rangan, A re-examination of the community of inquiry framework: Social network and content analysis, *Internet High. Educ.* **13** (2010) 10–21. doi:10.1016/j.iheduc.2009.11.002.

[5] V. Kovanovic, S. Joksimović, Z. Waters, D. Gašević, K. Kitto, M. Hatala, and G. Siemens, Towards automated content analysis of discussion transcripts : A cognitive presence case, *Proc. Sixth Int. Conf. Learn. Anal. Knowl.* (2016) 15–24. doi:10.1145/2883851.2883950.

[6] H.U. Hoppe, Computational Methods for the Analysis of Learning and Knowledge Building Communities, *Handb. Learn. Anal.* (2017) 23–33. doi:10.18608/hla17.002.

[7] E. Ammenwerth, and W.O. Hackl, Monitoring of students' interaction in online learning settings by structural network analysis and indicators, *Stud Heal. Technol Inf.* **235** (2017) 293–297.