

CHAIN OF DEPENDENCIES: A NEW VISUAL HEURISTIC TO DISCOVER THE UNDERLYING LOGIC OF AN ARGUMENT

Mark C. Marino and Jessica Wells Cantiello

Mind maps, bubble maps, and other graphic organizers have been popular tools in education for decades. In fact, most students arrive in college having used some form of them. However, most of the scholarship on the subject focuses on the ways in which these tools can help middle and high school students build on prior knowledge to facilitate content understanding (Griffin et al.; Goodnough and Long) or develop their reading comprehension skills in literature classes (Morris). In addition, much of the work on mind mapping more recently has focused on the pros and cons of digital vs. hand-drawn maps and the effectiveness of mindmapping software (Tucker et al.; Lamont).

In composition studies, mapping is often identified as a component of prewriting, but most scholars do not offer well-articulated discussions of the process and how it can be useful for the development of student writing. In fact, some scholars decry the bubble map as an oversimplified tool that doesn't always work as intended. Jacqui Dornbrack and Kerryn Dixon's review of high school curriculum in Cape Town includes one common, if perhaps somewhat extreme, critique of the strategy: "the visual nature of the mind map, which should be a generative tool, appears to be reduced to a meaningless task as is evident from the generic cloud bubble with four or five words attached." While Dornbrack and Dixon note a particularly egregious demonstration of the bubbling technique, the bubble map can at times generate similar lackluster results either due to student apathy or poor instructor modeling. Their concern is likely shared

by many writing teachers, who have seen firsthand that though students can generate these webs of ideas fairly easily and with little direction, these associative visualizations do not offer much by way of developing the logic of the paper. To build on the bubble map to better serve the needs of developing sophisticated arguments in a college-level writing course, we have developed the Chain of Dependencies, a visual heuristic which combines creating the associative diagrams of bubble maps with developing more complex logical relationships between ideas and identifying the necessary context to make a more complex argument to a well-informed skeptical reader (i.e., an academic).

Mind maps are commonly attributed to Tony Buzan, a British popular psychologist, but the technique has a much longer history in the writing classroom and in knowledge representation itself. Katherine Watson traces the system of logical representation back to third-century Neo-Platonist philosopher Prophyry, who offered his students visual representations of logic to represent “a concrete way how human reasoning progresses.” And no doubt the technique of writing like ideas together in clusters is as old as writing itself. In fact, some form of bubbling surely predates sentence writing. However, the process of visualization via bubbling likely entered rhetoric studies in the early 1980s when the process movement gained popularity, and with it came the need for tools to use during the early stages of the writing process in order to identify and develop topics and foci (Yood).

Organizational theorist Martin J. Eppler offers a comparative analysis of similar visualizing approaches, including conceptual maps, mind maps, conceptual diagrams, and visual metaphors. By Eppler’s typology, a concept map is “a top-down diagram showing the relationships between concepts, including cross connections among concepts, and their manifestations” (203). A conceptual diagram is “a systematic depiction of an abstract concept in pre-defined category boxes with specified relationships, typically based on a theory or model” (203). A visual metaphor, often seen in the “infographics” of today’s internet, is “a graphic structure that uses the shape and elements of a familiar natural or manmade artifact or

of an easily recognizable activity or story to organize content meaningfully and use the associations with the metaphor to convey additional meaning about the content” (203). Finally, the mind map is “a multi-colored and image-centered radial diagram that represents semantic or other connections between portions of learned material hierarchically” (203). While Eppler primarily sees these visualizations as ways to depict knowledge, as heuristics they can be used to discover connections and relationships between ideas, which is indicated in many of the definitions quoted above.

Our principal goal was to evolve the mind map from a tool primarily used to generate an assortment of content into a tool that could also be used in the formulation of an argument by exposing underlying arguments. In our heuristic, we hoped to build on the successes of mind mapping, brainstorming, and other visual heuristics by deepening the line of inquiry involved in relating one bubble to the next. We wanted a tool that went beyond generating ideas and establishing *associations*; we wanted one that would aid in the process of developing *arguments*.

