Using Concept Maps in Political Science

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Abstract:

This paper tests the effectiveness of concept mapping as a classroom technique and curricular tool. In it, I use survey data and semi-structured interviews to assess student perceptions of the learning and the impact of concept mapping. I find that concept maps are an excellent way to encourage thorough reading of complex texts.

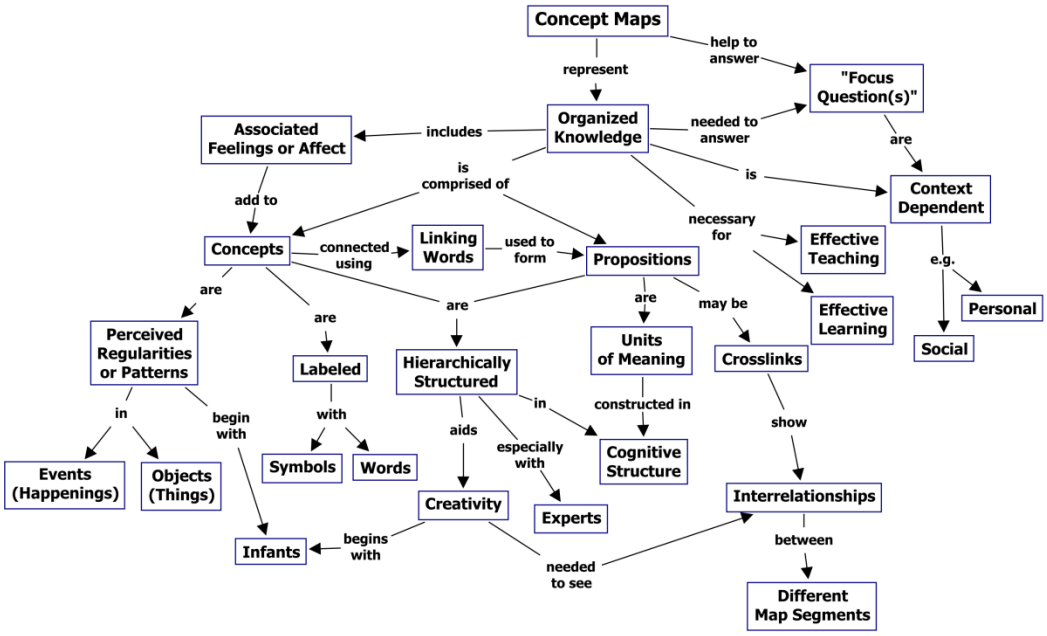
Concept maps are a simple, powerful tool that dramatically enhances student learning. The social sciences are deeply textual – for example, relatively few students of political science will find themselves in the position to directly cause the international dynamics we discuss, although virtually all of them will read reports of political activity and form opinions based (we hope) on the learning that occurred in our classrooms. Knowledge within the field is primarily conveyed in written form, through books and articles. Thus, as educators, a chief concern is the creation of mechanisms to facilitate student retention and cognitive integration of written material. In this working paper, I argue that one of the best techniques for the study of texts is actually visual – rather than simply produce another text that is an abbreviated summary (as in notes or outlines) or a long-form application (as in essays), students ought to create a picture of the ideas we want them to learn.

The notion that some information can be usefully conveyed in graphic (rather than purely textual) form is not a new one in the history of human thought, nor is it particularly novel in political science. We are, after all, the discipline renowned for our ability to capture the world on a 2x2 table, express causality in the line of a regression, and boil the presentation of our work down to a handy PowerPoint. Nonetheless, we tend underutilize graphical representation of texts themselves, both in our classroom instruction and in our assignments to students. Empirical study and education theory suggest that concept mapping is a particularly powerful form of graphical representation for student learning; thus, I suggest that the practice should be adopted widely in political science education. In this working paper, I discuss the theory and practice of

concept mapping and report on its relative success in my SS357: Advanced Introduction to International Relations class.

What is a Concept Map?

Concept maps are graphical representations of knowledge. A specific type of node-link diagram, they connect concepts using labeled arrows, which then form logical propositions. Novak and Cañas (2006) represent the idea in the concept map below:



Read from top to bottom, this map enables the readers to form numerous logically coherent sentences about concept maps in terms of both what they are and what they are meant to do. This sort of map implements the approach pioneered by Novak (2012), which asks students to respond to a "focus question" with a hierarchically-organized structure that places broader concepts towards the top of the map. In this section, I review the educational literature that supports this approach to mapping, its application in other fields, and compare this method of mapping political science arguments to other textual and node-link representations.

