

# Exploration of Peer Effects through Digital Forum Interactions

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**ABSTRACT:** This submission presents a work-in-progress on the identification of peer effects using data collected in digital learning environments. One of the central claims in the economics of higher education is that peer exposure has potential to affect academic choices and educational attainment. Studies of peer effects using learning analytics data, however, have been scarce, and mainly focused on highlighting social selection, i.e. phenomenon when similar learners choose to interact with similar learners. This poster presents exploratory work that examines a different peer mechanism: social influence through online forum interactions where *a change* of learner attributes is associated with the attributes of peers they interacted with online. To examine if the change of learner performance is associated with the performance of the peers they interact with in online forum, we examined temporal development of forum interactions at the university-level collected during 2013-2016. The submission reports on preliminary results. The associations found in our analyses should be interpreted with caution as the mechanisms of selection and influence in blended and online environments are unlikely to be fully equivalent to those observed in traditional social networks.

**Keywords:** peer effects, digital networks, online forum, stochastic actor-oriented models

## 1 PROBLEM FORMULATION

One of the central claims in the economics of higher education is that peer exposure has potential to affect academic choices and educational attainment (Winston and Zimmerman, 2004). Peer effects are considered to exist when a person's behavior is affected due to the presence of peers with particular characteristics (ibid., p. 396). For instance, adding more female learners into peer groups can lead to the increase in scores in reading and math; whereas high school students from underprivileged groups that are exposed to low achieving cohorts, score lower themselves (Hoxby, 2000). Studies reviewing evidence of peer effects on scores reported them as modest-sized and statistically significant (Sacerdote, 2011). This suggests that interpersonal relationships developed during learner trajectories contribute to the learning outcomes.

Traditional peer effects research considers social friendship or direct face-to-face classroom and high-school interactions as a foundation of peer-to-peer relationships. These relationships are usually inferred from learner-reported data of peer networks. Only a handful of studies leveraged learning analytics approaches to explore if technology-mediated interactions may capture peer effects on one's attainment and learning. For example, learning analytics research using co-enrolment records (e.g. Gasevic, Zouq, and Janzen, 2013; Gardner, Brooks, Li, 2018) suggests that in both fully online and residential programs student performance can be, to some extent, predicted, using information about their course peers.

Research using peer interactions collected from online forums similarly suggests the relevance of peer attributes and patterns of communication to student learning. Learning analytics research on online forum interactions has shown that high performing students often interact with high performing students. An example is a study of online interactions by Huang & Chen (2018) who found that higher-prestige students formed a dense ‘rich club’ less likely to interact with a lower-prestige group. However, the mechanisms behind this pattern remain unclear. A pattern of a high achiever interacting with a high achiever can result from two distinct mechanisms: 1) social selection or homophily, where high achievers choose to interact with high achievers; 2) social influence or peer effects, where high performers may have influenced lower-achieving students who over time improved their performance. Temporal analyses show that often online forums garner social selection processes (Huang and Chen, 2018; Vaquero & Cebrian, 2013). Yet, to what extent they also contain the presence of peer effects, i.e. social influence processes, has not been explicitly addressed.

## 2 RESEARCH QUESTION

To explore if both social selection and social influence processes may be observed through digital forum interactions, this study inquired:

*To what extent longitudinal networks of online forums interactions result from peer selection based on performance, and to what extent from peer influence?*

This research question did not assume that learners impacted other learners’ grades, but rather that the association of changes in performance with previously occurred peer interactions could serve as evidence of the presence of peer effects. We assume that the specific mechanisms for social selection and influence are unobserved in our model, given that we only leveraged student log data to construct networks and their average grades at the semester level.

## 3 METHODS

Using forum interactions in an in-house online platform of a large XXX university, we constructed four networks representing online interactions from September 2013-February 2016, of the cohort that started in 2012. Student grades were averaged across each semester representative of the time slice. Average grades in the previous semester were used to predict interactions between peers in the subsequent semester; forum interactions in the previous semester were used to predict grades in the subsequent semester. To this end, stochastic actor-oriented models (SAOMs) were used (Snijders, 2011). SAOMs require a threshold of stability across data observations in time slices, which appears to be a challenge in the temporal forum interaction data. We have obtained the sufficient data overlap by modelling networks of students who had interactions across at least two semesters. Final model included interactions between 230 students, whereas their intermittent interactions with other students were added to the model as controls for the effect of less frequent digital encounters.

## 4 RESULTS

Convergence of the final model was 0.23, goodness of fit was acceptable. The model supports the growth of ties ( $\beta=5$ ,  $SE=0.1$ ,  $p<0.001$ ) and reciprocity ( $\beta=3$ ,  $SE=0.1$ ,  $p<0.001$ ) in the digital

interactions, as well as controls for tie formation propensity by both performers whose grade was in the lower 25% bracket ( $\beta=0.6$ ,  $SE=0.1$ ,  $p<0.001$ ) and performers whose performance was in the highest 25% bracket ( $\beta=0.2$ ,  $SE=0.1$ ,  $p>0.05$ ).

According to the results of this work-in-progress study, social selection processes were not statistically significant across the entire student population ( $\beta=0.07$ ,  $SE=0.69$ ). This differed for the performers whose grade was in the top 25% of the university ( $\beta=0.57$ ,  $SE=0.1$ ,  $p<0.001$ ). Specifically, these high achievers tended over time to form clusters within online interaction.

The model shows that overall student performance as observed through the networks have improved ( $\beta=1.23$ ,  $SE=0.57$ ,  $p<0.05$ ), in particular that was true for learners whose performance was in the higher brackets to start out with ( $\beta=1.57$ ,  $SE=0.6$ ,  $p<0.05$ ). In relation to peer effects, we observed a strong significant effect of performance assimilation ( $\beta=33.6$ ,  $SE=3.7$ ,  $p<0.001$ ). The model supported the tendency of learners' grades to assimilate with the grades of those they interacted with during their university study.

The findings describe online interactions that were sustained between two learners for at least two semesters. Yet, we are cautious to interpret the mechanisms for the observed effects. Our replication of the model in another context suggests that the patterns may be contingent on the country and university cultures. The poster will present the results of the final model, specify the directionality of peer effects, and discuss study's limitations.

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