

## Towards a Rational Society: Scaling Argument Mapping in Higher Education

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**Abstract:** Argument mapping (AM) is the activity of plotting a diagram representing the logical connections between evidence and the claims it supports, with boxes connected by lines. AM can massively benefit students and their communities. Not only is it about twice as effective at improving student critical thinking any other method and enhance student math, science, and writing skills, thus demonstrating its use in an academic setting; there is also reason to think AM represents a larger commitment to democratic education. Improving critical thinking *en masse* opens up the possibility of improving democratic health by improving democratic attitudes such as tolerance and open-mindedness, epistemic confidence, etc. However, AM's incompatibility with federal accessibility standards hinders its widespread adoption. In this paper, we review the research on AM, critical thinking, and the benefits thereof. We then argue that a still-developing web-based application, Argumentation, could make AM accessible and thereby unlock the method's benefits for students and their societies. Finally, we identify some avenues for further research that an accessible AM app would open.

**Keywords:** Argument Mapping, Critical Thinking, Democratic Education.

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### Introduction

Most educators would say that helping students develop critical thinking skills is a primary goal in higher education. However, we are not achieving this goal to the extent that we could. This paper will argue (1) that the widespread adoption of argument mapping in higher education would solve this problem and (2) to get argument mapping widely adopted, it needs to be brought up to federal accessibility standards and made easier to teach. Finally, (3) we'll discuss how we've taken some major steps towards achieving these goals within the Argumentation web-based application.

In the United States alone, we spend hundreds of billions of dollars on higher education (NCES, 2022). And one

of the main promised returns on this investment is improvements in student critical thinking. But despite these billions, we see only modest achievements in those critical thinking skills: we see a increase of 0.3 in the effect size of the standard deviation in critical thinking gains with a first semester in college versus no college (Huber & Kuncel, 2016) and a 0.4 standard deviation increase from a semester that includes a critical thinking course (Abrami et al, 2015). Argument mapping, then, can vastly improve higher education's critical thinking outcomes, taking the gains from small to modest.

Argument mapping is a diagrammatic representation of an argument. The claims are represented with color-coded boxes and the logical relations between those claims as lines therein. You add your "Main Contention" at the top with reasons for or against (which have their own reasons for and against, and so on and so forth) branching out like a tree underneath. Argument mapping has a substantial visual component, which helps students understand complex arguments (as noted by Tim van Gelder, 2015). We believe its tactile component--dragging and dropping and navigating--could similarly contribute to understanding and learning for blind students, though research on this hypothesis is needed.

There exists now a substantial body of research, including randomized controlled trials and meta-analyses, attesting to the hypothesis that a semester of college with an argument mapping course leads to about twice the gains in critical thinking as a semester of college without (Tim van Gelder, 2015). Not only this, argument mapping forces students to confront "cognitive and interpersonal challenges," resulting in "more deliberate and fair-minded approach[es] to understanding them." (Kaepfel, 2021) Some evidence goes as far as to suggest better overall argument comprehension (Dwyer et al., 2010). We also see better writing (Cullen et al., 2018), scientific reasoning (Murungi & Hirschheim, 2022), mathematical reasoning (Indrawatinigsih et al., 2020), and better recall of course content (Eftekhari & Sotoudehnama, 2018).

What makes AM so effective? Dwyer et al. (2010) lay out three explanations of AM's efficacy: first, AM involves dual visual-propositional modalities and this enables the learner to process information more efficiently; second, learners bring "Gestalt grouping principles" to bear on argument maps and this helps working and long-term memory retain the map's content; third, and finally, AM organizes content hierarchically and this, too, helps content enter into and stay in memory. A fourth explanation is that argument mapping is particularly amenable to scaffolding and this enhances learning. A typical critical thinking textbook introduces arguments with multiple premises and intermediate conclusions in a single chapter; argument mapping textbooks give each of these difficult topics their own chapter.

The main barrier to argument mapping's widespread adoption is accessibility standards. Argument mapping is a diagrammatic method. A blind person can't draw an argument map with a pencil and paper nor can they use any of the existing digital applications. The US, EU member states, Canada, Australia, and many other countries have laws requiring that college courses be accessible to students with disabilities. Because existing argument mapping applications aren't accessible, and because creating a separate accommodation for blind students isn't feasible, argument mapping has remained at odds with these disability laws. And this has held back institutional

support for it. Certainly, it can't be commended as a "best teaching practice" when it doesn't meet standard legal requirements.

We believe this challenge can be met. We're developing a web-based application, Argumentation, which will be fully accessible. Users will be able to create and edit maps using either the mouse or key commands and a screen reader. We're optimistic we can achieve full accessibility because we've designed the app using principles of inclusive design, like "no decision for us without us." Specifically, we've consulted with blind people, including blind accessibility experts, about our major design decisions. We've also, as a company, undergone significant accessible design training and research. And, finally, we have commissioned a third-party accessibility audit. This has provided us with a concrete roadmap to meeting all WCAG standards before the Fall 2023 semester.

We'll need other materials, in addition to the app, to make argument mapping courses accessible. In particular, existing argument mapping textbooks are full of images of argument maps that the blind have no way of engaging with. We're writing our own textbook that will include links to accessible maps in the Argumentation app when discussing examples. The textbook is intended to help assist in the development of an argument mapping course (either wholly or supplementally). We've also written a "quickstart guide" that will explain how to give accessible lectures, and create accessible videos, about diagrams like argument maps.

Importantly, Argumentation is not just an accommodation for blind students but, rather, is designed to make argument mapping more user-friendly and pedagogically effective for all students. It is not an either/or business, but a both/and one. We hope that the app will, therefore, "open the floodgates" to argument mapping, ideally making it the standard practice for improving critical thinking.

We would like to consider one final point of interest. There is good reason to suppose that argument mapping will improve not just critical thinking but also society. First, the critical thinking skills that argument mapping seems to strengthen are associated with better decision-making, including socially-salient decision-making like getting a flu shot or drinking and driving (Butler, 2017). Second, argument mapping also helps students think more open-mindedly about controversial issues (Kaepfel, 2021).

Furthermore, there is reason to think that better critical thinking skills tend to make society more democratic (Aslan, 2018; Lantian et al., 2021; Glaeser et al., 2007). So, since argument mapping dramatically improves critical thinking, it's likely that widespread adoption of argument mapping would improve democracy. (We need more research to confirm and develop this hypothesis.) There are powerful reasons, then, for societies to invest in a large-scale shift to argument mapping, not just as a possible teaching method but as a democratic teaching method aimed at nurturing the democratic spirit and the critical engagement necessary to foster and complement its very possibility.

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