

features, that projectiles accelerate in the downward direction only. All activity sheets that included answers to these questions were coded, 212 sheets. All coding was done blind to whole class or small group condition.

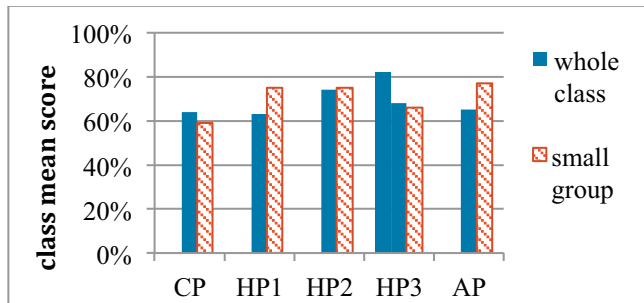


FIG 5. Class mean performance on four animation activity sheet questions as percentage of a perfect score.

Scores were very similar across all classes. Most students in both lesson formats exhibited considerable understanding about the meanings and implications of the visual features and visual relationships. There did not appear to be an advantage for students in the small group condition over those in the whole class condition (Fig. 5).

VII. DISCUSSION AND CONCLUSIONS

Although video analysis revealed considerable variation among groups, there was no evidence for an overall advantage for the small groups in this study. These findings complement those of Stephens and Clement [2], which also showed, in a somewhat different context, no evidence for an advantage for hands-on work with a visual tool over utilizing the tool in a whole class discussion format. There, too, the whole class discussions had many more visual support episodes than the small groups analyzed. While the earlier study involved a sophisticated highly interactive computer simulation, the present study investigated what would happen if we used a simpler tool that included fewer features and fewer moving elements on screen. The present study also included a third teacher and larger n .

A striking observation was the clustering of support codes around teacher visits to the small groups. For example, the code map of the discussion from Teacher B's HP3 small group class shows that in an 18-minute

discussion, almost all the analytical codes, including those for student-to-student support, occurred between minutes 9 - 13 when the teacher was present with the group (Fig. 6). This clustering was observed for both of the small group discussions we analyzed in which a teacher stopped by. (The other was Teacher A's CP small group.) On the other hand, such conceptual and perceptual support was generally observed throughout the whole class discussions.

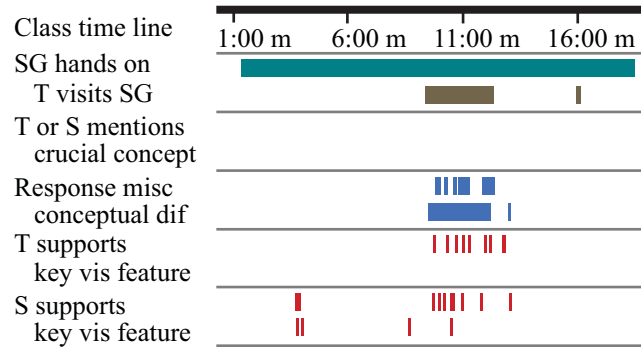


FIG 6. Codes clustered around teacher visit to small group.

These results suggest a hypothesis that could help explain the pre-post results: that there are complementary strengths and weaknesses in the two lesson formats. We believe that more research is needed to determine when and for whom each format might best be used. In addition to hands-on-controls experience with animations, we suggest that students, especially those who may need support for recognizing and interpreting the meaning of visual features, might benefit from at least some whole class discussion with the computer visuals. We observed teachers using a number of teaching strategies to accomplish this and have included those strategies on our website [10].

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