Studying Student Communication during Synchronous Online University Teaching with Social Network Analysis

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Abstract

In the light of nation-wide containment measures to COVID-19, most university programs in the Czech Republic took a form of online courses. Both the instructors and the students have found themselves facing challenges stemming from online learning including a lack of real-time classroom participation and interaction. Importantly, student participation in classroom during lessons as part of cognitive engagement is a critical predictor of academic success. While in-person participation at school is currently out of question, participation in online courses comes into play. This study provides an initial exploratory insight – a detailed graphical investigation of synchronous interaction in four online university courses at Masaryk University with the help of social network analysis. Visualizations using social networks proved to be a useful tool for analyzing synchronous online interaction as it gave a clear picture what the interaction during the lessons looked like, and allowed an effective comparison both within and between the courses. With the exception of one lesson exhibiting high degree of student-student interaction, the prevailing interaction pattern present across all courses was a star-shaped two-way interaction pattern centered around the teacher.

Keywords: *online learning, e-learning, student communication, student engagement, social network analysis*

1. Introduction

In the light of nation-wide containment measures to COVID-19, starting mid-2020, most university programs in the Czech Republic took a form of online courses [1]. While some online learning had already been utilized before the virus outbreak, the present scale of online learning at established Czech research universities is unparalleled. Both the instructors and the students have found themselves facing challenges stemming from online learning including a lack of real-time classroom participation and interaction. Importantly, student participation in classroom during lessons as part of cognitive engagement is a critical predictor of academic success [2]. While in-person participation at school is currently out of question, participation in online courses comes into play.

This study aims to provide an initial exploratory insight – a detailed graphical investigation of synchronous interaction in four online university courses at Masaryk University with the help of social network analysis. Social network analysis aims to grasp, understand, and measure social structures and provide a framework for their analysis [3]. In this study, university students and teachers will be operationalized as actors and interactions during online sessions between them as ties forming social networks. Present research dealing with online student interactions employing social network analysis is usually limited to asynchronous interactions in discussion forums and chats [4, 5, 6]. This study therefore aims to fill the gap by employing social network analysis to investigate interaction in online synchronous courses.

This study has the following aims:
- investigate patterns of interaction in four online university courses with social network analysis
- investigate the feasibility of social network analysis for the study of online synchronous interaction

2. Methods
2.1 Sample and data collection
This study is based on a non-probability sample comprising four university teachers at the Faculty of Arts at Masaryk University. The teachers and their lessons were chosen based on recommendations from their students and fellow colleagues marking their lessons dialogic and interactive. From each teacher, recordings of three consecutive 90-minute-long online lessons in the middle of the Fall 2020 semester were included. The Fall 2020 semester at Masaryk University (and in the Czech Republic)

was marked by a transition from on-site and blended learning to fully online learning. Table 1 shows basic sample characteristics. All teachers had groups of similar sizes of approximately 30 students.

pseudonym	position at university	teaching exp. in yrs.	subject taught	group size
Ann	PhD student	1	linguistics	31
Ben	Assistant professor	6	literature	24
Cora	Assistant professor	7	teacher education	27
Dan	Assistant professor	15	philosophy of education	29

Table 1: Basic sample characteristics

The data were collected in accordance with the principles of research ethics of Masaryk University and the data collection was approved by the Research Ethics Committee of the Masaryk University. All four teachers gave written consent to data collection. All students were informed about the purpose of the study and the scale of data collection either by the respective teachers or by the researcher in an explanatory letter. All participants could withdraw their consent at any time. The collected data comprise recorded online lessons followed by recorded online interviews with the teachers. All personal data on participants were anonymized.

2.2   Coding interaction
Once the recordings were obtained, interaction in online classrooms was classified into 4 categories: 1. non-addressed question; 2. addressed question; 3. answer; 4. new idea. Non-addressed questions originated from the teachers and were directed towards all students – e.g., "What do you imagine as melodramatic elements in contemporary films?". Addressed questions originated both from the teachers and from the students and were directed towards a specific person calling their name – e.g., "Is there another reason why this would end up in this bad way, Lucie, you are implying that in your response paper. What is your idea about that?". Answers originated both from the teachers and from the students and were directed towards a specific person who had asked the respective question – e.g., "Well, I noticed that in the play, most characters were kind of non-realistic to the time that the play was played in…" as a response to a teacher's question. New ideas were utterances developing a specific topic originating both from the teachers and from the students and were directed towards a specific person who had said something previously – e.g., "Yes, I think that he, the author, he felt this need to be in complete control of absolutely everything that was going in there." as a student's response to another student's answer. New ideas differed from answers in that they were spontaneous, not a reaction to a question, and the person was not called upon. Moreover, a total utterance time of each actor in seconds was recorded.

2.3   Interaction networks
Once the interaction was classified, it was visualized with social network analysis in a *ggraph* package [7] with Davidson & Harel's [8] algorithm. The visualizations are made in a faceted manner, so that the position of actors in the graph remain same across the consecutive lessons and allow comparison of who interacted with who.

