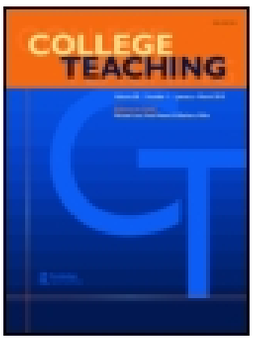

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Concept Maps: Active Learning Assessment Tool in a Strategic Management Capstone Class

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ABSTRACT

Teaching a business program capstone class presents a double challenge, requiring the educator to integrate different functional areas of business and evaluate student learning. This paper discusses concept maps as an active learning assessment tool in teaching a strategic management capstone course. Concept maps are used to meaningfully depict knowledge and present illustrations of relationships between concepts in a particular course. This study reviews 54 individual and 19 group concept maps collected over three semesters. The analysis affirms that concept maps are a powerful pedagogical tool that requires students to reflect on the knowledge gained during a course.

KEYWORDS

active learning; assessment tool; capstone course; concept map

Introduction

According to Bailey, Oliver, and Townsend (2007, 66), a capstone is "a top or crowning stone of a wall"; as such, a university capstone course is a "culmination of students' studies in a particular subject area." Capstone courses are designed to holistically integrate previously acquired knowledge and skills, helping to bridge theory and practice (Rowles et al. 2004). For an academic instructor, the challenge is to not only "design an effective teaching exercise for use in the capstone course that is rigorous, integrative, and interdisciplinary" (Sanyal 2004, 55) but also assess student learning. Assessment is a multidimensional process used to evaluate classroom learning and to provide feedback for improving both learning and teaching (Michlitsch and Sidle 2002).

In extensive prior literature on capstone courses in management and business programs, one of the most commonly identified goals is integrated understanding of the different functional areas of a company's business activities (accounting, finance, human resources, marketing, and management; Hartenian Schellenger and Frederickson 2001; Mong 2011). Concept mapping helps to align this goal and the type of assessment used to measure its achievement. According to Ku, Shih, and Hung (2014), concept maps are mainly suited as: (1) a teaching method; (2) a learning tool; and (3) an assessment tool.

This paper investigates the use of concept maps as an assessment tool. It is structured as follows. After first defining a concept map, the paper then describes how and why a concept map can serve as an assessment tool. Next, results of the study conducted on the use of concept mapping in a strategic management capstone course are presented, followed by conclusions on its effectiveness.

Theoretical background

Capstone course in strategic management and assessment of learning

Strategic management is defined as the process of making decisions and planning, implementing, and evaluating actions that sustain an organization's successful long-term performance (Thompson et al. 2016; Wheelen et al. 2015). Since this process involves analyzing different aspects of business—e.g., accounting, marketing, manufacturing, and human resources—students usually take the strategic management course as the capstone class in their academic program.

Capstone courses are designed to meet three major goals: (1) consolidate and apply knowledge gained from previous courses in a variety of disciplines; (2) serve as a bridge to professional employment; and (3) develop students' soft skills to increase their employability (Domke-Damonte, Keels, and Black 2013; van Acker and Bailey 2011). Capstone courses do not usually deliver new content, focusing instead on how to holistically combine different aspects of managing a

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business (Bailey, Oliver, and Townsend 2007). Traditional tests and examinations might be ineffective for this type of a course, as these assessment methods are frequently found to lead to memorization (Ramsden 2003), meaning that student grades may not reflect achievement of the learning goals. There is, thus, a need for a type of evaluation that measures more active and deep learning (Asikainen et al. 2013). In this regard, the learning-oriented assessment approach introduced by Carless (2007) might be a better choice.

As colleges increasingly shift from lecture-only teaching to interaction in the classroom (also known as active or engaged learning; Malliaris and Guder 2015; Sanyal 2004), a recent trend in teaching strategic management is to give students' authentic experience to help them understand the challenges of a business environment (Domke-Damonte, Keels, and Black 2013). Students are partnered with local businesses and complete a project that benefits all the participants. Students, thereby, gain experience in a real-life business situation, in which they have to develop a strategy and present it to businesses owners and/or their classmates. For educators, the challenge remains of how to evaluate students' grasp of holistic strategic management, which they are expected to develop through their learning activities.

