USING VISUAL MAPPING TO COMMUNICATE CONNECTIONS BETWEEN LEARNING OUTCOMES AND STUDENT TASKS

Jay Wilson & Vincent Bruni-Bossio, *University of Saskatchewan*

Visual mapping is a method of presenting course material in a visual format to aid comprehension. This paper looks at applications of visual mapping in post-secondary courses to engage university students more deeply from the very beginning of a course, through creating visuals to which students can be constantly referred. We discuss our efforts to design visuals of learning outcomes, objectives, concepts, and processes in multiple courses. We will highlight the process we used to build the graphics and keyways these graphics improve the communication and understanding of learning outcomes, content, themes, and processes, primarily via knowledge visualization and visual perceptual learning. We also discuss sharing our discoveries with colleagues to help further develop our understanding of this approach.

Jay Wilson, Professor, University of Saskatchewan. Dr. Wilson is Head of the Department of Curriculum Studies at the University of Saskatchewan. His program of research centers on innovative learning design, experiential learning assessment, and design studio learning environments.

Vincent Bruni-Bossio, Associate Professor, University of Saskatchewan. Vince Bruni-Bossio is a Department Head in the Edwards School of Business. His program of research focuses on governance and strategy in organizations. He examines the norms, behaviors, and practices that influence decision making by boards.

INTRODUCTION

For university professors, it is difficult to know if students can access and understand the materials we are teaching. Even when underlying learning outcomes for a course are clearly articulated, the mental processes students must develop and the logic they must follow to achieve each learning outcome can be challenging. For example, it may be easy to state that someone should learn how to use an analytical tool to inform a decision by the end of the course, but teaching someone the mental steps and psychological processes needed to use the tool when making a real-life decision is not easy to impart. Decision making is complex and requires that we understand the pitfalls of decision making, such as cognitive biases (Russo & Shoemaker, 2002) and groupthink (Janis, 1991). Trying to teaching someone the theory of decision making is akin to explaining to the theory of how to ride a bike before they have tried to ride one.

Professors have utilized a range of methods to ensure students achieve learning outcomes; some are successful; others are not. We may organize our lectures differently, employ a range of instructional strategies, or use new materials. These efforts may be in vain if our students do not understand the mental process and logic needed for learning in our courses.

Often, we find instructional success by trying new approaches or by borrowing them from other disciplines and then purposefully applying them in our specific contexts. However, what works for one group may not work for others, and, for this reason, we may still struggle with the issue of how to teach students to think about issues.

Applying visual mapping is one method that has been successful in laying out the mental and logic processes needed for a student to achieve learning outcomes. Visual mapping aligns with Meyer's (2014) Cognitive Theory on Multimedia Learning, which outlines that, when a learner has lower prior knowledge on a subject, using a graphical representation contributes to retention because the key concepts are more visually accessible to the learner.

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In the approach introduced in this paper, we seek to assist student learning by purposefully visually mapping the learning outcomes, objectives, and tasks students must perform in a course. These visual maps are visual representations of the critical elements of our courses in Business and Education presented as a one-page image using shapes, colors, and showing the relationships of ideas graphically. These visuals illustrate the mental and psychological processes students need to develop for the intended learning to occur.

A graphical representation of learning (e.g., a visual) promotes discussion of the conceptual connections that students should be making in their respective disciplines and how these connections relate to the learning outcomes of the course. Overall, using visuals to communicate key learning concepts and processes is an approach we have found helps students understand the primary purposes of the class. We have also discovered that visual references reinforce the meaning behind tasks students complete because they see the connection with their learning. For these reasons, we decided to use visual mapping in our courses to improve the impact we were having on students.

Verbal and non-verbal feedback from students led us to believe that, at times, they were confused despite our efforts to communicate clearly about content. Our instructional efforts included using multiple teaching opportunities such as explaining concepts to students in lectures, creating exercises to apply concepts, follow up discussions in class, and meeting with students individually or in groups outside of class times to explain the concepts more specifically. Throughout these teaching opportunities, we noted that students were still struggling to understand concepts and how these concepts connected. For example, when presenting students with analytical tools, it was difficult for students to grasp how the conclusions from the tool could be used to inform decision making. In our experience, without an understanding of the intention behind a tool or framework, students only gain superficial knowledge of what they are taught. To assist students with grasping the underlying concepts in their learning process, we experimented with visual maps. We developed the maps through a combination of research, discussion, trial and error, and building upon the work of others.