3. Results
Figure 1 shows interaction patterns in the individual lessons. *Course A (teacher Ann)* lessons were marked by a gradual increase in interaction. While the first lesson was dominated by teacher's non-addressed questions and only four students reacted to the teacher; by the third lesson, seven students were interacting, spontaneous interaction in the form of new ideas became prevalent, and student-student interaction centered around one student became present as well. The one student triggering student-student interaction was active in all lessons. *Course B (teacher Ben)* lessons were marked by a relatively consistent pattern of interaction comprising mainly teacher-student and student-to-teacher interaction. Each lesson, approximately a half of students communicated at least once. While in the first lesson the teacher employed mainly non-addressed questions, in the subsequent lessons, he employed a greater number of addressed questions. Third lesson was also marked by an occurrence of spontaneous student-student interaction. Compared to other courses, *Course C (teacher Cora)* lessons showed the highest interaction – both in terms of quantity and students involved. All types of interaction were present in all three consecutive lessons and interaction in lesson 2 was marked by frequent student-student interaction involving ten students. Interaction patterns in *Course D (teacher Dan)* lessons differed in time. In the first observed lesson, all types of interaction were represented and around a third of the students interacted at least once. In the second lesson, three students not
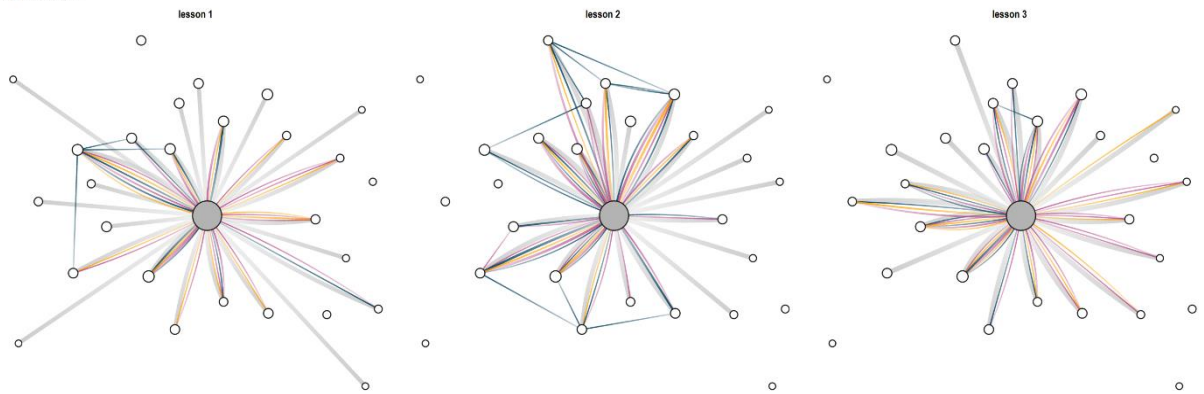
Course A (teacher Ann)
1 teacher, 31 students

lesson 1   lesson 2   lesson 3
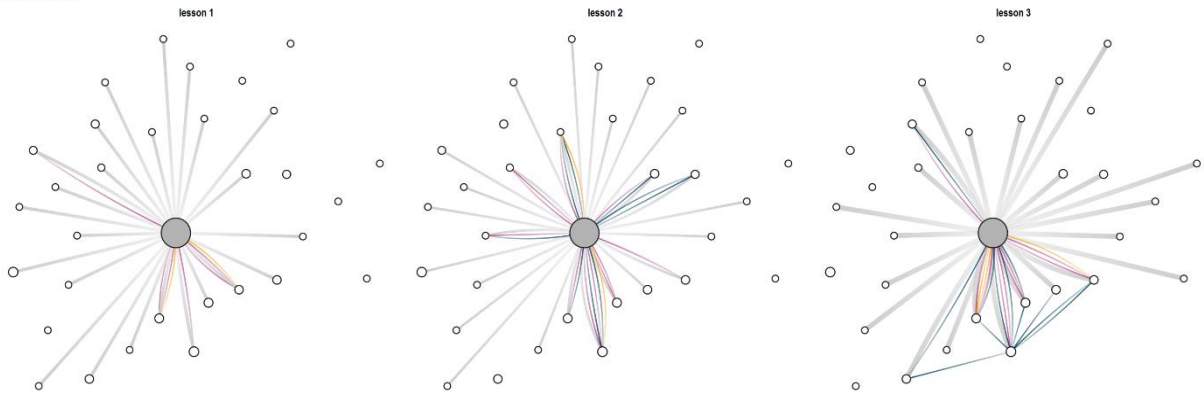
Course B (teacher Ben)
1 teacher, 24 students