In developing this tool, especially because we were shifting away from the traditional goals of mind mapping (i.e., coming up with an idea for what to write about) to a different objective (i.e., developing an argument and deciding what information was needed to convey that argument and how to organize that information), we entered into a larger theoretical conversation about purpose and audience in the writing classroom. Traditional mind maps, like those discussed in the aptly titled “Mind-Map Your Way to an Idea” (Kirchner), align with the notion of writer-based prose, wherein the writer is essentially writing for herself. This is often a necessary stage in the writing process, particularly for developing writers or those struggling with writer’s block, since generating context with oneself as the intended audience is much easier than writing for some faceless other. It should be noted that some instructors and scholars, following from the influential theories of Peter Elbow and others, advocate the development of writer-based prose not simply as a means to an end but as an end in itself, a way for students to take ownership of their own writing and experiences. Our writing

classes, however, strive to help students create a reader-based prose, building on the notion that academic writing is about joining a conversation with other people interested in what you have to say. Thus, one goal for our new heuristic was to help (or really, force) students to envision the reader very early in the writing process and figure out what the reader would “need to know” in order to be convinced of the claim the student wanted to make.

Linda Flower, who popularized the notions of writer- and reader-based prose, explains this concept this way:

In the best of all possible worlds, good writers strive for Reader-Based prose from the very beginning: they retrieve and organize information within the framework of a reader/writer contract. Their top goal or initial question is not, “What do I know about physics, and in particular the physics of wind resistance?” but, “What does a model plane builder *need to know?*” (34, emphasis added)

By integrating these need-to-knows into the earliest stages of the writing process, the Chain of Dependencies aims to move students away from the need to shift from writer- to reader-based prose during drafting or even revision. The idea is that by keeping the reader in mind throughout the process the students will, eventually, internalize the notion of reader-based prose and begin to see writing as part of Flower’s “reader/writer contract.” In the shorter term, we wanted the tool to help students decide what kind of context to provide and the necessary order of their points, in terms of what the reader would need to know and in what order.

However, we were concerned that such a tool might merely lead to an information dump. Students have a tendency to mistake large quantities of information, even if well wrought, with conveying a cogent argument using that information as support. For that reason, we stressed that the tool would be used to uncover underlying assumptions rather than merely accumulate background information. By thinking about the reader, writers would need to explain and unpack every assumption, traveling backwards into

their thought process through adding more and more bubbles. What was important, then, were not just the bubbles, but the connections between them and where they came from, the ideas that gave meaning to the relations between the bubbles.

The Heuristic

The Chain of Dependencies (CoD) is a flexible, visual heuristic designed to aid students in the development of sophisticated college-level arguments. However, the device can easily be adapted for writers of any age or experience.

In our experience, it is best to introduce the tool using mind mapping and bubble diagrams as a point of reference, but being careful to highlight the differences between what they may have done before and what this tool can help them do now. Most students by the time they reach college have used some form of bubble diagram; however, most will admit that the tool is useful primarily in the ideation or brainstorming phase and not in the developments of arguments. In college writing classes, students need to move from collections of ideas, as might be found in the three main points of a basic five-paragraph essay, to a coherent argument. That means it is not enough to have ideas; a student must know the relationship between the ideas.

The students begin with their principal assertion. This might even take the form of a thesis. In our working example (see Figure 1), we use an assertion that the film *Pulp Fiction* captures the zeitgeist of the 1990s. We draw that in the middle of the diagram. Then we ask what readers might *need to know* in order to understand that claim. Obviously, they would have to know what the zeitgeist of the 1990s is, and so we introduce the concept of “retro” as one possible avenue. Immediately, a problem arises. What did “retro” mean in the 1990s? What was retro, meaning what did people look back on with nostalgia? Also, what was the nature of that nostalgia? Was it a dreamy wish for the past, the way the 1970s looked back at the 1950s in a pop-culture pastiche such as *Grease*? Or was it a distorted, twisted nostalgia, like the work of David Lynch in *Blue Velvet*? Certainly, there’s no right answer, but we offer a sense that

the nostalgia epitomized in *Pulp Fiction* is laced with and shaped by irony.

From there we move in a variety of directions. To understand the nature of the film, readers would need to know the plot of *Pulp Fiction*, the genre of Tarantino movies, and perhaps something about post-modernism. On the other hand, to better understand the nostalgia of the film, readers need to understand the nature of race relations and drug culture in the 1990s as contrasted with previous decades. None of these relationships is simple, nor can any be explained merely by the diagram. However, by creating this chain of relationships, in which each item tries to address what knowledge each claim depends on, we are able to trace out a set of assumptions that ultimately inform and constitute an argument.

