Virtual Teams in Massive Open Online Courses

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Abstract. Previous work on MOOCs highlights both that the current MOOCs fail to provide the kind of social environment that is desired and that social interaction and exchange of support is important for slowing down attrition over time. However, little is known about how to support virtual teams in a MOOC context. In this paper, we demonstrate what factors distinguish successful and nonsuccessful virtual teams in NovoEd MOOCs, where team collaboration is an integral part of the course design. In particular, we find team leaders play a central role in determining team performance. We discuss implications for continued work towards intelligent support for team leaders in MOOCs.

Keywords: MOOC · Team based learning · Leadership behaviors

1 Introduction

Learning is a social act. Research suggests that Massive Open Online Course (MOOC) students prefer to study in groups, and that social facilitation within the study groups may render the learning of difficult concepts a pleasing experience[6]. Yet for most students, their experience with a MOOC is watching videos and taking quizzes. Around ten percent of the students participate in the discussion. This experience is more interactive than reading a textbook, but far less engaging than working with one's peers to create a shared understanding of knowledge.

NovoEd[1] began as a solution to promote social learning in a MOOC context. NovoEd's technology encourages active and peer learning through team based exercises, calibrated peer evaluation and feedback and visible student work[4]. The team-based MOOCs in NovoEd report a higher completion rate than traditional MOOCs[2]. Nevertheless, not all teams are successful. In our NovoEd MOOCs, more than half of the teams fail to submit the final team project. Prior work in CSCL also highlights the fact that vitual teams require support to function smoothly[7].

Despite the substantial amount of research on groups, there is comparatively less consistent evidence for which group processes promote good group

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[1] https://novoed.com/
[2] https://gigaom.com/2013/04/15/novoed-another-stanford-mooc-startup-opens-small-group-learning-services-to-public/

outcomes[3]. To support team based learning in MOOCs, we first identify the critical group activities and processes that distinguish successful and nonsuccessful teams. We find that the leader's behaviors are more predictive of team performance than activity count of a whole team. This study is an important step toward assessing the feasibility of using unobtrusive behavior as indicators of performance among real-world project teams.

2   NovoEd Virtual Teams

Our NovoEd dataset consists of two NovoEd MOOCs: elementary and secondary Constructive Classroom Conversations. They were offered simultaneously in 2014. The statistics are shown in Table 1.

Table 1. Statistics of two NovoEd MOOCs

NovoEd	#Registerd Students	#Students successfully joined a group	# Teams	# Course Weeks
Elementary	2,817	262	101	12
Secondary	1,924	161	76	12

2.1   The Nature of NovoEd Teams

Students in a NovoEd MOOC have to create or join a team in the beginning of the course. The student who creates the team will be the team leader. The homepage of a NovoEd team displays the stream of blog posts, events, files and other content shared with the group as well as the active members. Students can also communicate through private messages. The leader can select classmates based on their profiles and send them invitation messages to join the team. The invitation message contains a link to join the group. Subsequently, new members may request to join and receive approval from the team leader. Only a team leader can add a member to the team. Also, groups can only be deleted by its team leader.

Throughout the course, team work is a central part of the learning experience. In our two NovoEd courses, small tasks ("Housekeeping tasks") such as "introduce yourself to the team" are assigned(but will not be graded) early on in the course. Instructors encourage students to collaborate with team members on non-collaborative assignments as well. Individual performance in a group is peer rated so as to encourage participation and contribution. Collaborations among students are centered on the final team project, which accounts for 20% of the final score. The team project is to design a lesson plan collaboratively.

2.2   Latent Variable Modeling

In our NovoEd courses, slightly less than half of the teams successfully submit the final team project, but even within that set there is interesting variation on

success according to the teacher assigned grade. Teams who failed to turn in the project received a 0, whereas the others received either 20 or 40. We refer to this score as the **Team Score**.

In order to understand the relative importance of factors contributing to Team Score as a success measure, we constructed a structural equation model. We included two latent factors we referred to as Team Activity and Leadership Behaviors that we hypothesize are predictive of team performance.

Team Activity. In this section, we describe the variables that account for variation in level of activity across teams. **MemberCnt** is the number of members in the team. Group size is an important predictor of virtual group success[5]. **Delete** is 1 if the team leader deleted the team. **BlogCnt** is the number of team blogs that are posted. **BlogCommentCnt** is the number of team blog comments that are made. **MessageCnt** is the number of messages that are sent among the team.

