Tools to support thinking and regulating scientific inquiry

M. Anne Britt[1], Steven McGee[2], Randi McGee-Tekula[2], Kathryn Rupp[1], Karyn Higgs[1], Kathleen Easley[2], & Amanda M. Durik[1]

BACKGROUND

Applying what is taught in science classes to the real world today requires more self-regulation and epistemic cognition than in the past (Chinn, Barzilai & Duncan, 2020).

NextGen Science standards highlight the importance of engaging students in authentic practices of science that can be used to evaluate science claims (Achieve, 2013). E.g.,:

- Planning and carrying out investigations
- Analyzing and interpreting data
- Constructing explanations
- Engaging in argument from evidence

These practices can be used to evaluate claims outside the classroom (e.g., social media).

To be able to spontaneously use these practices to detect and evaluate claims in this post-truth era requires students not just learn the practice but also learn the following about the practices:

- Set appropriate epistemic goals to evaluate the truth of claims
- Acquire knowledge and skill of using practices that achieve this goal
- Value these goals which require additional effort and then exert that effort

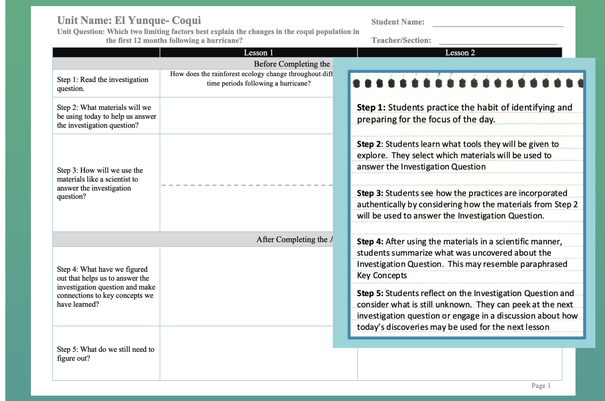
The RESOLV framework was used to create 3 tools to help students begin to develop these practices, know when to apply them and begin to value them as tools in science (RESOLV model; Britt, Rouet, & Durik, 2018)

- Investigation Steps chart
- Evidence sorter
- Causal model diagram

According to RESOLV, readers create a task model when reading. This is a regulation structure, that applied to inquiry learning, includes a representation of the goal state, practice or strategies for achieving the goal, and its value.

A set of tools, co-designed with teachers, to develop science practice and their regulation may help with epistemic cognition outside the classroom

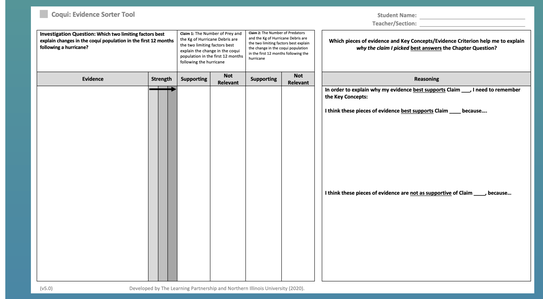
Figure 1. Investigation Steps chart and the epistemic cognitions it supports

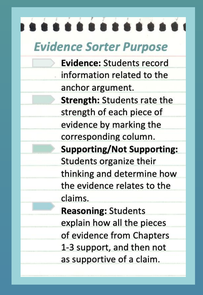


Epistemic supports:

- Analysis of inquiry question to explicitly create a goal and select practices and methods of addressing the question.
- Evaluate results in relation to goal and question to better understand how the results answer the question and what still needs to be addressed.
- Puts the focus on the evaluation of goal achievement rather than the activities.
- Should connect the utility of scientific practices with claim evaluation to increase value of effort

Figure 2. Evidence sorter and the epistemic cognitions it supports

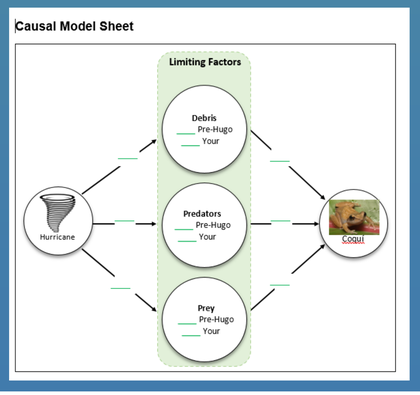




Epistemic supports:

- See the connection between evidence and scientific principles for reasoning in an argument
- Evaluate claims more systematically for what supports and does not support to reinforce attention to limits and counter-evidence
- The importance of evaluating what makes evidence stronger or not as strong and discussion of what those criteria are

Figure 3. Causal model diagram and the epistemic cognitions it supports



Epistemic supports:

- Learn the importance of tracking support for claims in an explanation
- Learn the importance of tracking when a potential factor does not have support in an explanation

TOOLS

Investigation steps chart

- Tool to help students create an appropriate task model to framing the inquiry tasks
- Teacher-use feedback improved emphasis on student's role in scientific practices, encouraging connections with overall goal (unit question) and subgoals (investigation question), and prompting connections for reasoning statements

Evidence sorter

- To supports students' evaluation of evidence toward potential claims, organizing that evidence, and connect evidence to reasoning
- Teacher-use feedback improved format to decrease cognitive load, encourage each piece of evidence to indicate which claims it supports or refutes, encourage each piece of evidence to have a reasoning statement, and encouraged the development of a digital version

Causal model diagram

- Tool to help students record and organize elements in their explanation of the outcome by showing the relationships between different model components.
- Teacher-use feedback improved by making it digital, providing labelled relations and sets of elements to select from.

Through the use of tools that bring students into the discussion about the process of scientific inquiry, students should develop appropriate epistemic cognition and practices that can be used when they encounter scientific claims.

[1]Northern Illinois University, [2]The Learning Partnership

Northern Illinois University

The Learning Partnership