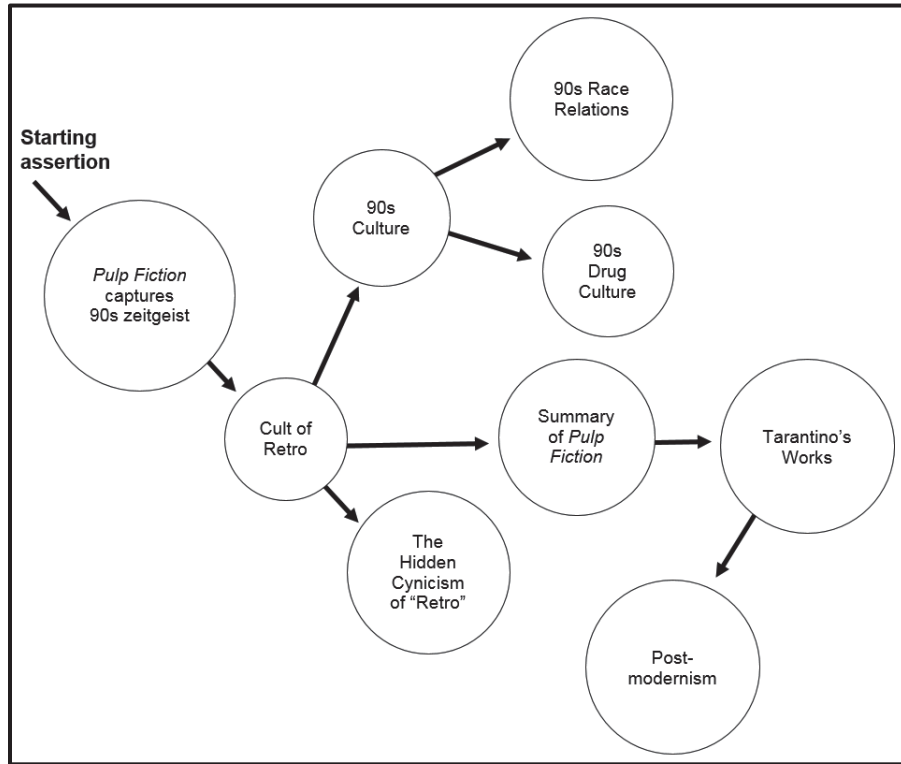


Figure 1: Sample Instructor-Generated CoD about Pulp Fiction

This original Chain of Dependencies was created for an Advanced Writing in the Arts and Humanities class, so the focus on a single film and its relationship to culture worked well in that context. When teaching a lower-division class thematically focused on education and intellectual development, Jessica created the following sample chain based on an argument she was writing for a collection on the state of English studies (see Figure 2). Like the *Pulp Fiction* chain, this CoD begins with a fairly well-developed

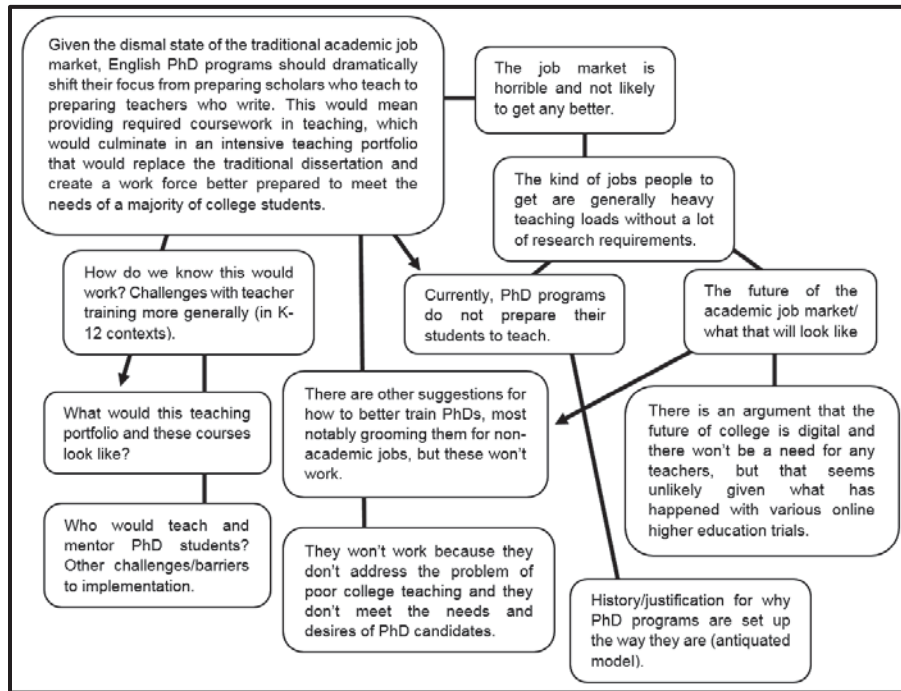


Figure 2: Instructor-Generated CoD about Graduate Studies in English

thesis statement, highlighting the role of this particular heuristic beyond the initial idea-generating phase of the writing process. However, unlike the original model, this chain has a variety of organizational options, as evidenced by the three arrows emerging from the original bubble, representing the three major things a reader might need to know if provided only with the thesis statement: the state of the job market, how Ph.D. programs currently train their students, and what the proposal would look

like. So, in this model, the writer is rehearsing different structural schemas while also exploring the connections between ideas. Like the previous chain, this is not a complete plan for an entire essay, but it does flesh out some necessary context and provide multiple visions for a conceptual structure moving forward. Unlike the previous chain, which is a teacher-generated engagement with a hypothetical paper topic, this one stemmed from the instructor's real-life writing process, thereby serving not only as a model of a CoD but a reminder to students that their instructor is also actively involved in writing and that these tools have applications outside of the classroom.

