

Combining peer-assistance and peer-assessment in a synchronous collaborative learning activity

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Abstract. One unique characteristic of learning systems that support peer collaboration is that these systems have the potential to supplement or replace software-based representations of domain- and learner-models with the representations implicitly formed by peers. In order to realize this potential, a collaborative activity must sufficiently motivate peers to reflect, collect, and communicate these mental models. Peer-assessment represents a class of activities that address this challenge by design. In this work, we describe a project, currently under development, in which peer-assessment is melded with peer-instruction to create a new learning activity for an existing collaborative learning platform. We present the rationale behind the design of the activity, focusing specifically on how it draws from and synthesizes the three modes of learning supported by the Grockit platform: adaptive individual study, live collaborative small-group study, and instructor-led skill-focused lessons. By treating teaching as a demonstration of learning, we illustrate how a single activity can peer-assess mastery and peer-assist learning.

Keywords: collaboration, peer-tutoring, peer-review

1 Introduction

Part of the appeal of incorporating collaboration into an intelligent tutoring system is that collaboration introduces the available network of learners as a new resource to draw upon when designing and implementing the modeling and instruction processes. In letting students work together, these systems enable peers to serve as a new source of explanations, hints, and answers to unresolved questions and misunderstandings, which supplements the domain-specific intelligence built into the system with the natural intelligence of a student's cohort of peers. Additionally, the ability to interact with others introduces a social component into the learning experience that serves as a motivation for student engagement and retention [3]. However, just because students in these learning environments *can* engage in productive dialogue with their peers doesn't necessarily mean that they *will*. This poses a question to those who design collaborative learning systems, representing both a challenge and an opportunity: How can we affect the nature of student interactions by means of the design of the system itself? A variety of approaches have been pursued to create productive student collaborations, include (a.) leveraging game mechanics as a motivational structure to encourage specific types of

engagement and interaction [1,2], (b.) determining appropriate opportunities during the course of a peer study session to prompt students (or some subset of them) with suggestions of a particular question to raise or topic to discuss [6], and (c.), defining specific roles, responsibilities, or scripts for each student to follow when participating [4].

In this work, we introduce a project that is currently in-development at Grockit, in which a new collaborative activity that combines peer-to-peer assessment and peer-to-peer instruction, which is embedded within Grockit's existing platform for synchronous collaborative learning. In this activity, a student can elect to reinforce knowledge and demonstrate mastery of a skill by leading a group of their peers through a sequence of challenges, taking on the role of a *peer-tutor* rather than simply a *peer*. This is tentatively called a *TeachIt* activity ("TeachIt to Grockit"). The outcome of the assessment is determined based on a combination of peer-evaluation, self-evaluation, and a quantitative metrics collected automatically by the ITS during the session. Heffernan and colleagues have built and studied tutoring systems that both assist and assess [5]. In this work, we seek to examine that combination in a collaborative context. In combining peer-assessment with peer-instruction, we believe that a system may be able to enhance learning through more productive collaborations and enable students to demonstrate – and be recognized by their peers for – mastery of specific skills in the domain.

2 Context: Grockit

As the TeachIt activity is situated within an established collaborative learning environment, a brief overview of the Grockit environment can both motivate and ground the design of the activity. Grockit (<http://grockit.com>) offers a web-based collaborative learning platform through which students can learn primarily through working practice problems, engaging in synchronous interactions with peers and with instructors, and by reading and asynchronously discussing expert-authored explanations. While the platform is currently being piloted in several school districts, most students use the system on their own time, such as high-school students continuing to study over the summer months or post-college students studying for graduate school entrance exams. For these students, Grockit offers a venue for studying with other students who share a common learning goal, which otherwise may not be feasible.

