Developing Effective Visualizations to Understand and Scaffold Collaborative Textual Practices

ABSTRACT: This **poster** will describe and compare different visualizations for collaborative writing using cloud-based platforms (e.g., Google Docs). The aim is to develop effective visualizations for a Learning Analytics Dashboard (LAD) to understand the processes undergirding cloud-based group writing and to support team textual practices. Theoretically situated in the literatures on Collaborative Learning Analytics, collaborative sense making, and social annotations, the visualizations will provide valuable and varied insights to researchers, educators, and students. We will be testing the visualizations and the final LAD with undergraduate students, instructors, and researchers from the fields of learning sciences and educational psychology.

Keywords: Cloud-based writing; collaborative learning analytics; Google docs; social annotation

1   CLOUD-BASED COLLABORATIVE TEXTUAL PRACTICES

Collaboration and communication are critical 21st century skills for the knowledge economy (Trilling & Fadel, 2012). Students must develop these competencies to be successful in teams. In today's information-rich world, these skills are also essential for collaborative sensemaking, wherein diverse people engage with complex information to develop a shared understanding (Ntuen et al., 2006). This understanding is often externalized into a textual product. Such collaborative textual practices are becoming increasingly widespread through adoption of cloud-based tools, such as Google Docs and other tools that allow commenting called *social annotation* (Zhu et al., 2020). However, there is a paucity of research on how students engage in group authoring and ways in which educators can support them in virtual environments in large part due to lack of synthesized data.

1.1   Collaborative Learning Analytics: Visualizations in LAD

Collaboration Learning Analytics (CLA) is an emerging subset of the larger field of learning analytics that is gaining popularity due to its capability to capture authentic experiences through data collection at scale (Piety et al., 2020). The data collected through the CLA can be synthesized and presented to stakeholders (researchers, educators, students) through Learning Analytics Dashboards (Verbert et al., 2013).

1.1.1   Objective
This poster describes and compares different visualizations that would be employed in a LAD to provide stakeholders with actionable insights on collaborative writing in virtual environments. The different types of visualizations under development will capture individual and team-level engagement and collaboration as students use cloud-based platforms in small groups. For this poster, we will be working with Google Docs and collecting data through its API.

2   METHOD

As part of a NSF project (Award #1915563), undergraduates will work in groups to co-author a document in Google Docs. During and after the writing assignment, students will be given feedback using visualizations in a dashboard. Instructors and an inter-disciplinary team of researchers will also have access to this data. The data on the edits, comments, and responses by each team will be extracted using the Google Docs API. This data will be converted into different visualizations targeting students, instructors, and researchers. Several visualization types will be tested. In a mixed method exploratory design the stakeholders will complete surveys and follow-up interviews about the effectiveness of the visualizations. We would also measure the impact the visualizations in terms of actions taken by students as a direct result of the visualizations.

3   UNPACKING COLLABORATIVE WRITING THROUGH VISUALIZATIONS

Examples of the visualizations under development are presented in Figure 1. The last two visualizations DocuViz and AuthorViz (Wang et al., 2015), do not convey information about comments and communication patterns, which is a critical parameter in cloud-based collaborative writing. Further, they are visually complex whereas the proposed visualizations (A to D) have been designed to be informative to the stakeholders.

Visualization A provides information on both the quantity and quality of comments/annotations. Targeted to educators and researchers, it can be used for formative feedback and understanding team engagement. Work progress depicted on the y-axis can be set based on the word limit of the assignment. Visualization B combines information about comments and edits over the week. Meant for students, educators, and researchers, it can help collaborators keep the team accountable and for educators to determine level of progress. For researchers it gives high-level information at a glance. Visualization C has been designed primarily for students and educators. It compares performance across teams and would update daily. Educators can use it to identify teams that need support to accelerate progress. Visualization D are network graphs depicting patterns of exchange between the collaborators. The networks can accommodate larger teams, and the data can be used to determine centrality measures, which would identify team dynamics, such as students who control the flow of information and those who are the most influential. This is targeted to researchers who study teams and communication flows.