Case Studies

We used the CoD several times in classes. Mark used it twice for his introductory college-level course focused on identity and diversity, for two separate papers each. In the first paper (although the third in the assignment cycle), students were asked to evaluate the relative diversity in a social (though not necessarily online) network. They had to consider the obstacles to and contributing forces to diversity, which could be measured with respect to any, or any combination of, identity characteristics. In the fourth paper, students needed to evaluate the effectiveness of a program or policy designed to increase diversity within a different network. Both assignments required complex reasoning and the interrogation of underlying assumptions.

While Mark used the tool early in his paper sequence, Jessica assigned the CoD in preparation for the final paper in the same introductory writing course focusing on a different thematic (education and intellectual development); the assignment asked students to advocate for an approach to solving an entrenched educational issue. This assignment was unique in that some students were exploring an issue brand-new to them, while others had written an earlier paper with a similar topical focus, though different argument. This influenced the development of the CoD because some students (those who had done research for a previous paper) were able to provide more contextual need-to-knows in the bubbles, whereas

the students who were delving into a new topic often framed their need-to-knows as questions and used the tool as an impetus for further research.

One student used the CoD to explore the role of the Black Student Union (BSU) in helping to foster diversity on campus (see Figure 3). The CoD led her to reflect on the history of BSUs at predominantly White Institutions (PWIs). That history led the student to reflect on the differences in the contemporary BSU, that it is constituted of “*20 or so different org[anization]s,*” which led her to consider the racial makeup of the fraternities and sororities on campus; since black fraternities and sororities are also part of the BSU, she further considered the history and goals of those Greek groups. When reflecting on the open nature of the BSU, she encountered the misconception that BSUs are only for black students. Looking into the BSU also helped her turn her eyes outward to the larger networks in which the BSU engages, including the Black Alumni Association; its scholarships for Black students, which help diversity on campus; and their mentorship program, which connects students to “*big industries.*” A final link points to “*my experience.*”

The paper the student wrote offered a strong analysis of the role of the Black Student Union raising many of the points from the CoD in a coherent fashion. It was clear from analyzing the arguments that the CoD had helped her consider the role of the Black Student Union, beyond its overall relationship to diversity on campus. More importantly, in the essay, it was clear that the student recognized logical relationships between these associated points and was able to clearly signpost those in the essay itself. In fact, the chief weakness of the essay grew out of a portion of the essay that discussed part of her experience that, perhaps not coincidentally, is not fully developed on the CoD.

