DALITE: Asynchronous Peer Instruction for MOOCs

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Abstract. This demonstration will feature the Distributed Active Learning Integrated Technology Environment (DALITE), a novel LTI compliant application which allows Learning Management Systems to include an asynchronous peer instruction component as a part of their course. It has been successfully used in three different MOOCs on the edX platform (Harvardx,MITx,McGillx). This tool not only enables a novel type of formative assessment based on student self-explanations, but also provides a rich source of peer-assessed natural language data for educational research.

Keywords: Peer Instruction, Massive Open Online Classrooms

1 Introduction

One of the most widely accepted active learning pedagogical strategies is Peer Instruction (PI)[10]. The typical script followed by a teacher using PI:

1. teacher displays a multiple choice question item to their class, asking students to individually indicate their answer choice for what they think is the answer. This can be done using flash cards, signalling with fingers, or with wireless clickers. The intention is to give all students, no matter how introverted or confused, an opportunity to elicit their prior knowledge, anonymously
2. once all answer choices have been tallied, the teacher asks students to discuss with their neighbouring peers, and encourages them to convince one another of their own answer choice.
3. after this discussion, teachers prompt students to once again, individually, indicate their answer choice (which may now be different than before).

Typically, there is a major shift in the distribution towards the correct answer choice due to the student discussions. The benefits of this as a classroom practice, especially in comparison to conventional, lecture-style content delivery, has been documented in different contexts([5],[6],[9],[8]). It is with this success in mind, that our team of physics teachers and education researchers, working at colleges in Montreal, Canada, set out to develop a homework tool that would be centred on the same foundations of self-explanation, and intentional reflection surrounding a compare-and-contrast exercise. With the aim of delivering PI *asynchronously*, after several iterations([3][4]) of Design Based Research[1], we present the most recent implementation of the Distributed Active Learning Integrated Technology Environment (DALITE).

2 DALITE

Students log into DALITE, and work on an assignment which typically contains four to six multiple choice questions. For each question, there are three screens they must flip through, each with the following structure:

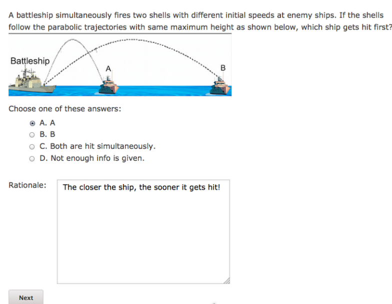

Fig. 1. DALITE: Asynchronous Peer Instruction, part 1

1. As in figure 1 above, the question is displayed, and the student selects one of the multiple choice answers. They are then prompted to write a couple of sentences that explain why they selected their answer choice. These little paragraphs will from now on be referred to as "rationales".

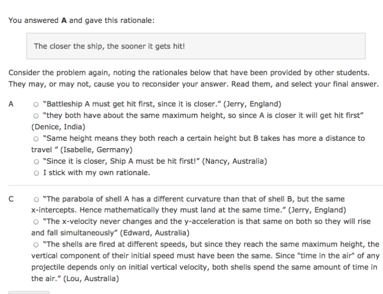

Fig. 2. DALITE: Asynchronous Peer Instruction, part 2

2. Once a rationale is given, the system presents two sections of text: one for their answer choice, and one for another choice to the question (figure 2). Each section contains four rationales, written by previous students. The goal is to give students a chance to reflect on their thinking by providing them with an opportunity to compare and contrast other rationales, and maybe change their mind. The student is prompted to read the rationales from the two sections, and decide whether they would like to keep their answer choice, or switch. What's more, the student is asked to vote on one rationale out of the ones displayed, that they best like (They always have the option "I stick with my rationale").
3. The third screen recaps everything that just happened: the question is shown, alongside their two answer choices (one from each of the previous two screens). What's more, the rationale they originally wrote is reflected back to them, right next to a rationale they chose during the second step.

The "attributions" associated with each rationale, are randomly generated from a database of fake names and places, keeping any given student's rationales anonymity among peers (This "attribution" feature can be turned off). Also, DALITE has a "sequential" mode for step 2, where instead of presenting all the rationales for evaluation at once to the student, each one is presented one-at-a-time, for an individual "thumbs up/thumbs down".

3 Scalable Asynchronous PI

In previous studies, we have shown that

- DALITE is as effective as in-class Peer Instruction for Quebec college level physics courses[4] (in terms of gain on the Force Concept Inventory[7])
- students appreciate the usefulness of the platform for formative assessment
- teachers are able easily integrate DALITE into "flipped-classroom" pedagogy
- weak students and strong students alike write rationales in DALITE that earn the votes of their peers [2]
- the tool provides a novel source of data for the Educational Data Mining, Learning Analytics, and Natural Language Processing research communities. Since students are constantly "up-/down-voting" their peers' rationales, there is a bootstrapping effect for the social annotation of constructed response data.

DALITE is now an open-source, Django-based web application, written to be compliant with the IMS Global Learning Consortium's *Learning Tools Interoperability (LTI)* standard, so that most major Learning Management Systems (LMS) can implement *asynchronous* PI, as an external resource (For those teachers who do not want to commit to any LMS, the tool will also be available as a standalone web application beginning in the fall of 2016). Over the past year, DALITE has been used on the edX platform as part of three different MOOCs (*Justice* from Harvardx, *Advanced Classical Mechanics* from MITx, and *Intro* *to Body* from McGillx). It is interesting to note that the design of DALITE was originally motivated by a pedagogical goal of physics teachers, which was to reveal misconceptions about scientific concepts. However the tool is being successfully used in contexts where there isn't necessarily a correct answer, as there is in sicence. In both *Justice* and *Intro to Body*, DALITE was used to elicit student opinions on ethical and scientific issues. The "up-voting" process allows instructors and students to easily determine which rationales are seen as most convincing by the participants of the course.

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