Using Temporal Analytics to Track Idea Growth and Obsolescence in a Knowledge Community and Inquiry Approach to Elementary Astronomy

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ABSTRACT
In this paper, we propose a possible application for the use of temporal analytics in an elementary science classroom that has adopted a Knowledge Community and Inquiry approach to a 9-week curriculum unit on astronomy. We describe a multi-phase curricular script that includes activities conducted using an online note-writing platform called "Common Knowledge." In highlighting the transient nature of students' notes as they progress from one phase of inquiry to the next, we suggest that temporal analytic tools would be beneficial in tracing the uptake and/or obsolescence of students' ideas within a knowledge community. Design considerations related to the granularity of student interactions in a knowledge community (e.g. individuals, small groups, whole class) are also presented.

Keywords
Learning analytics; Knowledge Community and Inquiry; collective inquiry; science education; elementary education

1. PROPOSED ROLE OF PARTICIPATION
The proposed application is submitted to fulfil the role of a *practitioner presenter*.

2. PROPOSED CONTRIBUTION
In addition to the first author's experiences as a science educator, each of the authors have nurtured longstanding relationships with classroom teachers throughout their research, engaging practitioners as active participants and professional contributors to interdisciplinary co-design teams. Consequently, the ideas put forth in this proposal advocate for analytic tools that represent the needs of classroom teachers and can be readily incorporated as part of their instructional practices.

In adopting the role of practitioner presenters, the authors will contribute data from a classroom enactment of a grade 5/6 inquiry unit on astronomy with the aim of investigating how temporal analytic approaches might be used as a potential feedback mechanism to represent idea growth and/or obsolescence within a multi-phase curricular script for collective inquiry.

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3. TEMPORAL ANALYTIC STANCE

3.1 Educational Context
We conducted a 9-week curriculum intervention in two grade 5/6 classrooms (n=46) at a local elementary school. Students investigated topics related to astronomy using a collective inquiry model called *Knowledge Community and Inquiry* (KCI) [1, 2]. This recent KCI research has sought to move beyond the realm of computer-based learning environments by leveraging advances in ubiquitous computing, situated within physical classroom spaces, to support new forms of collaborative interaction. For example, large displays, often ambient in function (i.e., passively present "in case" participants can make use of them), serve to reflect the state of progress within the community, including emergent themes, patterns or gaps in knowledge that remain to be addressed. These tools and materials complement the pedagogical aspects of the curriculum, providing a source of productive feedback and support to students and teachers as they engage in collective inquiry.

3.2 Sources of Data
Throughout the enactment of this 9-week curricular unit, students from both classes used tablet computers to contribute text-based notes using a platform called *Common Knowledge* (CK) [3]. In addition to the note content, title, and timestamp, this dataset also includes a series of semantic tags that students applied to each other's notes, as well as build-on notes that were optionally added by other students.

3.3 Conceptualization of Temporality
The enactment of this curriculum took place over three distinct phases [4]. During the first phase–the "Brainstorm Phase"–students drew upon their existing knowledge to brainstorm ideas related to the overarching inquiry topic (i.e. astronomy), contributing notes to a shared CK knowledge base. These notes were aggregated on a communal display at the front of the classroom, and were also accessible on individual student tablets. Students subsequently tagged these brainstorm notes using a series of socially-negotiated tags. These tags gave rise to four emergent themes, representing the "voice" or interests of the knowledge community [1]. Using these four themes, students then formed small groups around a particular topic of interest, and then proceeded to the "Proposal Phase." During the Proposal Phase, students created a new kind of note (i.e. a proposal note)

which responded to the brainstorm content and proposed a more focused area of investigation. Students then voted on each other's proposals, identifying investigations that sounded worthwhile to pursue. The final phase of the inquiry script was the "Investigation Phase," in which students conducted focused investigations on their proposed topic. The artifacts generated throughout the focused investigations were posted to a shared display for the group (i.e. there were four group-level displays in total, situated around the classroom). Students then engaged in a "knowledge walk" in which they visited each of the other groups' shared displays, engaging in knowledge exchange with their peers and making explicit connections to their own work.

Of particular relevance to this workshop is the ephemeral nature of the brainstorm notes. That is, once the Proposal Phase had begun, students' brainstorm notes were no longer made visible or accessible to the whole knowledge community on the shared displays. However, if a brainstorm note had been tagged with one of the four themes, the small groups of students working on that particular theme could still access a read-only version of those notes on their tablets. During the Investigations phase, the brainstorm notes were no longer visible on either the common display or the tablets.

The intention behind this design feature was to remove excess clutter from the learning environment. However, an important temporal aspect of this design concerns the ways that the ideas contained in the brainstorm notes were carried forward through time from one phase to the next. Exploring and understanding the patterns by which ideas grew or were rendered obsolete as students progressed through each inquiry phase is something that would serve to inform both practitioners and researchers in future iterations of KCI curricula.

3.4 Granularity of Analysis

The efforts of a knowledge community require analyses that consider individual (I), small group (G) and whole class (C) contributions. Therefore, of importance to this work is the notion of *orchestrational planes* [5], which refers to the ideas and activities that are contributed at each IGC level.

In the inquiry script described in the preceding section, brainstorm notes were submitted by individual students (I), but were then aggregated into four distinct categories using tags that were generated and negotiated by the whole class (C). During the Proposal Phase, ideas from the brainstorm notes were worked on by small groups (G), but were then voted upon by the whole class (C). Because information generated from each orchestrational plane influences the activities, materials, and interactions that occur in another, it will be important to consider the design of analytic supports that facilitate these transitions.

4. ACKNOWLEDGMENTS

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