lesson 1   lesson 2   lesson 3
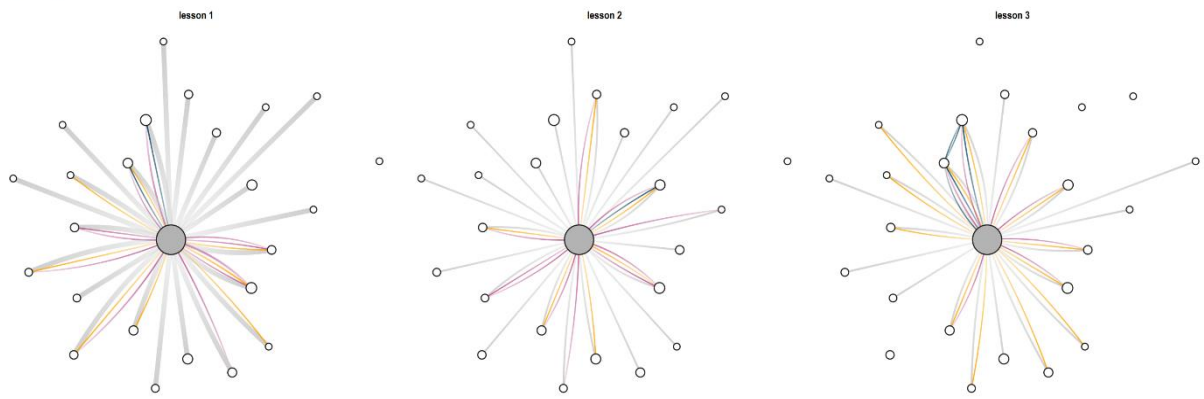
Course C (teacher Cora)
1 teacher, 27 students

lesson 1   lesson 2   lesson 3

Course D (teacher Dan)
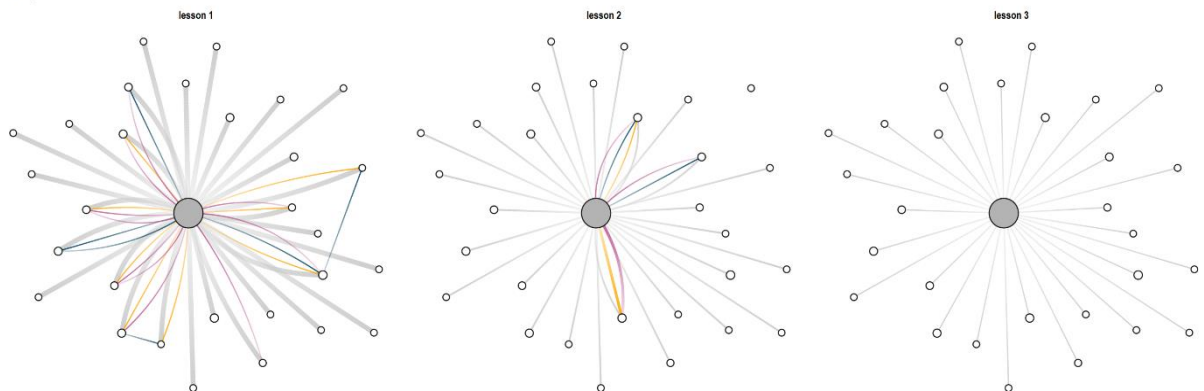1 teacher, 29 students

lesson 1   lesson 2   lesson 3

Figure 1: Visualizations of online synchronous interaction in twelve lessons. Each row corresponds to a different teacher and subject. Columns represent consecutive lessons in a faceted manner – position of actors remains same across the lessons.

Grey color = teacher, white color = student. Actor size = total utterance time. Edge color = type of interaction (grey = non-addressed question; yellow = addressed question; pink = answer; teal = new idea). Edge width = number of interactions. Edge direction is denoted by the gradient – the ligher side is sender, the darker side is receiver.

previously communicating interacted with the teacher. The last lesson did not contain any interaction apart from the teacher's non-addressed question.

All sample courses contained all types of interaction (non-addressed questions, addressed questions, answers, and new ideas) as well as all directions of interaction (teacher-student, student-teacher, and student-student interaction as well). This mirrors this study's expectations as the teachers were selected based on reports from their students and colleagues as having interactive lessons. The interaction patterns across all lessons were heavily centralized around the teacher creating a star-shaped two-way interaction pattern [4]. This interaction pattern suggests that while many students were engaged in some form of interaction, it was mostly initiated and controlled by the teacher. The interaction pattern at the Lesson 2 of the Course C diverts from the star shape the most and has characteristics of student-led lessons.

4. Discussion and conclusion

This study aimed to provide an insight into synchronous interaction patterns in online university courses. The courses were selected based on reports of being interactive and thus all courses exhibited rich forms of interaction. Visualizations using social networks proved to be a useful tool for analysing synchronous online interaction as it gave a clear picture what the interaction during the lessons looked like, and allowed an effective comparison both within and between the courses. With the exception of one lesson exhibiting high degree of student-student interaction, the prevailing interaction pattern present across all courses was a star-shaped two-way interaction pattern centered around a teacher. Interaction in lesson was therefore heavily teacher-centered. However, all teachers in the sample employed many non-addressed open questions allowing student-centered discussions and when student-student interaction happened, none of the teachers intervened. It is therefore possible that to some extent, the teacher-centered interaction is facilitated by the online mode of communication where students do not see others in classroom, restrain from spontaneous interaction to prevent communication interference, and acknowledge teacher as a moderator calling students up to communicate.

A qualitative part of the research will follow and build on the presented quantitative analysis. The further research will aim to investigate strategies leading to interaction in synchronous online lessons.

Acknowledgements

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