The Ausubel Theory of Learning

In the late 1950s, David Ausubel argued that learning is a process of expanding and refining cognitive structures, not simply accumulating information (Ausubel and Blake 1958; Ausubel and Fitzgerald 1961). Today it is commonplace to decry rote-learning, but it is less widely understood what is meant to replace it. Ausubel maintained that rote material has negligible impact on long-term learning because it fails to attach itself to a meaningful cognitive structure – either because there is no such structure in place or because it fails to adhere to the structures the student has already created. Thus, after an initial period of retention the rote material is forgotten, meaning that it cannot be recalled and does not influence thinking or learning.

By contrast, if a student engages in meaningful learning, a cognitive structure is either created or adjusted to accommodate the new information. Ausubel asserted that this structure placed information in a context, giving it both subordinate and superordinate placement within the student's cognitive framework. Eventually, the specifics of the learned material will be forgotten, but through a process that he called "obliterative subsumption," which means that the impact of "forgotten" material on the cognitive structures into which it was placed persists even when the specific material cannot be recalled. This is the difference between rote and meaningful learning (Novak 2012: 66). If meaningful learning has occurred, then these changes in the cognitive structure will carry forward the gist of the material and will inform future learning.

This is of central importance for the curricular design of both individual courses and larger programs of study (majors, degrees, etc.) Within courses, rote learning is problematic because students tend to forget material in 6-8 weeks (Novak 2012), which will inhibit learning through two pathways. First, students lack recall of foundational material presented at the beginning of the semester when they deal with more complex material presented at the end of the semester. Second, the forgotten material interferes with new learning through "proactive inhibition" (Ausubel et al 1958), wherein the unorganized fragments of previously encountered material are confused with current teaching. Across a program of study, the effect is

compounded. If learning is mostly rote, then a four-year program of study is severely limited in the mastery it can expect students to achieve because they aren't really in a four-year program of learning, they are in 16 consecutive 6-week trials of rote retention.

Novak's approach to concept mapping is an application of Ausubel's theory of meaningful learning to classroom instruction. Concepts are organized hierarchically in order to facilitate obliterative subsumption, so that as students "forget" the specifics of the material they are taught they retain the general structure. Moreover, as students become more comfortable with concept mapping, they are asked to introduce their own meaningful concepts, which embed the maps in existing cognitive structures. Finally, because the maps use logical operators as linking words, the students are able to convey their beliefs about the relationship(s) between concepts to teachers, who can affirm or correct them. Students are also able to recall the reason(s) they connected concepts at a later date.

Concept mapping in practice

Concept mapping has been put to a variety of uses: generating curriculum within a department (Simon 2010), augmenting printed materials (Hirumi and Bowers 1991), providing a basic outline of the course for students (Earl 2007), and delivering instruction (Blankenship and Dansereau 2000). However, this working paper focuses in particular on concept maps created by the student. Nesbit and Adesope's 2006 meta-analysis of the impact of concept mapping found that "across several instructional conditions, setting, and methodological features, the use of concept maps was associated with increased knowledge retention." (413)

There are a variety of options for student-created maps. Students can work on a single concept map which they refine iteratively in conjunction with the teacher over the course of the semester (All and Huycke 2007), students can do student maps on complex readings (Nesbit et al 2006), students can build upon a scaffolding presented by the teacher (Novak et al 2006), students can organize concepts that are given, they can create their own, or any mixture of all of these (Novak 2012). The unifying element of this approach is that the student must somehow relate concepts in a way that is meaningful to them. That is, given concepts that either they

create or the teacher provides, they must represent the logical connections between them in a manner that addresses the "focus question" of the map.

This stimulates meaningful learning through multiple pathways. First, the process of concept mapping requires deep engagement with the material, especially when the student is required to generate concepts. Second, the student is required to express logical connections in their own words, which connects them to pre-existing vocabularies and logics. Third, it opens space for a student-teacher discussion about the logical connection of ideas that contributes to meaningful feedback and an iterative process.