STARTING OFF

Both authors work in professional colleges (Business and Education) where it is required that students understand and can apply their understanding in complex and authentic situations. Teaching in a professional college also means students need to reach a level where they will retain and apply learning in their careers. Both authors have used real-world examples, case studies, and experiential learning strategies to reinforce core course concepts. The authors' experiences suggest that while these approaches work at times, in many

instances, feedback from learners and observation showed that a gap still exists in students' understanding of basic concepts.

To address this gap, the authors hoped visuals might help. The challenge was ensuring the visuals would not be teacher-centered in a way that would interfere with the focus on student learning during experiential exercises.

Through trial and error, the authors learned using visuals to enhance student learning providing much-needed guidance before students embarked on their student-centered activities. This approach aligns with scaffolding (Glazewski & Hmelo-Silver, 2019), which begins with an initial input of information from the instructor and then gradually transferring the responsibility for learning.

The process began in earnest when we met to discuss using graphics in our teaching and reflected on existing practices and how we might expand on them. It was then that we realized that we were already using graphics in some of our courses as logic maps and logic models but not necessarily to provide an overview of the whole course. One of us had already undertaken some exploration of generating a visual representation of what was important, but the efforts were peripheral rather than foundational. Part of our experience involved observing student learning during marketing, project management, assessment, and program evaluation courses. We noted that students often seemed confused about how the content and exercises in the classes linked together to form a coherent understanding of a subject. We wondered how we could assist students in developing a greater understanding of the content they were learning. We were aware that some colleagues used prepared imagery to communicate the logic of class and illustrate specific concepts and strategies. Although the approaches varied from using a visual metaphor for an entire marketing course to a logic maps in strategy types courses, we thought there might be an opportunity to expand on the work of our colleagues to understand better how visuals can help student learning. We wanted to find a clear and concise approach that was repeatable when teaching students complex and abstract concepts learned in courses such as program evaluation, decision-making, strategy, and marketing. We had not come across an approach that tied a course together previously but felt visuals might hold the key to success.

THEORETICAL FOUNDATIONS

Difficulty in Meeting Market Demand for Student Learning

Rather than set off blindly, we began by reviewing existing research to support and guide our intent. Our initial review of the literature focused on the design constraints of courses when trying to meet market demand. For example, research showed that there are gaps between the needs required in

the job market and the skills taught in universities (David et al., 2011; Jackson & Chapman, 2012; Pfeffer & Fong, 2002). Ensuring proper skill development is often dependent on how a course-based curriculum is designed and delivered. Our courses are grounded in experiential learning and cover a range of topics, including senior undergraduate strategy courses, an MBA strategy course, graduate-level, and undergraduate level Education courses. Kolb's (1984) work on experiential learning (EL) that emphasizes "the process through which knowledge is created through the transformation of experience" (p. 41) was helpful in guiding our understanding. The increasing expectation of professional colleges to ensure that students have appropriate skills for the job market has resulted in a call for more experiential/practical learning (David et al., 2011). As a result, our colleges, like many colleges, have focused heavily on capturing the benefits of community-engaged learning and service learning, two forms of experiential learning where students work with the surrounding community as part of their learning process (McCarthy & McCarthy, 2006; Lenton et al., 2014; Kahne & Sporte, 2008). Despite the benefits, these types of courses are often more demanding, requiring a higher workload from students combined with high ambiguity in terms of outcomes (Lenton et al., 2014). Communicating the learning outcomes for such courses can also be challenging, especially since students often struggle to see how tasks connect to learning outcomes (Eyler & Giles, 1999).

The experiential learning components of our courses in areas such as program evaluation, business strategy, decision-making, and others often including complex, intangible processes. Within this context, we were helping students understand what they were learning posed an interesting challenge for us, forcing us to find an innovative solution.

The Challenge of Aligning Learning with What is Taught

Regardless of whether a course is experiential or not, the main challenge of explaining to students why they must complete certain tasks always exists. For example, our experience and conversations with other professors using multiple approaches have revealed that irrespective of the type of course, students are often unable to integrate different foundational concepts of the course for themselves.