Three distinct modes of study are supported: (a.) individual practice, (b.) small peer-group study, and (c.) instructor-led lessons. The algorithms and affordances used in these three modes draw on three corresponding areas of research: (a.) Individual practice draws on work in the Intelligent Tutoring Systems field, including techniques for adaptively choosing challenges based on statistical models of response likelihood. (b.) Peer-group study draws on work on communicative activities in Computer-Supported Collaborative Learning, such as techniques for discussion scripting and group formation [4], and (c.) Instructor-led lessons draw on collaboration tools common in the E-Learning field, such as shared slides, whiteboards, real-time document editing, and audio streaming.

Each of these modes of study offers a different combination of benefits and drawbacks. Solo study offers the ability to target a study session to the specific needs of the individual student, but lacks the motivational effect of a social experience. Group study

offers a scalable approach to creating an environment where students can raise questions and get immediate answers from others, but the quality of these collaborations may vary. Instructor-led lessons offers a structured environment in which one person leads the session, encourages discussion, and offers explanations and examples as needed, but a limited pool of instructors makes lessons difficult to coordinate and to scale. One of the goals for the TeachIt was to create a single activity that could draw on and combine these various benefits while avoiding or alleviating the associated drawbacks.

3 Concept: TeachIt

The TeachIt is a group session initiated and led by one student, as a way for that student to demonstrate their mastery of a particular skill in the learning domain. Domains focused on declarative knowledge and those focused on procedural knowledge seem to both be equally-suited for the activity. That student begins by selecting a skill for the TeachIt, among a list of options that may be limited based on some criteria (e.g. only skills that they have answered ten or more questions correct, only skills that they haven't already demonstrated mastery in, etc). The student can opt to begin the session immediately or schedule it for some time in the future (allowing others to plan to attend). When other students see the TeachIt in the list of joinable sessions, the special nature of the activity is communicated: Within the TeachIt, there will be one student responsible for leading discussion, answering questions raised by others, and explaining how to solve each problem. The session will not have the standard per-question timer (to allow for longer discussion). The TeachIt includes a fixed number of questions, all of which involve the specified skill. Finally, the student will be asked to complete a short peer-evaluation form following the conclusion of the session. For the student leading the TeachIt, expectations are also conveyed: their role in the session is explained, and they are told about the self- and peer-evaluations that will follow the session, which focus primarily on their ability to explain how to solve the problems as a demonstration of their own understanding, and their ability to address questions posed by their peers.

Following the conclusion of the activity, students complete brief evaluations based on a simple rubric. Free-text responses about the student's session are also elicited, and these are shared both with the student and with the community at-large. One possible direction to pursue with the design of the activity, currently under consideration, would be to make the record of each TeachIt publicly-accessible afterwards, effectively adding it to the student's public profile or participation portfolio.¹ Finally, quantitative data collected by the system itself may be taken into account, such as the number and difficulty of questions that the student answered correctly. The primary factor for determining the student's success will be the scores from the peer- and self-evaluation rubrics.

Classifying the TeachIt activity – with respect to the individual practice, small-group study, and instruct-led lessons – is not straightforward: The student leading the session chooses the specific topic for assessment/instruction, so the choice is based on that student's individual study needs at the time (a benefit generally associated with solo study). At the same time, the presence of other students in the session make it a social

¹ Doing so may motivate students to treat the assessment more seriously, or it may instead dissuade students from participating in the first place.

activity (a benefit generally associated with small-group study). For the other participating students, the TeachIt offers structured leadership approximating an instructor-led lesson, but without the scheduling restrictions inherent with a limited pool of available instructors. The TeachIt format illustrates how a collaborative activity can cross the boundaries of traditional modes of study, resulting in an experience in which peers play an active role in both teaching and testing one another.

The TeachIt format was the result of one set of responses to a set of high-level questions regarding how Grockit might assess mastery, such as: *Is assessment done by instructors or by peers? One-on-one or in group settings? Who initiates assessment? What are the evaluation criteria?* In using teaching as a demonstration of learning and in simultaneously making peer groups responsible for performing the assessment, we arrive at the design of a new activity that joins peer-assistance with peer-assessment in the context of an existing network of synchronous collaborative learning.

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