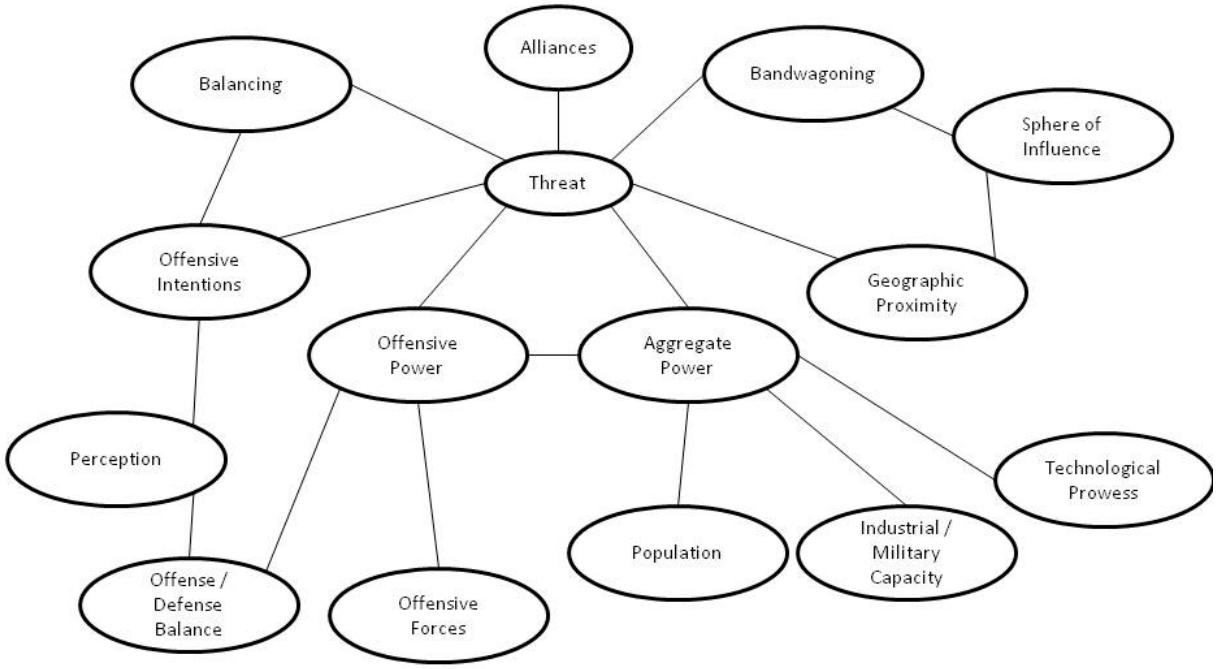
Concept Mapping: An Illustrative Comparison

While the theory of learning and empirical research presented thus far indicate the potential of concept mapping for inducing meaningful learning, it may not be altogether clear exactly what a concept map looks like in the context of a political science course. Thus, rather than continue to describe them in the abstract, in this section I simply illustrate three possible methods for teaching Walt's Balance of Threat theory: a set of simple rote facts, a node-link diagram, and a concept map.

In an introductory International Relations course, Walt's Balance of Threat theory presents a nice example of the extensions of structural realism that are archetypical of the trajectory of contemporary realist thought. It is also attractive to the writers of multiple choice and true-false questions because of its clear exposition and lists of various sorts. Thus, a rote approach to learning balance of threat could emphasize the following:

- States balance against threat, not just power
- Threat is a function of aggregate power, offensive capabilities, offensive intentions, and geographic proximity.
- When states ally against their greatest threat, that is called balancing; when they ally with their greatest threat, that is called bandwagoning.
- States rarely bandwagon. Balancing is the most common behavior.

