Top Kapp: A Display above a Whiteboard to Support Inquiry-Based Active Learning

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Abstract

In some inquiry-based Active Learning classrooms students sit in small groups at bell-shaped tables facing a shared team whiteboard. Teachers can introduce a problem (minds-on), have students collaborate in small groups to solve a problem (action), and then synthesize learning as a class (consolidation/reflection). Small student groups may have limited knowledge of their overall inquiry progress and may be ill-equipped to decide on "next-steps" in their collaborative inquiry. Students looking away from the whiteboard to digital resources such as web pages can interrupt their cognitive flow of the small group. In addition, teachers face challenges in efficiently monitoring student activity due to poor of visibly of the collaborative work due to occlusion from students' bodies. Teacher can have difficulty in orchestrating the activities of many small groups. To address these challenges and to introduce new possibilities in Active Learning, we propose Top Kapp – a high and glanceable display that sits atop a whiteboard and dynamically displays immediately relevant information to teachers and students as determined by students' in-the-moment whiteboarding activity.

Author Keywords
Classroom orchestration; digital capture whiteboard; peripheral displays; computer-supported collaborative learning.

ACM Classification Keywords
H5.2 Information interfaces and presentation (e.g. HCI): User Interfaces – Graphical user interfaces.

Introduction

There is a growing pedagogical shift away from Sage on the Stage towards learner-centered education. Examples include the Flipped Classroom [7], Knowledge Building Communities [5], and Active Learning in Physics [3] where peer instruction and collaboration are used to engage students in the learning process. Although the literature has supported Active Learning [2, 3] our classroom observations and those of other researchers [2] have shown that technology-supported inquiry can introduce a number of challenges for both students and teachers.

Collaborative student-driven inquiry may ask students to not only direct the inquiry topic but also the inquiry methods. Such decisions on process should be informed by a clear understanding of their collective progress thus far. However, we observed that student groups can become so mired in their task at hand, that they have little awareness of the "big picture" of their group's emerging knowledge trends. A second observed challenge students face is that they often reference information (e.g. website) on their mobile devices to inform their current work. But to do this, students often have to shift their focus away from their shared whiteboard to a small digital display not visible to group members. We've observed that students attempt to overcome this obstacle by bringing the reference display closer to the shared whiteboard and then look back and forth between the two as they discuss and reconcile information.

For teachers, monitoring and coordination of collaborative classroom activity can increase their cognitive load compared to traditional instruction [1]. Monitoring the efforts of several small groups to provide continuous constructive feedback is a challenge because students' bodies occlude the teacher's line of sight to the content [2]. As a result, teachers only have awareness of the group they are currently interacting with, as they cannot see the work of other groups unless teachers physically visit a group. A second challenge teachers face is that the more groups there are, the more difficult it is to keep track of groupwork statuses such as which groups have requested help, or which have completed the activity and are waiting idly for the other groups to finish.

In this position paper, we present Top Kapp, a novel approach to address these challenges by providing appropriate visualizations and content to inform learners' collaborative process, and by increasing the glanceability of whiteboard-driven content, making it easier for teachers to monitor and coordinate an active learning classroom.

Background

Various tools have been developed in Computer-Supported Collaborative Learning (CSCL) to support collaborative learning in the digital classroom for both teachers and learners. Such tools have been developed for classrooms where the students' activities center on platforms such as multi-touch tabletops, tablets, online

activities, and virtual reality among others (see [6] for a systematic review). This position paper explores the use of a high and glanceable display above a group whiteboard that dynamically displays immediately relevant information as determined by learners' in-the-moment whiteboarding activity.

