There are 2 main aspects covered in this research: **Multimedia Authoring** using Macromedia Director and **advanced literacy teaching research** based on, “Inquiry learning”, which aims to educate children regarding being able to correctly include causal variables and exclude spurious variables from study.

This research addressed the question of how best to design inquiry activity based learning for middle-school students. Inquiry learning is defined by (de Jong and van Joolingen, 1998) as, “an educational activity in which students individually or collectively investigate a set of phenomena – virtual or real – and draw conclusions about it. Students direct their own investigatory activity, but they may be prompted to formulate questions, plan their activity, and draw and justify conclusions about what they have learned.”

Middle schools science curricula should, (Kuhn, 2000 p520), identify “a sequence of well-delineated cognitive competencies that become the objective”, of the curricula. The authors offer the observation that when students make errors in answering questions asked them as part of their inquiry activity the reason for the error may be based in incorrect underlying assumptions existing within the student’s minds. For example, (Kuhn, 2000 p497), “In this article, we raise the possibility that students at the middle school level, and sometimes well beyond, have an incorrect mental model that underlies strategic weaknesses, and that impedes the multivariable analysis required in the most common forms of inquiry learning. Like many mental models, this model may be resistant to revision.” Additional discussion is devoted to making sure the reader understands that learning good science requires the student to accurately build predictive and/or causal models based on correct selection and ranking of, (Kuhn, 2000 p497), “individual variables (which) each manifest their individual effects on one or more dependent variables. Such effects are normally additive, although one effect may in some cases influence (interact with) the effect of another variable.”

This study used the Macromedia Director multimedia development environment to present students information needed to predict the amount of flooding at building sites along a lake. The outcome variable was flood depth. The input variables were: soil type (sand vs. clay), elevation (high vs. low), and water pollution (high vs. low). For correct analysis to occur the student must be able to understand, “individual features (variables) will contribute their respective effects to the outcomes”
The student must be able to determine whether or not a given variable should be included as being causal, or excluded. The co-occurrence (incorrect) mental model (Kuhn, 2000 p499) some students create happens when a student incorrectly assumes the variable level, rather than the variable itself, is the causal factor. Formulation of a correct causal model requires that the student needs to test one variable at a time and hold other variables constant in order to achieve predictable results. When students succeed in their self-directed inquiry learning they will have correctly excluded variables that do not contribute to the outcome being studied. When students make incorrect inferences and do not progress in their learning even over many months the co-occurrence (incorrect) mental model is said to be the root of their confusion. Additional description of metalevel functioning is provided and summarized in a graphic (Kuhn, 2000 p502).

The study consisted of 42 middle-school students presented with a macromedia Director based multimedia teaching tool that provided information regarding building sites along a lake. Correct choice of causal variables was said to indicate student success in learning how to apply scientific reasoning. Specific examples of the pretest assessment and delayed posttest assessment results are provided. In addition, examples of screen shots and students actual work on the problems are included. Statistical analysis of results studied the proportion of valid inferences, the mean number of inferences per instance examined and pre and posttest distribution of participants by patterns of valid inferences (Kuhn, 2000 p509-511). The teaching tool was found to be effective with some students but not with others. The authors pointed out that in situations outside the school setting (Kuhn, 2000 p517), “It is important that their interpretations not be compromised by an inadequate mental representation of the multivariable causality that such data are likely to reflect … equally critical is metalevel understanding of the strengths and weaknesses of inference strategies that may be effective, effective but inefficient, or ineffective and fallacious… to know what we do not know, when we have a way to find out, and when we will never know.” Patterns and mechanisms of change were derived by additional evaluation of the study results. For example, the authors concluded that both use of a correct mental model and understanding of task objectives are required for correct completion of cognitive tasks. The shift in mental models, like strategy shifts was found to not happen all-at-once but instead occurred over time in slow and gradual increments.

Study implications for science education offered suggested approaches to assist students who did not appear to receive benefit from instruction. Three possible areas of further investigation were said to be: investigatory intent, the mental model of multivariable causality and metalevel understanding. Since there is much current interest in inquiry learning additional and varied aspects for further study
were left open for other researchers to specify and pursue. As the reviewer, I was surprised to note no suggestion was made for use of additional pre-teaching in basic statistics. For me to understand at all what the authors were studying I had to rely on past study of statistics.