Professors face an ongoing challenge to align learning with what they intend to teach. Clearly defining and expressing learning outcomes and objectives enables professors to reflect on what they want to teach and compare this with what students learn (Allan, 1996). Another significant challenge for professors is to view learning from a student's perspective to ensure that learning outcomes and objectives not only align with tasks but are also clearly understood by students (Allan). Harden (2002) outlines that what is most critical is that outcomes and objectives be clear, user-friendly

in nature, and highlight the key learnings. These points must be addressed while still offering a flexible framework, consideration of the appropriate knowledge, skills, and attitudes needed in practice, articulating what is achieved and assessed, and engaging both teacher and student to give them some ownership in the process (Harden).

Foray into Using Visual to Enhance Learning

To assist professors in demonstrating how learning outcomes and objectives are linked to tasks students must complete, we utilized a process that integrates principles from three relevant areas of the literature (knowledge visualization, visual perceptual learning, and alternative tasks for learning).

Research shows that knowledge visualization enhances innovation and creativity in team processes using templates and sketches (Eppler et al., 2011; Suthers, 2001). At the K-12 level, "anchor charts" have been used to successfully create connections that will support learners in their understanding of vital and complex concepts (Hendrix & Griffin, 2017). These graphic reminders help to reinforce learning by minimizing student cognitive loads (Kaufman, 2010). Knowledge visualization is particularly useful for connecting learning outcomes and objectives with tasks because it enhances the ability to assess information, facilitate knowledge transfer, and share insights among individuals (Anglin et al., 1996; Eppler & Burkhard, 2007). In our experience, students often state they feel overwhelmed in classes where the outcome requires learning a process without a clear right or wrong answer. Leveraging principles of knowledge visualization can, therefore, help learners to understand connections between ideas and encourage them to ask questions about why and how things are linked.

Every discipline also has core concepts that students struggle with, often referred to as "threshold concepts" (Meyer & Land, 2003), that need to be approached in multiple ways to be understood. Each unique way of addressing the threshold concepts gives the learner another avenue to explore. Visual mapping provides a point of discussion for threshold concepts using metaphors and connections.

Using a visual picture to map out course objectives and tasks also draw upon a phenomenon called task-irrelevant visual perceptual learning (Watanabe et al., 2001; Watanabe & Sasaki, 2015). The key idea is that the type of task used for visual perceptual learning does not need to be relevant to performing the actual subject or skill, but instead enhances learning by only increasing exposure to the subject matter or task (Watanabe et al., 2001; Watanabe & Sasaki, 2015). Using a visual map as part of the learning process does not, therefore, interrupt learning but rather, by asking students to look at learning outcomes and processes from a different (e.g., visual) perspective, augments and improves the learning process.

OUR DESIGN PROCESS

As alluded earlier, in one of our many conversations about teaching and learning, the idea of using visuals was raised by both authors. We experienced similar instructional challenges, and both had experimented with using visuals on a limited basis. Recognizing our shared curiosity, we decided to explore developing a formal process around using visuals to teach important course content and process to students.

Both authors teach upper-year undergraduate and graduate courses, which requires that students learn intangible processes that often lead to intangible outcomes. This instructional dilemma posed the added challenge of helping students to understand what they were learning as well as learning the required skills.

For example, one author taught a capstone strategy course in a business school. This course required that students learn how to think through strategic analytic processes to arrive at the best option. In another example, one author taught a program evaluation course that uses a logic model to show a process, but the emphasis was not solely on the image but using it as a supplement to the process. Another example was working with pre-service teachers introducing them to the concept of assessment. They had to understand the three types and different situations in which they would apply them. Anyone who has taught courses like these, where learning outcomes are not easy to articulate for students, will most likely have witnessed students expressing frustration when trying to understand what they need to learn.

The challenge of trying to explain a complicated process to students led to many failed experiments that included various discussions, special assignments, and private meetings individual meetings with students. One of these experiments included the Business professor meeting with student groups in one-hour sessions to discuss the logic of the strategy process. Although these student-instructor meetings helped build trust with students, the group discussions left the learners confused and unable to complete specific tasks. At this point, the author had not used visuals of any kind. The following year, the author tried the same approach of meeting for one-hour with all student groups and in one of these meetings, in a moment of desperation, drew a series of boxes to illustrate the logic of strategy (see Figure 1).