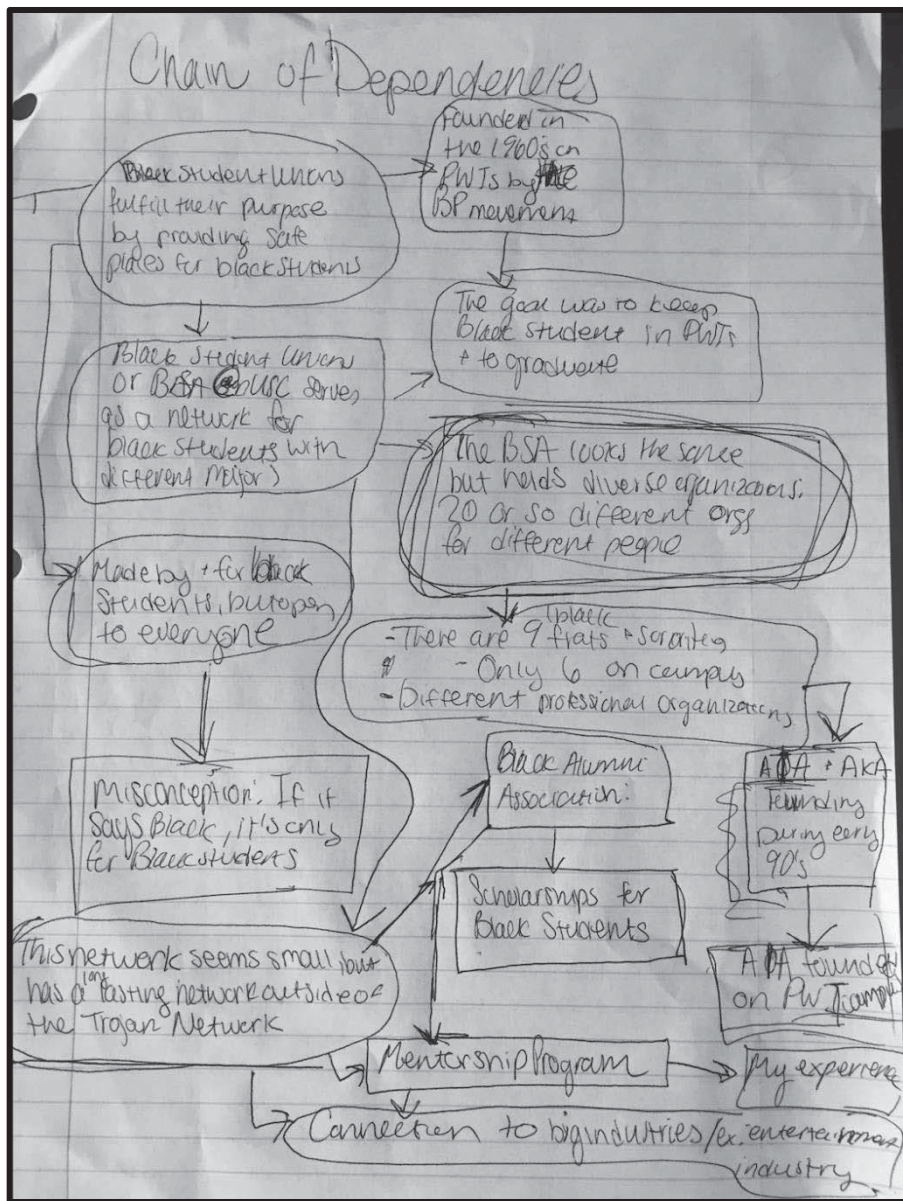


Figure 3: Student-Generated CoD about BSUs

Another of Mark's students analyzed the network Snapchat for its potential for enabling or limiting diversity (see Figure 4). She used a diagramming program to create hers and used the process in a very

different way. Rather than tunneling through the history of Snapchat, she considered various affordances of the platform.

This student used the CoD not to pursue the social context of a human network but the affordances and uses of an electronic network. The first link leads off to a consideration of the ten-second combustion of Snapchat media, which the student felt put “*more control in the sender’s hands*” and hence “*more privacy*,” while also leading to “*no tangible reference to image sent*” which she found led to “*no judgment*” and members being “*free to post for the sake of sharing rather than the pursuit of likes*.” At the same time, as a social media with “*sharing moments*,” Snapchat also led to “*unspoken judgment*” and “*intimate knowledge*” of “*day-to-day activities*.” These features lead to a “*fear of looking lame*,” a belief in the authenticity of images and “*unplanned images*.” Note how the student also marks two paradoxes, the lack of judgment and unspoken judgment as well as the self-censoring of “*leaving out details of daily lives*” and so-called “*authentic images*.” This heuristic led this student to write a sophisticated essay analyzing the affordances and paradoxes of Snapchat. The student’s organization of this seemingly more organized CoD led to a paper that was equally well structured. However, it is worth noting that the relationship between the ideas in the CoD is not hierarchical, despite the appearance of the branching tree-like structure. Instead, this CoD is highly dialogic, with the student raising ideas only to suss out their internal contradictions or paradoxes. Also, it is easy to see on this CoD the places where the student notices connections with other ideas.

Such clarity perhaps suggests that an electronic version of the CoD is preferable to a hand-drawn one, but we feel that such a reading mistakes form and product for a useful process. Certainly, the second student was able to identify paradoxes and contradictions. However, we see in the first example a student who is discovering relationships between ideas as she goes, as indicated by changes to the printed text, multiple arrows drawn, and multiple outlines of boxes for emphasis. We cannot easily see the process of discovery in the second instance, which is more polished, but not by any means a superior use of the CoD. In fact, the better use of the CoD