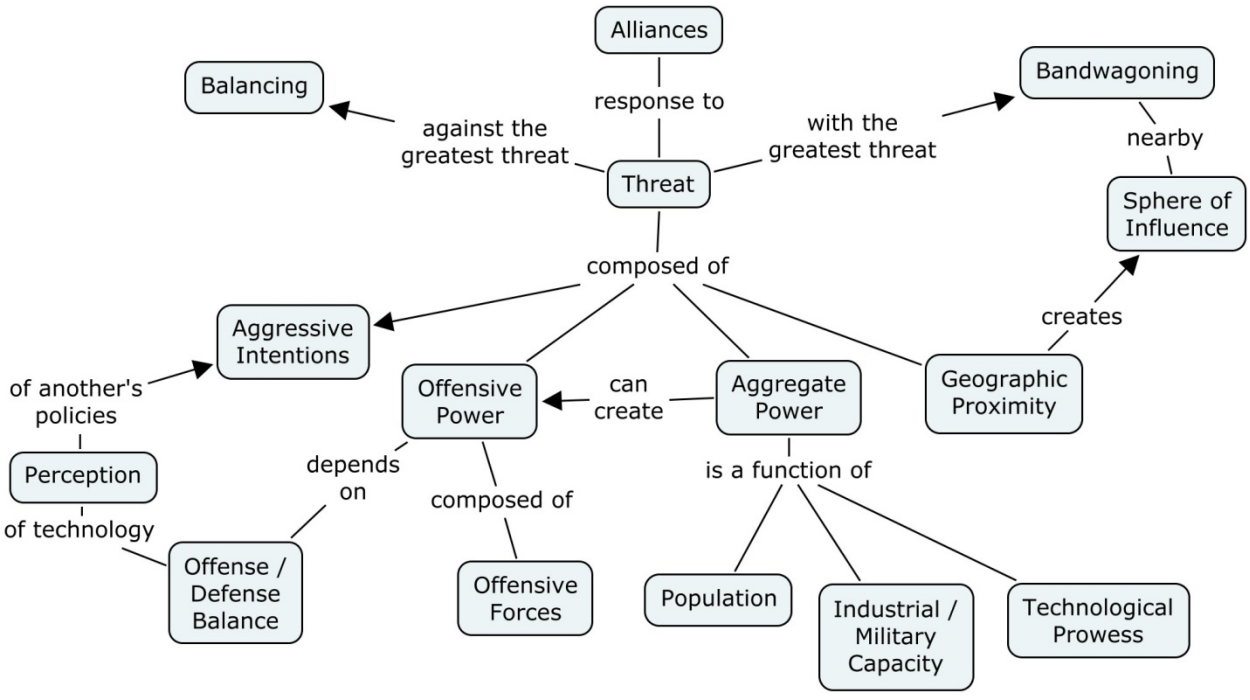
This list, while not exhaustive, is the sort of thing that most first-year undergraduates would be expected to know and would be tested on, in either a direct fashion (listing these facts) or an indirect fashion (applying the theory in essay form, which implies a paragraph that enumerates these facts and establishes what the theory is.) It is important to note that there is nothing wrong with this information per se – rather, the problem is that information presented in this form is almost certain to be forgotten. Rather than inform their understanding of international relations as they move through the world, it will simply become another piece of knowledge that is possessed temporarily and then discarded at the end of the semester.



An alternative to an evaluation of the student's ability to articulate these facts in notes, answers to quiz questions, or essay paragraphs would be to have them construct a node-link diagram. The diagram above is a visual expression of the basic facts listed above, plus the sub-components of the four elements that compose "threat." One can easily imagine creating such a diagram on the board during a lecture, drawing the lines in one at a time and providing a brief explanation of the connection between the concepts. This sort of visualization is quite common during brain-storming and has the advantages of being quick, interactive, and not just "more-of-the-same" text for the student to plow through or produce.

The issue with this sort of diagram is that the links all look the same, which visually implies a homogeneity of relationship where there is none. For example, balancing and bandwagoning are responses to threat, while offensive intentions, offensive power, aggregate power, and geographic proximity are components of threat; however, all these concepts have some relationship to threat and all are identically represented. As an educator, this creates difficulty in identifying and correcting student mistakes, because the information conveyed is fairly limited. Similarly, this limitation also reduces the value of this diagram to the student because it requires the creator of the graph to remember why they drew all the lines in the first place without any hints as to the original logic.

Concept maps address these limitations. The diagram below contains exactly the same concepts and connections as the node-link diagram above, but includes logical operators between the concepts.