Students immediately responded positively. Although these original diagrams were completed on scrap paper and, therefore, not retained, we can say they were fundamental in comparison to the final chart that is used in the course now. The first charts outlined three boxes. The middle box was labelled "Decision" to represent a necessary decision. Above this was a box labelled "Analysis" which was separated into three sections to represent different types of analysis needed for the decision. Below the decision box was another labelled "Solution". The visual illustrated that students needed

FIGURE 1. Initial diagram from student meeting.

to complete an analysis before deciding on solutions. Since the first draft, the chart has evolved in sophistication to outline various aspects of strategic analysis needed in the decision process. Students have expressed that the visual assists with understanding the logic of what is being taught and as a platform for communicating and asking questions about the logic.

In the course on assessment, there were times where out of frustration or as a teachable moment, the Education instructor would begin to illustrate his understanding of the evaluation on the whiteboard or on paper (see Figure 2). The process usually consisted of grabbing a marker and trying to illustrate the progression through the three types of evaluation. Other times, it was using paper and a document camera that projected to the screen.

The image was usually one color—black and big enough to see but not clearly labeled. The instructor would use what made sense to him to guide the creation of the graphic and would stop during the drawing process and explain or highlight what was being created. The random act of creativity began to become more regular overtime. In the class where it was drawn, and in subsequent lectures, the graphic would be referred to by the instructor. It became a powerful learning tool. Some students would take pictures of the

FIGURE 2. Assessment course sketches.

map with their phones, but in the first three instances, no permanent class-wide artifact was created. The whiteboard drawing seemed to be effective but was not a formal part of the learning process. In the fourth year, the application of the doodling evolved so that as a group, the professor and students doodled together. The discussion focused on what was happening, and more input from the students was solicited. The instructor would capture the image once complete and upload it to the course learning management system for reference. The just-in-time whiteboard approach was successful; so, it was expanded to ask students to come up with a unique visual model in successive courses. In year five, visuals became part of an assignment in the course where students were asked to create a visual that represented their understanding. These creative artifacts were submitted for feedback as a formative assessment. This process evolved to include not only hand-drawn images but also web images and memes to create visual metaphors.

Based on these experiences, both of us believe that students learn better with visual reinforcement, even if it was not intentional or was merely supplemental. Excited with these outcomes, the authors began to wonder if using visuals intentionally and as a major focus in our courses might assist other professors.

FIGURE 3. Whiteboard business strategy example.

NEXT STEPS

Armed with the knowledge from our experience, the experiences of others, and published research, we set about our task of creating visual maps as an ongoing learning tool for our specific courses. We took on the challenge of how to make the use of visual maps, a process that instructors across institutions could integrate into their courses. We decided to engage in two processes. First, we would create visuals for all our courses, and second, we would assist other professors in doing the same.

As shown earlier, the visuals were designed and constructed based on the outcomes or objectives of the courses. Outcomes and objectives represent foundational course knowledge as well as the overarching learning components. However, one challenge with all courses is ensuring these outcomes clearly articulate this information. Before we could design visuals, we needed to review each outcome and make sure it made sense with course design. With this in mind, we reviewed the outcomes of our courses. This review included comparing what we were doing to professional expectations and looked for drift, which happens over time with program changes. We expanded, updated, or revised our outcomes. Once we expressed the written outcomes in a manner that represented the intent of the course, we moved on to the creation of the visual maps. We noted, at this point,

FIGURE 4. Whiteboard education evaluation example.

FIGURE 5. Final management consulting course.

FIGURE 6. Final program evaluation course.

that the process of preparing to draw visual maps had already altered how we thought about our courses and improved our ability to articulate learning outcomes.

Working with colleagues in a collaborative setting, we began by creating and sharing a few sketches and pictures we had taken of whiteboard examples (see Figures 3 and 4).

During this design process, we exchanged ideas between ourselves and helped our colleagues to do the same and sketched out a few basic designs. There were no required elements, and we encouraged everyone involved to create something that worked for them.

Each professor created visuals for their courses and then explained the sketches to other colleagues for comments. While collaborating and brainstorming helped, it was still difficult for ourselves and many of our colleagues to come up with visuals that communicated the logic of what needed to learn.

After many failed attempts to create a visual for each course, we realized two key factors. First, we realized that to be valid for teaching, a visual had to appropriately articulate the learning outcomes as well as the area of learning. Second, given the complexity of the diagrams and visuals considered, we realized the final visuals would require us to engage the services of someone with graphic design skills.

