# Showing Evidence; Analysis of students' arguments in a range of settings

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**Abstract:** The purpose of this study is to investigate evidence-based arguments generated through the use of a web based tool, *Showing Evidence.* Six of 40 sample classrooms during 2004-2005 were purposefully sampled from the tool's database. Analysis focused on identifying the physical and argumentation schematic structures of possible evidence based explanations using Toulmin (1958) and Walton (1996) frameworks. Findings demonstrate student's ability to depict proper data for claims yet inability in structuring overall explanations.

## Introduction

Recent reforms in science education are encouraging the practice of constructing *evidence based* explanations in science classrooms through scientific inquiry (National Research Council, 1996; Kuhn & Reiser, 2005). These explanations form the basis of arguments student construct to show their understanding of science concepts. The practice of argumentation is an essential feature in education.

### Statement of the Problem

Students have difficulty in creating logical and reasoned arguments. These difficulties are compounded by the fact that the meaning of explanations are largely determined by the socio-interactive discourse that occurs within various contexts (e.g. Anderson, Chinn, Chang Waggoner & Yi, 1997). Many types of explanations generated from various levels of cognitive reasoning exist (Nagel, 1961). These issues have led the drive towards developing methodical tools for supporting both teachers and students as they engage in argumentation skills (Osborne, Erduran & Simon, 2004). One example is the Intel designed *Showing Evidence* software. In creating an explanation, students collect evidence, evaluate the evidence, and then make visible the connections between the evidence and the scientific concepts being investigated. This then needs to be communicated to the community (Kuhn & Reiser, 2005; NRC, 1996). These features are supported in the *Showing Evidence* tool. The goal of this study is to investigate how students used the supports present in the tool to construct evidence based explanations. Specifically, it is the feature of using evidence in argumentation that this study investigates. This study identifies both argumentation and explanation as both a process and product that students and teachers engage in during instruction (Kuhn & Reiser, 2005). Argumentation often includes the use of individual explanations generated by students to provide support to the larger issue. Argumentation is not only a reasoned causal account of how or why something occurred but also the use of evidence within a social context. Argumentation in the context of this study is seen as both a social and cognitive process. Argumentation is viewed as a scientific based activity whereby valid arguments and explanations are those that clearly demonstrate the relationship between evidence and claims and thus are designated as evidence based arguments. The research questions are: What types of explanations or arguments are generated across different grade levels? How are these explanations or arguments different or similar?

## Method

Six of 40 sample classrooms during 2004-2005 were purposefully sampled from the database by selecting for science-based issues. Of the samples, random samples of 10 artifacts were taken per class. All targeted science based debate topics with subject matter ranging from health sciences, physics, biotechnology, genetics, geology and mathematics. Data included students' written claim to a given question, written evidence, explanation and conclusion. Analysis involved identifying features and forms of existing arguments. Analysis was based on a rubric adapted from Toulmin (1958) and Walton (1996).

## Findings

Initial findings demonstrated students were able to develop multiple explanations but not all explanations were linked to a fully developed argument. In looking at the components of the explanations, a number of interesting findings suggest the tool is helping students develop explanations but additional support might be needed. We have

seen: (1) In all samples evidence relies largely on authoritarian sources (e.g. science text, internet based science topics, science professional journals). However there is a distinction between upper and lower grade levels as to what represents an authoritarian source. For example, the majority (27.4%) of high school samples used data sources taken from science professional journals whereas the majority of middle and elementary levels depended on public news media (41%). (2) Supporting evidence for explanations included redundancy for most samples (i.e. groups tended to use the same sources) but this was exceptionally higher in middle and elementary levels (10%); In addition, high school students supporting evidence emphasized specific scientifically topic relevant data (60%) whereas middle and elementary emphasized individual beliefs/ interpretations of data (70%). (3) For all samples, evidence represents scientifically grounded facts yet explanations rarely show clear connections between the evidence presented and claim noted. Student groups tended to list highly relevant data and yet they do not seem to be able to: (a) relate data sources to each other and (b) use them to relate to the claim(s). (4) Structures of explanations are largely in the form of claims for all samples with predominance demonstrated in middle and elementary levels (30% high school; 86.4% middle and elementary levels). Rarely found were complete arguments where claims, warrants and data were clearly connected. Justifications, when present, rely heavily on repeating supporting evidence and rarely consider counter claims to their original claims. Middle and elementary school samples (1.4%) demonstrate the proper choice of counterclaims yet no clear justification as to HOW they are used to strengthen the overall explanation is given. (5) Argumentation schemes were largely arguments from example (81%) for high school levels. This means high school levels rationalize explanations of data used by providing examples related to previous scientific content learned. Middle and elementary levels largely use arguments from sign (46%). Such samples used a general observed event from personal experience.

## Implications

Implications on improving the tool are suggested: providing options for uploading other sources of data, inserting additional dialogue boxes promoting users to construct a sentence that demonstrates HOW data relate to claim, providing tests credibility of chosen data, prompts challenging explanation validity, and changing explanation prompts to scaffold students in writing specific- topic content related (in this case science evidence based) explanations.

## References


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