The Approach

Top Kapp is the idea of a high and glanceable display above a whiteboard that is able to interpret whiteboard scribbles in real-time to display information about the progress and status of the whiteboarding activity to students and teachers. When used with a digital capture whiteboard such as SMART Technologies' Kapp whiteboard[1], the Top Kapp display opens the door to new interactions, visualizations, and applications; to support collaborative learning. Thanks to the ability of such digital capture whiteboards to digitally process dry-erase ink strokes on a whiteboard in real-time, instant dynamic changes occur in the Top Kapp display as a direct result of the words and sketches inked onto the whiteboard. The Top Kapp prototype is comprised of a sheet of frosted acrylic with an Intel Wireless Display (WiDi) Laser Projector, mounted on top of a SMART Kapp whiteboard (see Figure 1). Choosing a transparent display was intentional because it provides teachers more flexible classroom configurations. For instance, teachers can place the whiteboards in such a way that the groups cannot see what the other groups are writing, but the Top Kapp display is still visible to the teacher for monitoring and coordinating the activity. We describe below how our approach addresses the aforementioned challenges teachers and students currently face in collaborative active learning classrooms.

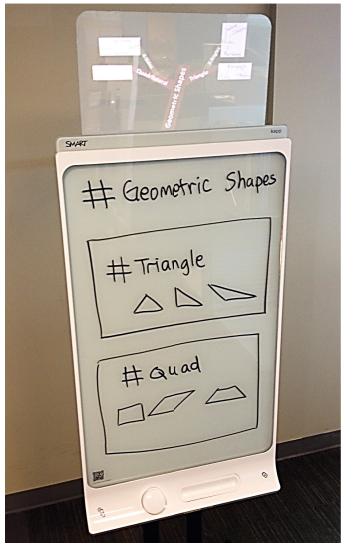

Figure 1. The Top Kapp Hardware Prototype

Visualizing Group Metacognition

The physical proximity of Top Kapp to the whiteboard can have a powerful affordance for the learners by showing an overview visualization of how the group's knowledge is growing over time and ultimately inform the group's decisions about their "next steps" in their collaborative inquiry (or problem solving) work. In other words, the Top Kapp display offers learners a secondary and high-level perspective of the task at hand, to inform their current work and future direction. A macro perspective visualization could show trending information such as emergent common themes, divergent themes, knowledge/data gaps, etc. Figure 2 shows a rudimentary visualization to illustrate how Top Kapp could inform the group whether they are currently

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in a phase of divergence, convergence, or making connections between ideas and concepts.

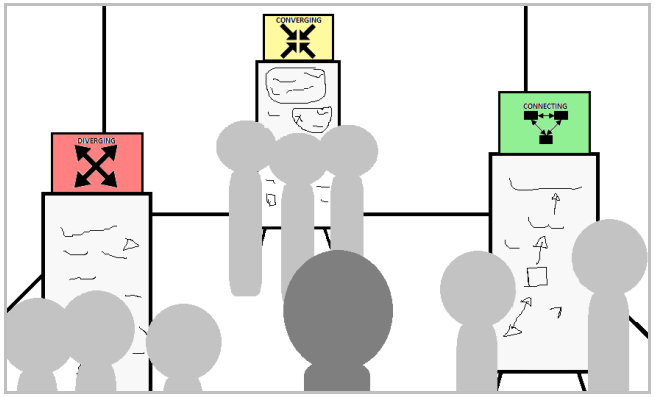

Figure 2. Top Kapp showing whether groups are diverging, converging, or making connections based on the activity at the whiteboard.

Supporting task flow

The physical proximity of Top Kapp to the whiteboard—the actual site of activity—also affords the learners easy switching to reference material to inform their immediate activity. As Figure 3 shows, students could be performing a web search or a Skype call with remote experts or group members to enrich their whiteboarding task. The proximity of the two displays is key as it minimizes cognitive disruptions to the state of flow [8].

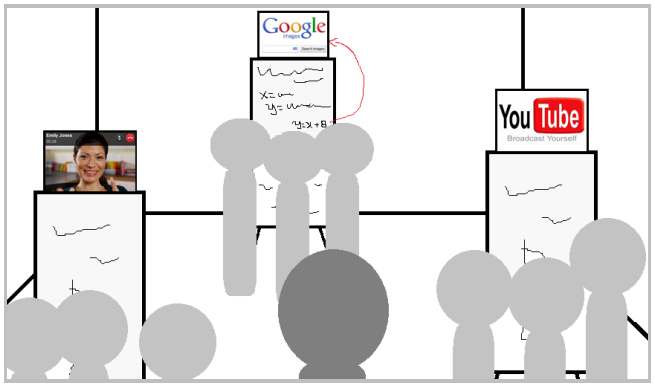

Figure 3. Examples of Top Kapp acting as a peripheral display to show secondary information.