Because the student and teacher share the convention that the map is meant to be read from top to bottom, unless otherwise noted by the arrows, it is a straightforward matter to produce comprehensible claims from this map, such as “Alliances are a response to threat, which is

composed of …" or "An alliance (that is a response to threat) that is with the greatest threat is bandwagoning." This enables the teacher to quickly assess whether or not students understand, for example, the difference between balancing and bandwagoning, and to correct mistakes. It also enables the student to come back to the map in the future for study and writing purposes. Finally, it allows the educator to develop deeper readings of the text. For example, the discernment of aggressive intentions is obviously somewhat subjective, whereas geographic proximity is obviously objective … but to what extent is offensive power a function of perception? To what extent does this theory depend on the subjective perceptions of actors (which can presumably vary) vice objective facts observable by all? The ability to engage in this sort of thinking and analysis is what separates rote and meaningful learning.

Teaching and Assessing Concept Maps

While concept maps seem to be a theoretically valid mechanism to achieve meaningful learning, their use is not particularly widespread in the social sciences. Thus, when I decided to employ concept mapping in my Advanced Introduction to International Relations course, I adopted a phased approach. The course itself uses five major texts in the field, and is taught over 29 lessons which are split into five sections (one for each book). In the lessons where we read a theory chapter, I directed that each student create a concept map and then had students peer edit each other's concept maps for the first five minutes of class. All maps had to have 15 concepts, could not use the word "is" as a link, and had to be at least three tiers deep. In the first section of the course, I supplied all 15 concepts in the syllabus. I then required students to produce maps with 12 given concepts and 3 of their for the second book, 6 given and 9 of their own for the third book, 3 given and 12 of their own for the fourth book, and 15 of their own for the fifth book.

I graded the concept maps at the end of each section. For the first and second books, I merely required the students to bring all their maps with them and then randomly selected a lesson to be submitted for grading. In subsequent books, I required the production of a larger "master" map that connected the work they had been doing into a coherent whole. These maps

could be as large as 35 concepts, but were designed to be combinations of older maps. Thus, students had multiple incentives (both short- and long-term) to keep up with their mapping.