After the first attempt, we decided to further develop the concept for ourselves and others by contracting a graduate student who had a degree in visual design to create materials for our courses. We asked the graduate student to take the basic sketches from the workshops and develop a series of potential visual course maps.

Each colleague met with the designer and used the visuals to explain the logic of the content they were sharing and to answer any questions the graphic designer might have. It was also essential for us to explain the learning steps to the designer so that he had a sense of what we were trying to do. After meeting with each of us to review course outcomes, the designer created a range of visual maps from which to choose. The designer then met with each professor involved in the process

individually to discuss the visuals and if they would be effective.

From these meetings, several designs were selected and shared with students. Feedback and preferences from other professors were solicited. It should be noted, one of our colleagues felt that the first visual proposed by the graduate student, which presented flow diagram had too much detail and, for this reason, failed to make the learning process accessible to students. The professor felt the visual would make it more confusing for students to understand the learning process. The visual designer had to return to the drawing board and recreate an entirely new visual. The new visual presented a visual metaphor instead of a flow diagram, which symbolized the key ideas in the course. This experience provided a lesson to us around the care needed to get a visual that can assist the learning process. It reinforced that having an inappropriate visual may, in fact, make the learning process more difficult.

Through such collaborations, revisions were undertaken, and a final choice made for each of the courses (see Figures 5 and 6).

Rather than restricted to set criteria in the beginning, we chose the visual maps based on our ideas and feedback from others. As we were creating the maps for the first time, we did not want to predetermine or limit our options.

Having someone skilled in visual design certainly helped; however, it also created the need to rely on someone not involved in the course. One benefit of this is that it facilitated new discussions about the courses by having to explain the course to someone who had not taken it. In this way, the process helped us to think more objectively about the course. For this reason, we were receptive and grateful for another perspective supporting the creative process. The evolution of each visual was ultimately based on the satisfaction of each professor but always open to modification based on course content changing and feedback from students and peers. One example (see Figure 7) of the importance of this feedback was an example where a student's design that was clearly understood by the learners was adopted for the course.

Although we developed what we considered a sound process, we had only used the process in seven courses involving four professors.

We needed to share our idea and process for more feedback and to experiment with more trial and error. Similar to the previous gathering, we delivered a two-hour presentation to

FIGURE 7. Education assessment course graphic.

local faculty. The event was attended by three professors and one instructor, representing the disciplines of Kinesiology, Nursing, and Instructional Design. We asked each to bring a syllabus to use as a guide. We presented an overview of our research and example from our courses. Then they were asked to take the outcomes from their courses and design a graphic. The process was well-received, and it gave us more insight into the development process from other areas.

A second workshop was planned and delivered at MOBTS, international teaching, and learning conference geared towards those instructing in business schools. To prepare for this workshop, we asked the graduate student to meet with three other professors at our institution and design a visual map for each of their courses. This approach allowed us to further test the idea before presenting at the conference and to present on a wider selection of courses. The workshop was attended by ten professors representing mostly schools of business. During the workshop, we included an opportunity for all participants to create visual maps for their course. This process revealed many more examples of visuals as well as ways to approach the creative process.

A significant learning component from working with colleagues and running the two workshops was the idea that visual had to use metaphors and a logic that makes sense to the area being taught. Throughout our process, we discovered a series of archetypal visuals that worked better for different types of courses. For example, we discovered that "process visuals," which showed a logical series of connected steps, were useful teaching courses that involved steps or thought processes students in following, such as in strategy, consulting, or project courses. A "concept visual," which showed how multiple factors came together to form

an idea for students that was integral to the course, was helpful for courses involving abstract ideas such as branding and marketing. “illustrative metaphors,” such as a person running to teach anatomy, were helpful in teaching courses where students had to learn many details that related to one main thing or idea.

OUR REFLECTIONS MOVING FORWARD

In conclusion, we summarize how this process impacted our practice in terms of design, discussion, assessment, and interaction with our peers.