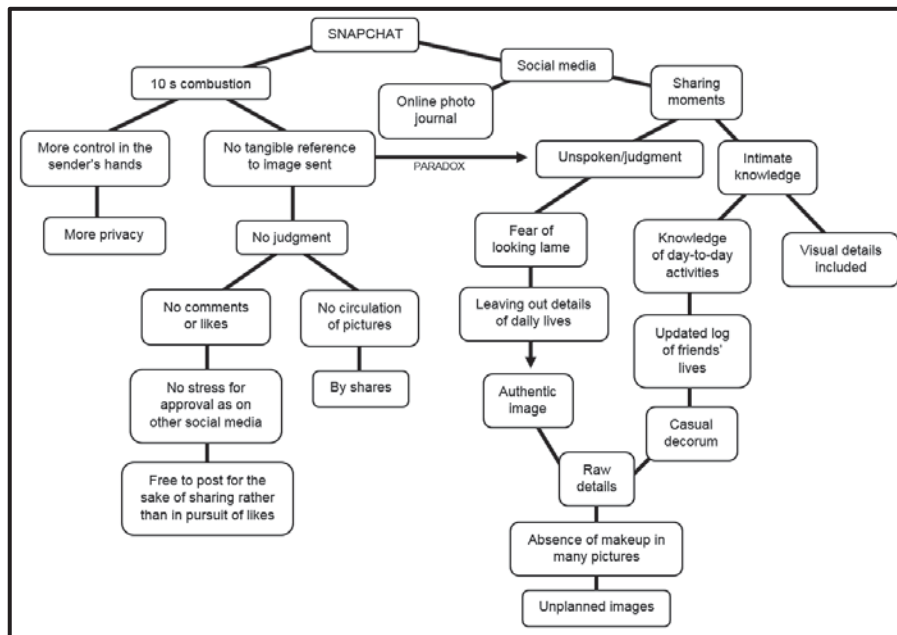


Figure 4: Student-Generated CoD about Snapchat

is no doubt as a process document, one that is meant as a stepping stone to understanding rather than as another showpiece in a final portfolio. We recommend these as tools of thought more than signs of perfected process.

In Jessica's class, a student used the CoD to explore his proposal that a theory from calculus could help improve how financial aid is calculated for middle-income students (see Figure 5). His CoD shows his acknowledgement that a reader would need to be introduced to a number of threads in his argument, including the details of the theory, their relationship to financial aid calculation, and the conversation around financial aid in educational circles, and the role that middle-income students play in that calculation. The frequent use of multiple arrows stemming from certain bubbles and connecting across the map illustrates the interconnectedness of the ideas but also highlights the challenges that this student faced with organization in the final product. Returning to the map throughout the process helped this student eventually determine a useful order

that took reader-response into account; he realized that it would work better to provide the necessary context, including the flaws in the current financial aid structure and current attempts to address those flaws, before providing the details of his proposal. In fact, he commented on this choice explicitly in the cover letter he submitted with his portfolio, which included this comment:

. . . in the first and second writing projects, I focus too much on arguing for my position before addressing any questions or backgrounds that need to be addressed. In my writing project 4, I addressed previous approaches to solve the current financial aid system, problem within the system, how the middle-income class is defined, and what exactly the current formula is before making an argument. I also found addressing the ‘need-to-knows’ very helpful in making a stronger argument and paper in general.

This student clearly internalized the use of the CoD for argumentation rather than idea creation; in the same letter he noted that he plans to continue to use a different heuristic “*in coming up with creative ideas*” and then transition to the CoD to “*make an argument.*”

While he didn’t state it explicitly, the CoD seems to have served as a kind of visual outline that allowed the student to know that he would get to the main thrust of his argument without needing to rush it. In short, he saw that he would eventually get to the math, but that the math would only be interesting or justified to a reader *after* the contextual information and a nuanced analysis of the complexity of the issue at play.

Student Feedback

Student feedback suggests that the CoD is helping to meet our original goals. The majority of students claimed that the tool was beneficial and enjoyable. While many students noted that they liked the visual nature of the tool, it was striking how many also commented on the way in which it helped specifically with organization, connection, and identifying counterargument or