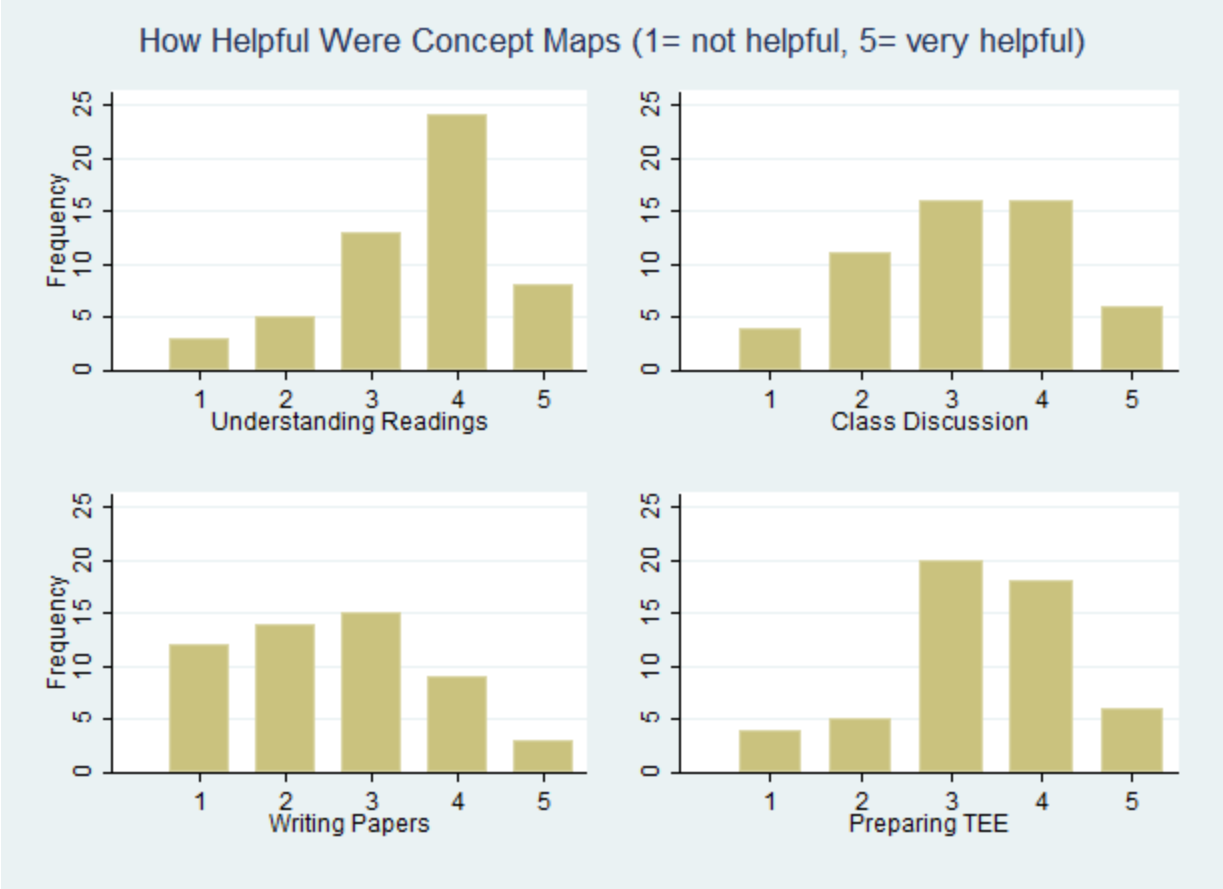
Assessment

The purpose of using concept maps in a curriculum is to achieve meaningful learning. If one were to wish to demonstrate the power of concept mapping on learning, the appropriate experimental technique would be to establish a control group, a treatment group, and place the test in the hands of a neutral administrator. Since there is already ample empirical support for the effectiveness of concept-mapping in post-secondary learning, I was disinclined to create two syllabi for the course in order to replicate those findings. Instead of measuring the impact on student learning directly, I decided to rely on student self-reports. Specifically, I was interested in changes in learner confidence, student impressions of the relative effectiveness of concept-mapping, and student assessments of the integration of concept mapping into classroom practice.

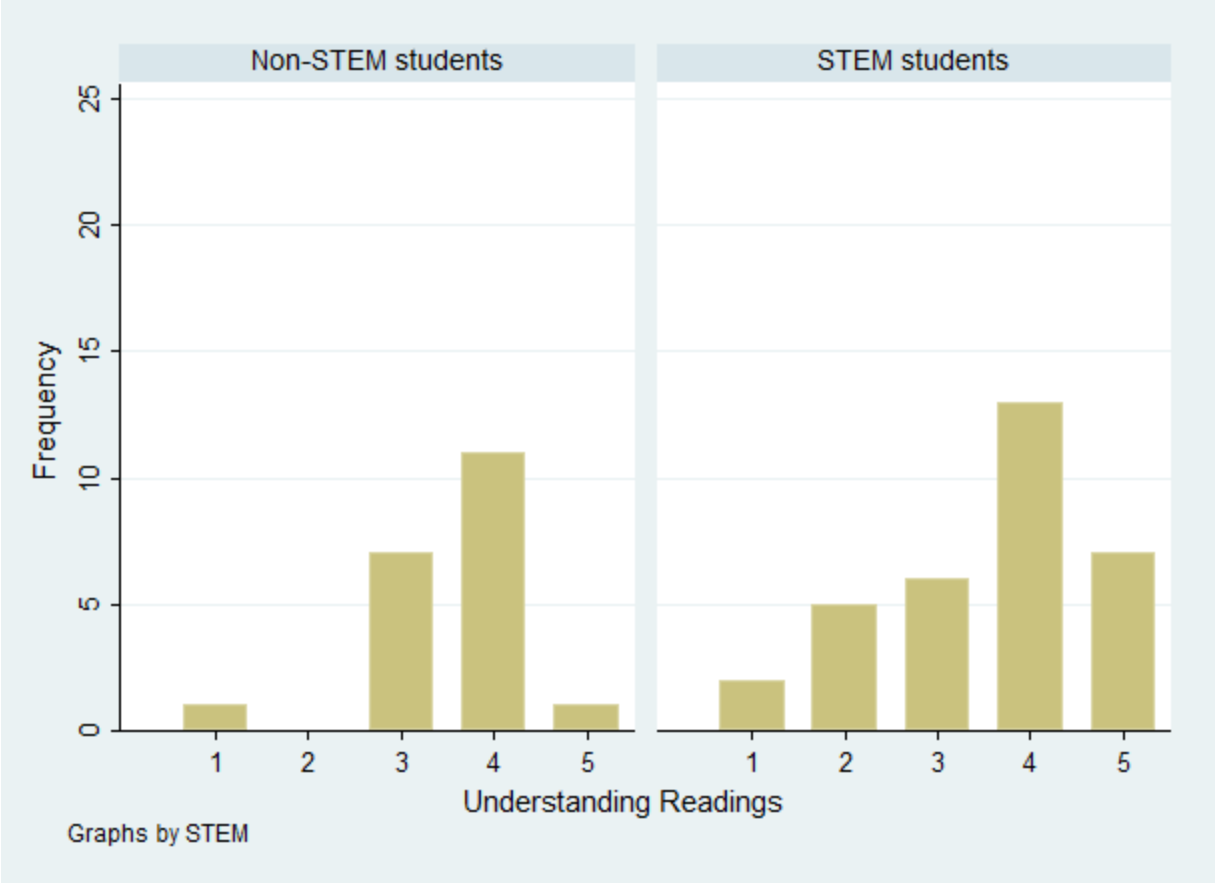
Following Bernstein and Allen (2013), I decided to employ a pre-test, a post-test, and semi-structured exit interviews. Another professor and I administered the pre- and post-tests, asking students to identify themselves only with their university ID number after explaining the purpose of the test. The interviews were conducted during the final lesson of the course, and resulted in very frank and open discussion of student impressions of the concept maps.

