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Student Use of Computer Tools Designed to Scaffold Scientific Problem Solving with  
Hypermedia Resources: A Case Study  
(Under the direction of MICHAEL J. HANNAFIN)

National science standards call for increasing student exposure to inquiry and real-world problem solving. Students can benefit from open-ended learning environments that stress the engagement of real problems and the development of thinking skills and processes. The Internet is an ideal resource for context-bound problems with its seemingly endless supply of resources. Problems may arise, however, since young students are cognitively ill-prepared to manage open-ended learning and may have difficulty processing hypermedia. Computer tools were used in a qualitative case study with 12 eighth graders to determine how such implements might support the process of solving open-ended problems. A preliminary study proposition suggested students would solve open-ended problems more appropriately if they used tools in a manner consistent with higher-order critical and creative thinking. Three research questions sought to identify: how students used tools, the nature of science learning in open-ended environments, and any personal or environmental barriers effecting problem solving.

The findings were mixed. The participants did not typically use the tools and resources effectively. They successfully collected basic information, but infrequently organized, evaluated, generated, and justified their ideas. While the students understood how to use most tools procedurally, they lacked strategic understanding for why tool use was necessary. Students scored average to high on assessments of general content understanding, but developed artifacts suggesting their understanding of specific micro problems was naive and rife with misconceptions. Process understanding was also inconsistent, with some students describing basic problem solving processes, but most students unable to describe how tools could support open-ended inquiry. Barriers to effective problem solving were identified in the study. Personal barriers included naive

epistemologies, while environmental barriers included a lack of communication activities and training.

The study proposition was neither supported or rejected by the data, since students did not use tools effectively. Future studies may find tools support higher-order thinking if study recommendations are followed: training students procedurally and strategically, perhaps longitudinally; using students' personal problem models as an explicit part of instructional strategies; balancing students' epistemological comprehension of problem complexity with self-directed, self-management tactics; and employing the teacher as dialectic facilitator.

INDEX WORDS: Open-ended problem solving, constructivism, problem-based learning, hypermedia, Internet, computer tools, cognitive tools, middle school, case study, qualitative, critical thinking, creative thinking, scaffolding, cooperative learning, motivation, epistemology

STUDENT USE OF COMPUTER TOOLS DESIGNED TO SCAFFOLD SCIENTIFIC  
PROBLEM SOLVING WITH HYPERMEDIA RESOURCES: A CASE STUDY

by

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B.S., The University of Tennessee, 1990

M.Ed., The University of North Carolina, 1993

A Dissertation Submitted to the Graduate Faculty  
of The University of Georgia in Partial Fulfillment  
of the  
Requirements for the Degree

DOCTOR OF PHILOSOPHY

ATHENS, GEORGIA

1999

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## DEDICATION

This dissertation is dedicated to my parents Jack and Martha Oliver, for their love, sacrifice, and support to jump start my academic career; to my grandparents Helen and Levi Oliver, and Betty and Lyndon Young, for teaching me about faith, honor, and love through your silent wisdom and impeccable Hoosier character; and to God for giving me life, wonderful people to share it with, and the beautiful blue ridges of home. “I lift up my eyes to the hills....” Psalm 121:1.

The days pass, and never return, and the South still waits for you.

Take the adventure, heed the call, now the irrevocable moment passes!

‘Tis but a banging of the door behind you, a blithesome step forward,

and you are out of the old life and into the new!

– The Adventurer to the Water Rat  
from *Wind in the Willows*, Kenneth Grahame

## ACKNOWLEDGMENTS

My sincere thanks is extended to my advisor Michael Hannafin for all the valuable lessons learned, the countless shared academic opportunities, and the many hours spent reading and providing comments on this study; to Tom Reeves for keeping me informed and encouraging me to apply for teaching opportunities, internships, and awards; and to Lloyd Rieber for modeling great teaching and for the many recommendations.

Thanks to Jim Slotta and Marcia Linn of the University of California-Berkeley for providing their Knowledge Integration Environment (KIE) computer tools for use in this study. Special thanks to Jim for responding to all of my frantic e-mails and for including me in the WISE online community of KIE researchers. Also, special thanks to Betsy Adams and George Dougherty for their generous help in preparing this study.

Thanks to my best friends for helping me maintain my sanity over the past 4 years: Janice Hardy, another cross-county traveler, for all the F-grade movies, midnight IHOP runs, and money-spendin' sprees; Toru and Hiromi Iiyoshi for all the shared meals, parties, racquetball, and relived '80's music; Kim Graham for the tailgates and Big Orange tickets in KnoxVegas; Lisa Bennett and Ricardo Serrano for the many shared beers and bands in Athens; Todd Thuma for the Athens tailgates and Dawg games; Linda Wang for the flea markets, junk houses, walks, and frozen margaritas; Laura Seybold for the Essen Haus polkas and fish fries; and Beverly Wood for sharing the open road in North Carolina, N'awlins, and across the Coastal Empire... you're the greatest! Finally, special thanks is extended to the 98-99 Tennessee Volunteer football team for defying the odds with your memorable 13-0 national championship season, and for keeping a big smile on my face throughout the preparation of this paper. Two miracles in one year!

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