Leadership Behaviors. Leaders are important for the smooth functioning of teams but their effect on team performance is less well understood[2]. We identified three types of leadership behaviors by examining the messages sent by team leaders to the team members. Definitions and example messages are shown in Table 2. 30 team leader messages are randomly sampled and then coded separately by two experts. Inter-rater reliability was Kappa = .76, indicating substantial inter-rater reliability. Then one of the experts coded all the 855 leader messages in the two NovoEd MOOCs into these three types of leadership behaviors.

Thus we design three variables to characterize team leader's behaviors. **Team Building** is the number of Team Building messages sent by the team leader. Team Building behavior is critical for NovoEd teams since only the team leader can add new members to the team. **Initiating Structure** is the number of Initiating Structure messages sent by the team leader. Initiating Structure includes typical task-oriented leadership behaviors. Previous research has demonstrated that in comparison to relation-oriented or passive leader behavior, task-oriented leader behavior is more predictive of task performance[1]. In MOOC virtual teams, usually the team leader needs to break the ice by introducing him/herself and kicking off social conversation when the team is initially formed. When an assignment deadline is coming up, the team leader needs to remind the team

Table 2. Three different types of leadership behavior of virtual team leaders

| Type	Behaviors	Example Team Leader Message
Team Building	Invite or accept users to join the group	*Lauren, We would love to have you. Jill and I are both ESL specialists in Boston.*
Initiating Structure	Initiate a task or assign subtask to a team member	*Housekeeping Task #3 is optional but below are the questions I can summarize and submit for our team.*
Collaboration	Collaborate with teammates	*I figured out how to use the Google Docs. Let's use it to share our lesson plans.*
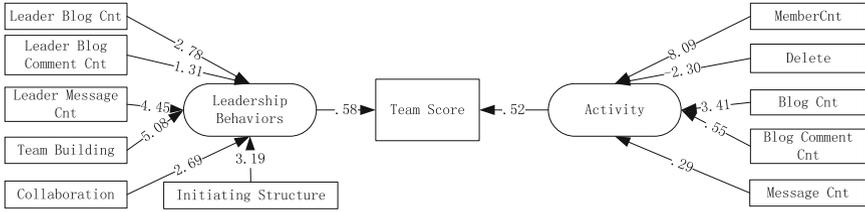
Fig. 1. Structural equation model with maximum likelihood estimates (standardized). All links represent significant relationships at the $p<0.001$ level.

members to start working towards meeting that. We refer to these initiation behaviors as Initiating Structure. **Collaboration** is the number of Collaboration messages sent by the team leader. Different from previous research where the team leader mainly focuses on managing the team, we observe the leaders in these virtual teams taking on important subtasks in the team project, which is reflected in this Collaboration behavior.

Results. Above we described two latent factors we hypothesize are important in distinguishing successful and unsuccessful teams along with sets of associated observed variables. In this section, we validate the influence of each latent factor on team performance using a generalized Structural Equation Model(SEM) in Stata. Experiments are conducted on all the 177 NovoEd MOOC teams.

Fig. 1 shows the influence of each observed variable on its corresponding latent variable, and in turn the latent variable on team performance. The weights on each directed edge represent the standard estimated parameter for measuring the influence. Based on Fig. 1, Leadership Behaviors contribute more to team performance, with a standard estimated parameter of 0.58. Among the three leadership behaviors, Team Building is the strongest predictor of team performance. Since team building messages significantly correlate with the total number of members in the team(r = 0.62), consistent with prior work[5], a team leader who recruits a larger group can increase the group's chances of success. We see also that the three leadership behaviors are more predictable than the crude activity counts, such as leader's team blog count. Team Activity is a less strong predictor of team performance. This is partly due to the fact that some successful teams communicate through Skype or Google Hangout and thus have smaller levels of activity in the NovoEd site, which renders that measure noisy.

3   Discussion and Future Work

Design of intelligent support for virtual teams in MOOCs could benefit from greater understanding of the reasons why some groups work well together while others do not. In our analysis, we identified two main factors that are predictive of virtual team performance: Team Activity and Leadership Behaviors. In particular, the team leader plays a critical role in distingiushing successful and

nonsuccessful teams. In future work, we will work on building awareness tools to support team leader performance through guided reflection using predicative models with the identified factors.

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