Another monitoring challenge teachers face is maintaining awareness of how the groups arrived to the present point in their inquiry. There is a high cognitive workload required of teachers as they have to remember the state of the whiteboard the last time they visited the group to make sense of the current state, accounting for scribblings the students may have added, erased, or modified. Top Kapp can help the teacher remember and make sense of the whiteboard session by providing appropriate visualizations of the scribbles. For instance, the idea progression of a group brainstorm could be visualized in Top Kapp as a word cloud (see Figure 4, right whiteboard), a mind map, or a more sophisticated visualization. This way, ideas erased, or modified since the last time the teacher interacted with the group would be captured and visualized in Top Kapp to show the process of how students arrived at the current state of the whiteboard.

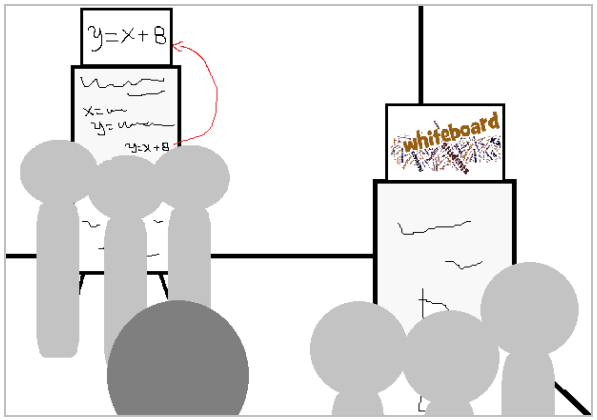

Figure 4. Two example applications of Top Kapp to help teachers monitor group work at the whiteboard.

Coordinating collaborative learning on whiteboards
Group work in collaborative Active Learning classrooms can be more difficult for teachers to coordinate than traditional classrooms, and these difficulties increase with the number student groupings. Such coordination activities include: assigning students to groups, assigning activities to groups, keeping track of groups that need assistance, and knowing which groups have completed an activity and which need more time.

Top Kapp can help teachers better coordinate whiteboard group work by displaying such information in a very salient way. For instance, Top Kapp can show group membership assignments on its high and glanceable display (Figure 5, right whiteboard). As the students find their group, they can write their name on the group's whiteboard, and Top Kapp would strikeout their name so that the teacher can quickly tell at-a-glance if all the groups are complete. Likewise, when a group has a question, or when they have completed the assigned task, instead of shouting out or raising their hand for an extended period of time, they could write #?, #help, or #done on the group's whiteboard which would trigger a status change in Top Kapp that is easily visible by the teacher from anywhere in the classroom (see Figure 5, left and middle whiteboard).

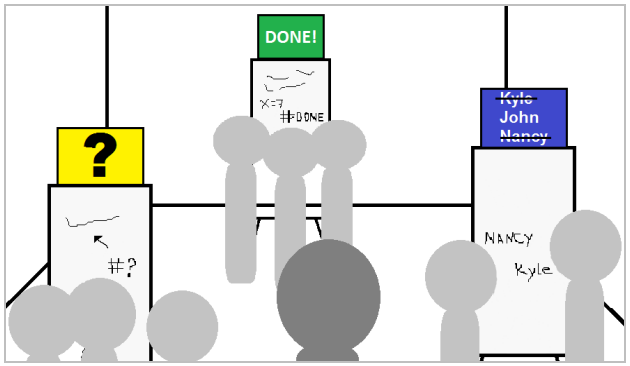

Figure 5. Three examples of how Top Kapp can help teachers coordinate several small groups.

Conclusion

We have described Top Kapp, a novel approach to collaborative active learning on whiteboards by addressing common challenges faced today by teachers and students. This work introduces new tools and design possibilities for those thinking about Architecting Collaborative Learning Places. As Active Learning a common practice there will be an increased expectation that educational technologies will more closely integrate with the mobile devices that students bring into the classroom. This position presents a vision for that integration, we look forward to our continued collaboration with this community.

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