UNIVERSITY OF CALIFORNIA, SAN DIEGO

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Factors Influencing Middle School Students' Sense-Making Discussions in their Small-Group Investigations of Force and Motion

A dissertation submitted in partial satisfaction of the

requirements for the degree Doctor of Philosophy in

Mathematics and Science Education

by

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2001

The dissertation of Cody Sandifer is approved, and it is acceptable in quality and form for publication on microfilm:

Chair

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This thesis is dedicated to:

Shannon Davis, my lovely wife, who happily supported my efforts even though she was never quite convinced that I would ever graduate

and

Shea, my wonderful son, who was absolutely convinced that I would finish

my thesis, even though he wasn't quite sure what it was

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I would first like to acknowledge that this thesis is finally done, and that I will actually graduate from school. About time!

I would next like to acknowledge that this thesis is possibly not the most exciting thing that you have ever read. If this is the case, I might suggest something by Hunter Thompson, John Irving, Ken Kesey, Flannery O'Connor, or Doctor Seuss. I cannot recommend these authors highly enough.

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RESEARCH CONFERENCE PRESENTATIONS

Sandifer, C. (2000, August). Factors influencing middle school students' small-group scientific discussions in their investigations of force and motion. Paper presented at the annual meeting of the Physics Education Research (PER) conference, part of the summer meeting of the American Association of Physics Teachers, Guelph, Ontario.

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ABSTRACT OF THE DISSERTATION

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by

Cody Sandifer

Doctor of Philosophy in Mathematics and Science Education
University of California, San Diego and California State University, San Diego, 2001

Professor Fred Goldberg, Chair

In this study, I adopted a combined individual and sociocultural perspective on learning in order to investigate small-group discussions in an inquiry-based middle school science classroom.

The specific purpose of the study was to answer the following research questions: (a) How can we classify students' sense-making statements?, (b) To what extent do students engage in sense-making discussion (SMD)?, and (c) Which factors provide support for students' SMD? To answer these questions, two groups were videotaped during the Interactions and Motion unit from the Constructing Ideas in Physical Science middle school curriculum.

To classify students' sense-making statements, I developed a six-component framework for sense-making discussion. My six components of sense-making discussion are: predicting a phenomenon or experimental outcome; clarifying the facts of a phenomenon or experimental result; describing and explaining a phenomenon or experimental result; defining, describing, clarifying, and connecting scientific concepts, procedures, processes, and representations; testing knowledge compatibility; and making a request for any of the above.

The extent of students' sense-making discussions was established by (a) documenting instances of student sense-making according to the six-component scheme, and then forming distributions of sense-making instances, and (b) calculating the percentage of time that groups dedicated to sense-making discussion.

To determine the influence that various factors have on students' sense-making discussions, I first drew on the research in collaboration, discourse, and nonverbal sense-making to arrive at an initial list of personal, group, task, and contextual factors that would likely influence the SMD in this study. I then picked out significant quantitative differences in sense-making between groups, students, and different portions of the curriculum (cycles, sub-sections, etc.), and determined to what extent the initial list of factors contributed to the significant differences in SMD, and also to what extent any additional factors contributed to these differences.

My analysis showed that many of the factors from the initial list helped to explain the differences in sense-making. I also identified six other factors that contributed to these differences: capacity for intra-group guidance, intellectual capacity, time available for sense-making, external guidance, awareness of the curriculum structure, and an awareness and valuing of the curriculum goals.