Results

Overall, students reported a statistically significant improvement in their comfort with social science (from 3.3 to 3.9 on a 5 point Likert scale) and seemed to find the concept maps helpful. In order to assess the role of concept maps in the overall class, students were asked to identify how much concept maps contributed to other class outcomes and activities. A majority of students reported that concept mapping was helpful or very helpful in understanding the readings, and significant portions of the class found the maps helpful in facilitating class discussion and studying for the final. Interestingly, most students did not use their concept maps when preparing their papers.



My initial hypothesis was that concept maps would favor visual learners and would disproportionately appeal to the STEM majors in the class. However, when I disaggregate the results by major, I found that STEM and non-STEM majors found the maps helpful / very helpful at similar rates (12/20 non-STEM majors, 20/33 STEM majors, respectively.)



Exit interviews, conducted as a class, yielded further insight into the strengths and weaknesses of concept mapping. In the main, students found the concept maps time-consuming and occasionally quite difficult. I required the students to submit five of the concept maps they produced for a grade, and all five maps combined were worth 20% of the overall course grade. Thus, at 4% per map, some students expressed a feeling that there was an effort / reward mismatch. I also had students peer edit one another's maps every class period to get the conversation underway; some students felt this led to a "blind leading the blind" dynamic and was of questionable utility. On the bright side, students reported that they appreciated the gradual introduction of the concept maps, would have liked to see them more integrated into classroom instruction and instructor presentations, and found that doing the maps carefully would yield better comprehension of the material.

Discussion

As previous empirical work in other disciplines predicted, concept maps were a useful pedagogical tool for social science instruction. The fact that both students who are attracted to reading-intensive courses and those who tend to shun them find concept maps to be useful is encouraging and indicates their utility in a broad array of educational settings.
My own impressions support the student self-reports: concept maps are especially helpful when unpacking dense, book-length theories of political science. In particular, concept maps demand slow, careful reading of relevant passages by the student and forces the student to articulate their understanding of the logic of the text. This can be a significant adjustment for students who are talented writers and have the ability to rapidly recall and verbalize the basic outline of an argument. Since these students are used to earning good grades and social affirmation for their ability to write their way onto right answers and make reasonable interventions in class discussion, it comes as a bit of a shock to learn that mastery of a book requires a deeper and more thoughtful (and, therefore, more time-consuming) reading than they have been used to. Thus, concept mapping slows down the high-aptitude students in a useful manner at the same time that it renders the text more accessible to visual and schematic learners. It has also had the salutary effect of getting students to come by office hours with their concept maps, during which they can receive additional one-on-one instruction on the material.