4   SIGNIFICANCE AND FURTHER RESEARCH

The visualizations in the LAD described here will provide data-rich, actionable insights to support and improve group-authoring in cloud-based environments. Given the widespread and ever-increasing use of collaboration tools supporting textual production as learning and professional work move to remote settings, this is both timely and critical.

The testing of the LAD and feedback about its visualizations from stakeholders will result in the design of more effective versions in the future. In terms of additional visualization types, epistemic networks of comments and responses can be added to get qualitative insights on communication patterns.

Finally, the development of the visualizations for the LAD described here for Google Docs can be expanded to other collaborative cloud-based textual tools.
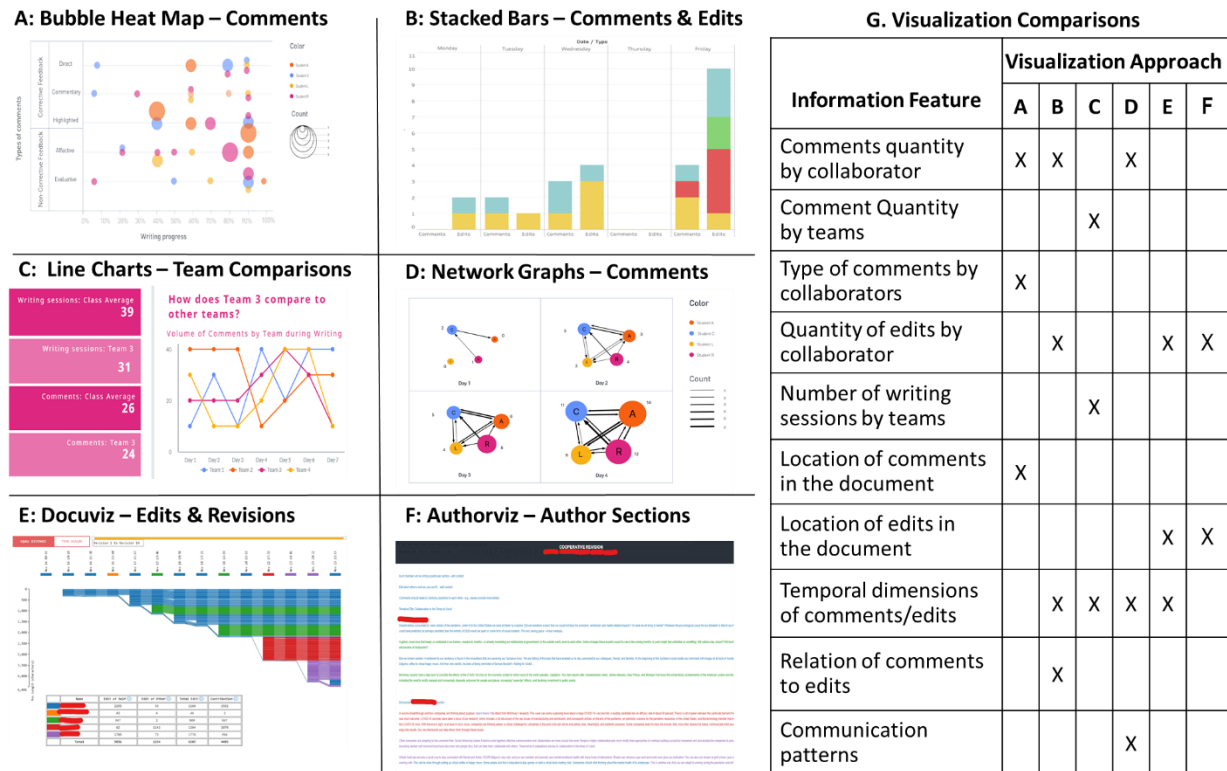

G. Visualization Comparisons

Information Feature	Visualization Approach					
	A	B	C	D	E	F
Comments quantity by collaborator	X	X		X		
Comment Quantity by teams			X			
Type of comments by collaborators	X					
Quantity of edits by collaborator		X			X	X
Number of writing sessions by teams			X			
Location of comments in the document	X					
Location of edits in the document					X	X
Temporal dimensions of comments/edits		X	X	X	X	
Relation of comments to edits		X				
Communication patterns				X		

Figure 1: Visualizations for understanding collaborative writing

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