Curriculum Design

The focus of our efforts (applying unique knowledge visualization and alternative task techniques for creating a visual map of learning outcomes and objectives with student tasks) aligns directly with many of the core elements of good curriculum design and effective teaching. Specifically, in the area of faculty education, this work is “demonstrating tools that help educators navigate predicted future classroom challenges” (MOBTS, 2018) and “generating dialogue around what learning is and how learning has changed over time” (MOBTS, 2018). Overall, what we are developing assists with the demand for educators to better explain *why* students must complete tasks, which increases understanding by students and accountability by educators. A key idea that we feel can be addressed further is the notion of two types of visuals; concept and process. Through feedback and usability testing, there appears to be a specific look or design that works best for the concepts we are asking the students to learn. More exploration in this area is needed, but we feel it is a path worth following. Choosing a design that fits a topic may provide an advantage over simply experimenting or starting from scratch.

A Reference Point for Discussion

A visual depiction of the learning process not only assisted us with the launch of the courses but can be referred to repeatedly. For this reason, it was essential for us to clearly explain the visual to the learners initially so that future conversations were based on a shared understanding. We found that explaining the visual at the beginning of the course was only a first step. The benefits of discussing the same visual map at various times in the term were that it allows for a constant revisiting of the mental process and logic needed for the course. This “revisiting” assisted in increasing overall student understanding and learning because it took students through a process of alternating between the course tasks and exercises and looking and discussing learning outcomes visually.

Our experience suggests that students benefited from using the visual mapping concept throughout the term to create an ongoing dialogue with other students about the

learning process. This initial success progressed to encouraging students to create their own visuals to demonstrate understanding and address individualized learning. We discovered that learners might find it very helpful to create their personal graphical representation of the work. What this means is that in addition to the main visual, sub-elements of the course content can be further divided. The level of granularity can be scalable based on the content, so aspects of the initial visual can be supplemented. Students may encounter other content that needs to be broken down further. This “personalized understanding” can also be shared with others.

The visuals facilitated foregrounding the content of courses over other factors such as the course title or the reputation of the professor. Students saw the content and how it unfolded and built upon itself. After using the visuals, students reported they had more confidence in the ability to understand the content. Visual maps assisted with student learning, particularly in courses with complex models or theories. Students shared that they had “a-ha!” moments due to the constant exposure to the visuals, which helped vital concepts make sense. When they were confused by specific relationships, the visual served as a touchstone that could be brought into play when needed.

Formative Feedback

As professors, we are always looking for feedback on our approaches to teaching. Using a visual allows for a formative evaluation of student experience and learning. We found that when discussing a visual, both professors and students were better able to identify and articulate areas where confusion existed. In some cases, the graphic-focused discussion resulted in an update or modification to the visual or a variation in the presentation of the visual. Using the same visual map at various times in the term can, therefore, not only increase student understanding and learning but also help the professor identify what is working and what is not.

Sharing

Another key part of this experience was sharing between professors. Even though we are in different disciplines, the ability to share with one another and see different versions of the visuals and different approaches to the designs were extremely beneficial. In assisting other professors with creating visual maps, we noted that creating the visual maps was an area where many professors we worked with struggled. Many found it challenging to determine where to begin when visually mapping a course. Many professors felt that incorporating graphics or models which already existed in their professions and courses or other premade materials was too generic and only tangentially helpful in teaching students. Such materials did not always capture the specific intent of the course. The process also has the promise to help new professors to a course through facilitating

the transfer of the overall understanding of what is to be taught. The visual mapping may also prove helpful for those coordinating multiple teaching sections of similar courses or for groups of professors with similar courses.

CONCLUSION

This experience helped us to examine our courses in a unique way that enhanced our understanding of linkages in content and tasks. The creation of visual materials also provided new and innovative ideas on how to communicate course learning outcomes. We had to more deeply understand or revisit our courses, a refresher of sorts that strengthened our instructional approaches.

It also was helpful to take students through a process of alternating between the course tasks and exercises, looking at and discussing learning outcomes visually. Using a visual map did not interrupt learning but instead enhanced it by asking students to look at learning outcomes and processes from a visual process. It allowed everyone to think about learning differently. The main activity in this process is to create visual logic to represent the overall course. Sometimes this process can be done in one visual, and sometimes it requires a series of related visuals. We feel that there is potential to use visuals more broadly in all disciplines. We will continue to use, change, and experiment with different designs. In our experience, using visual mapping has produced very positive results. Students have expressed that through the process, they have the means to discuss the entire course and to make linkages between tasks and learning outcomes.

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