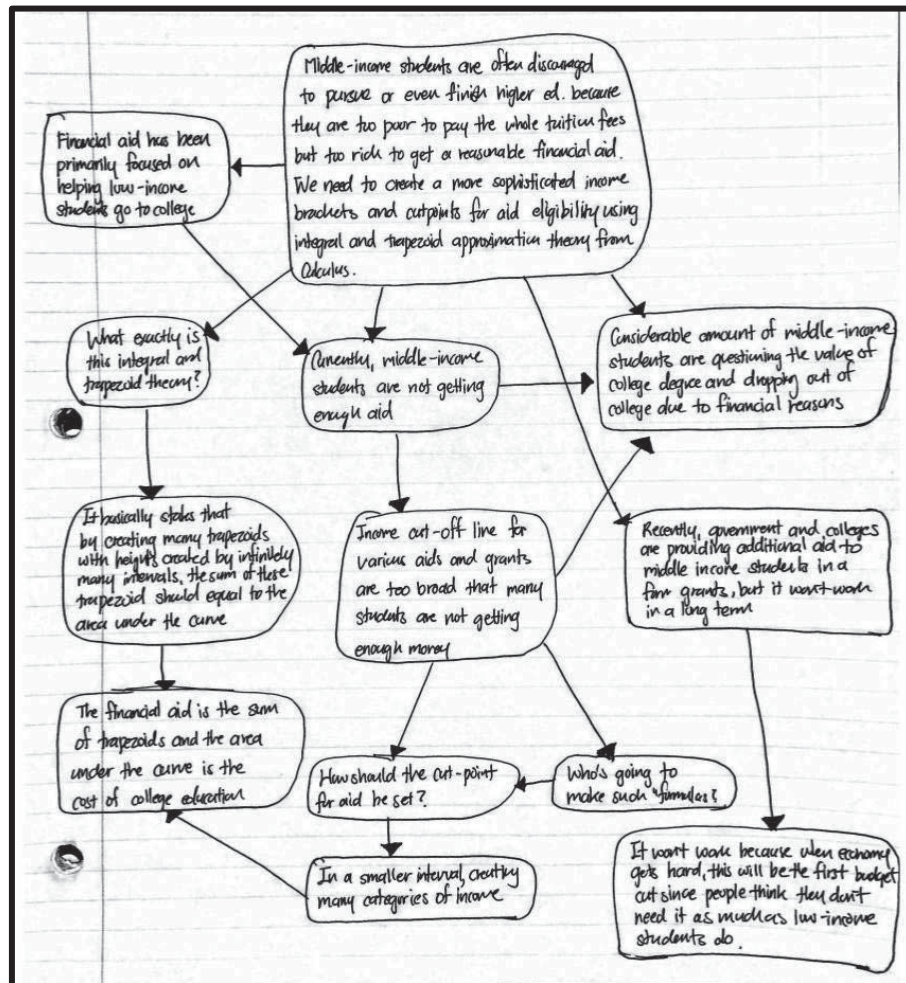


Figure 5: Student-Generated CoD about Financial Aid

“holes” in the logic. On this last point, student feedback suggests that doing the CoD before drafting may help students develop more complex theses that take into account different positions or potential counterarguments, or at the very least explore those counterarguments before they are proposed later in the process, often during peer review.

Here is a selection of student testimonials that illustrates these themes:

The chain of dependencies helped me to organize my thoughts and make links between my main points to create a cohesive argument. The chain of dependencies also helped me see holes in my arguments that I was then able to address in my essay.

The Chain of Dependencies helped me think of issues that I would need to bring up in my paper that I didn't think of before. It helped me with connecting all the different ideas I wanted to bring up in my paper. The CoD helped me most with my WP4 because I had so many separate ideas that I wanted to talk about and it helped me connect them. Also, I had to communicate to an audience that didn't know much about the topic so it helped me think of possibilities that I would need to address.

This activity helped me with figuring out what points of the issue I need to address. It helped me make connections across different topics and understand what points in history/current events to focus on. It also identified my biggest counterargument: whether this is more of a social issue than a procedural issue, and if a social issue can even be dealt with. But, it also helped me question if my solution to the procedural issue can in turn solve the social issue.

In short, most students found that the CoD did more than merely help them develop their thoughts; it helped them construct their essay.

However, the CoD did not work for everyone. According to some students, the heuristic lacked sufficient structure or seemed too “chaotic.” For those students, it seemed to help them “get their ideas down” but didn’t facilitate the ordering of points or development of logical connections in the way it did for other students. Others claimed that such heuristics rarely help them. While it is difficult to tell what would help the latter group of students, certainly the sense of “chaos” could be minimized by helping students to cull their CoDs or perhaps by offering more structured examples as points of reference. It would also be useful to emphasize the interaction between different writing tools and

the recursive nature of the writing process in general. The CoD can work well as a bridge between a more free-flowing idea development process (like free-writing) and a more formal outline, or it can be useful to return to it when stuck during drafting. Explicitly modeling the flexibility of the tool and its role as part of a toolbox of writing strategies might help address the concerns of both of these groups of detractors.

Perhaps the most positive feedback came in the form of a CoD that a student made for a paper in a subsequent class. While it is good to see what students can do with a heuristic in a writing class, it is gratifying to know that they find it useful in the challenging writing tasks that follow.