As I reflect on the exit interviews, the fact that the students find making the concept maps difficult and time-consuming strikes me as a good thing. The readings and the theories themselves are intricate and require careful study to grasp fully. The level of comprehension that I strive for in the course requires students to take more than a single quick pass through the text. Since I have no way to monitor student behavior outside the classroom to ensure that they are reading carefully, concept maps seem like an effective method for inducing the desired behavior. It is simply impossible to place all the required concepts in a logical relationship to one another without careful reading and reflection, and I view student complaints about difficulty as a natural expression of scholarly growing pains. I also have reason to believe that, as predicted by the literature, students who invest in the maps are being impacted by the material in a more

significant and durable manner. Whether this is borne out empirically or not will require additional research.

My class periods are 55 minutes, which severely constrains the number of classroom activities that can be undertaken in any one lesson. Were I teach a 75 – 120 minute class, I think the creation of concept maps as a class and the presentation of student concept maps on the board would be incredibly worthwhile. As it is, I find myself concentrating on discussion and textual analysis during class hours and leaving the concept maps to individual effort.

Conclusion

Concept mapping is a simple and powerful pedagogical tool that, according to student self-assessment, has a meaningful impact on the comprehension of social scientific arguments. Based on these findings, I am going to incorporate concept mapping into each of my course offerings and have recommended that others do the same. That said, there is a strong need for additional research into the impact of concept mapping on student comprehension, the benefits of various modes of concept map discussion and delivery, and the amount of weight that ought to be given to concept maps in syllabus design.

My research design in this project lacks variation on the independent variable, which limits the causal claims that can be made about concept maps. Yes, students say they are useful, but how useful they are remains a matter of speculation. While it would be ideal to conduct an experiment across sections, the issue I face is that the top students are hyper-competitive and tend to talk to one another. Thus, I would reasonably anticipate bleed-over from my treatment to my control group. The better alternative would be to conduct this experiment in a much larger core course and direct that only some discussion sections to incorporate concept maps. This would enable the assessment of the impact of concept maps in objective terms, which would then enable professors to conduct a cost/benefit assessment in terms of student time and grading requirements.

Understanding the impact of concept maps in these terms would also enable a more reasonable weighting of this particular course element in the overall grading scheme. If the maps are highly impactful and it is imperative that students perform the task, then it is probably worth sacrificing other graded requirements to put more weight on the concept maps and thereby induce greater student compliance. However, if concept maps are only effective in conjunction with other course requirements, it might be more prudent to accept higher rates of non-compliance in order to ensure the full range of course elements received at least some degree of student attention.

Finally, given the fact that concept mapping is new to political science, it seems highly probable that there are superior methods of content delivery and classroom utilization. By continuing to experiment and report on concept map techniques, it seems likely that this already powerful tool can be put to even better use.

All, Anita C. and LaRae Huycke. 2007. "Serial Concept Maps: Tools for Concept Analysis" *Journal of Nursing Education* May 2007: 217-224.

Ausubel, David P. and Elias Blake Jr. 1958. "Proactive Inhibition in the Forgetting of Meaningful School Material." *The Journal of Educational Research* 52(4): 145-149.

Ausubel, David P. and Donald Fitzgerald. 1961. "Meaningful Learning and Retention: Intrapersonal Cognitive Variables." *Review of Educational Research* 31(5): 500-510.

Bernstein, Jeffrey L. and Brooke Thomas Allen. 2013. "Overcoming Methods Anxiety: Qualitative First, Quantitative Next, Frequent Feedback Along the Way." *Journal of Political Science Education* 9:1-15.

Blankenship, Jason and Donald F. Dansereau. 2000. "The Effect of Animated Node-Link Displays on Information Recall." *The Journal of Experimental Education* 68(4): 293-308.

Earl, Boyd L. 2007. "Concept Maps for General Chemistry." *Journal of Chemical Education*. 84(11): 1788-1789.

Hirumi, Atsusi and Dennis Bowers. 1991. "Enhancing Motivation and Acquisition of Coordinate Concepts by Using Concept Trees." *The Journal of Education Research* 84(5): 273-279.

Nesbit, John and Olusola Adesope. 2006. "Learning with Concept and Knowledge Maps: A Meta-Analysis." *Review of Educational Research* 76(3): 413-448.

Novak, Joseph D. 2012. *Learning, Creating, and Using Knowledge: Concept Maps as Facilitative Tools in Schools and Corporations, 2nd ed.* New York: Routledge.

Simon, Jon. 2010. "Curriculum Changes Using Concept Maps." *Accounting Education* 19 (3): 301-307.