Ideas for Development and Expansion

In feedback, some students said they would have liked more of a structure given to them for the CoD. Since creating a structure of the argument is a second task, after the heuristic, we need to consider building secondary exercises that help the students spend more time drawing from their CoDs in the organization of the argument. Rather than overloading the students with a multiplicity of objectives when they are in the development phase, we could build this as its own class activity once the basic CoD has been developed.

As with any visualization heuristic, if students want to give minimal effort, they can create a relatively simple product and not reap much benefit (i.e., as you sow . . .). That problem could be overcome by requiring a specific number of links in every chain. However, as with most writing tasks, merely increasing the requirements of a task rarely will overcome half-hearted efforts. That said, if the problem was a weak understanding of the use of the tool, using more developed examples on the board in class might help to give students more directions to pursue.

Despite our warnings, sometimes a student's paper still developed into an "info dump." In order to counteract that tendency, in later experiments with the heuristic, we spent more time emphasizing the search for underlying assumptions, rather

than “context” more broadly. This emphasis seemed to help students see this heuristic more as creative and critical exploration of their own reasoning rather than merely as a tool for developing the informative context necessary to understand examples.

Other useful suggestions from the students included making CoD a group activity and making or finding an online tool that could create a CoD and allow the writers to edit it easily. Certainly, such tools exist, but we still wish to explore the use of CoDs in the lightest-weight, most easily accessible form, namely pencil and paper. The suggestion of making it a group activity is certainly useful, and it could also be employed in peer groups to encourage students to think with others. A final suggestion was “*having small ideas at first, and then making big (key) ideas built up from those smaller ones.*” This suggestion indicates that the tool may be useful earlier in the writing process as well, even before the student develops the working thesis. Though this signals a kind of return to (and perhaps comfort with) the more traditional mind-mapping goals, identifying the most basic assumption and moving toward more complex and abstract ones could also help students.

We are continuing to use the CoD in various contexts and look forward to seeing it develop. However, as with most tools, we realize that its evolution will depend on the creative engagement of students and faculty who use it, experiment with it, and revise it to meet their needs.

Works Cited

- Dornbrack, Jacqui, and Kerryn Dixon. “Towards a More Explicit Writing Pedagogy: The Complexity of Teaching Argumentative Writing.” *Reading & Writing*, vol. 5, no. 1, Jan. 2014, p. 1.
- Elbow, Peter. “Closing My Eyes as I Speak: An Argument for Ignoring Audience.” *College English*, vol. 49, no. 1, 1987, pp. 50-69.
- Eppler, Martin J. “A Comparison between Concept Maps, Mind Maps, Conceptual Diagrams, and Visual Metaphors as Complementary Tools for Knowledge Construction and Sharing.” *Information Visualization*, vol. 5, no. 3, Sept. 2006, pp. 202-10. SAGE Journals, doi:10.1057/palgrave.ivs.9500131.

- Flower, Linda. "Writer-Based Prose: A Cognitive Basis for Problems in Writing." *College English*, vol. 41, no. 1, 1979, pp. 19-37. *JSTOR*, doi:10.2307/376357.
- Goodnough, Karen, and Robin Long. "MIND MAPPING: A Graphic Organizer for the Pedagogical Toolbox." *Science Scope*, vol. 25, no. 8, 2002, pp. 20-24.
- Griffin, Cynthia C., Linda Duncan Malone, and Edward J. Kameenui. "Effects of Graphic Organizer Instruction on Fifth-Grade Students." *The Journal of Educational Research*, vol. 89, no. 2, 1995, pp. 98-107.
- Kirchner, Bharti. "MIND-MAP Your Way to an Idea." *The Writer*, vol. 122, no. 3 (3), 2009, pp. 28-29, ProQuest.
- Lamont, Judith. "Managing Critical Knowledge in Higher Education." *KM World*, vol. 18, no. 5, May 2009, pp. 20-25.
- Morris, Paul. "Planning at a Higher Level: Ideas, Form, and Academic Language in Student Prewriting." *The English Journal*, vol. 102, no. 2, 2012, pp. 85-92.
- Tucker, Joanne M., Gary R. Armstrong, and Victor J. Massad. "Profiling a Mind Map User: A Descriptive Appraisal." *Journal of Instructional Pedagogies*, vol. 2, Mar. 2010. *ERIC*, <https://eric.ed.gov/?id=EJ1056389>.
- Watson, Katherine. "A French Exception: Mind Mapping À La Française in the Cyberspatial Dimension." *TCC Worldwide Online Conference*, 2009, pp. 205-16. Google Scholar, https://www.editlib.org/p/43836/proceedings_43836.pdf.
- Yood, Jessica. "Present-Process: The Composition of Change." *Journal of Basic Writing*, vol. 24, no. 2, 2005, pp. 4-25.