Concept maps defined

Originally introduced by Novak in 1972 (Novak and Cañas 2006), concept maps were developed as a tool to depict changes in children's learning of science and their understanding of concepts. Three main principles of Ausubel's (1962) assimilation theory served as the foundation for this tool: (1) development of new concepts is based on prior relevant concepts; (2) knowledge is structured hierarchically, with the more inclusive general terms at the top and the less inclusive specific terms at the bottom; and (3) when meaningful learning occurs, the relationships between concepts become more precise (Cañas and Novak 2006; Novak and Cañas 2006).

Concept maps are probably the most commonly used graphical tools for meaningfully depicting knowledge structures (Croasdell, Freeman, and Urbaczewski 2003; Ruiz-Primo 2004). These maps use nodes in the shape of circles or boxes to represent important concepts in a particular subject area, and these terms are connected by lines. Words on the lines connecting two nodes describe the type of the relationship between those concepts (Jacobs-Lawson and Hershey 2002; Novak and Cañas 2006; Ruiz-Primo and Shavelson 1996). A combination of two nodes and a line between them is the smallest unit of analysis (Ruiz-Primo 2004). Although concept maps are usually represented hierarchically, with the most abstract concepts at the top and more specific concepts below, circular structures may be used to emphasize dynamic relationships (Cañas and Novak 2006; McDaniel, Roth, and Miller 2005; Safayeni, Derbentseva, and Cañas 2003).

Concept maps serve as visual aids to help students organize concepts holistically on one page, which reflects the depth of their understanding of particular concepts (Cornwell 1996). The following steps for creating a concept map are recommended (Croasdell, Freeman, and Urbaczewski 2003; Novak and Cañas 2006; Simon 2007):

1. identify a central concept and write that term in the middle of the page;
2. think of other related concepts and write them on the page near the central term;
3. connect related concepts with lines;
4. write a word or a phrase that describes the type of a relationship between connected concepts; and
5. keep adding more concepts and relationship lines until the full network of relationships is depicted.

Originally, concept maps were drawn by hand, but there are now several computer programs – e.g., Inspiration, Knowledge Manager, Cmap, and Smart Ideas – that can be used to illustrate a concept with icons and clipart (Novak and Cañas 2006; Simon 2007).

Use of concept maps as an assessment tool

Concept maps can be used for a variety of purposes: to evaluate an individual's or a group's knowledge of a topic; to develop new ideas; to communicate complex ideas; to share knowledge; or to explain the goals of a particular course (Cornwell 1996; Siau and Tan 2008). Since creating concept maps requires students to identify the relationships among concepts, then the mapping process is "a learning experience in and of itself" (Jacobs-Lawson and Hershey 2002, 28).

Although concept maps share some similarities with other forms of visual presentation of knowledge, they have unique characteristics. For example, flow charts illustrate the sequence of tasks rather than conceptual hierarchy; organizational charts represent hierarchy but not concepts and the types of relationships between them (Eppler 2006). Previous literature

identifies the following advantages of concept maps (Fiol and Huff 2007; Siau and Tan 2008):

- help to focus on one concept and trigger memory;
- encourage students to reflect on concepts;
- highlight the priority of key factors;
- can provide missing information;
- can reveal gaps in information.

Business capstone courses are designed to teach students how to integrate different aspects of strategic management into a holistic framework of a company's strategic position (Albert and Grzeda 2015). Therefore, a concept map may potentially be a useful means to evaluate student learning. In combination, the above-mentioned functions of a concept map seem well aligned with the capstone course's purpose. For evaluating learning, one of the advantages of concept mapping is that it requires students to demonstrate their understanding of particular concepts by graphically depicting those concepts and the relationships between them (Cañas and Novak 2006; Simon 2007).

A completed concept map can be analyzed using one of the following methods (Croasdell, Freeman, and Urbaczewski 2003; Simon 2007):

- counting the total number of concepts used on a map;
- counting the total number of relationships between concepts;
- evaluating the map's complexity;
- comparing a student's concept map to that produced by an instructor or expert;
- comparing maps created by the student at the beginning of term and at the end of term.

Concept maps represent a unique tool that allows both qualitative and quantitative analysis of an individual's knowledge of a topic.

Effectiveness of concept maps

Meaningful learning (as opposed to rote learning) instills knowledge structures conducive to developing creative thinking and problem-solving skills (Cañas and Novak 2006). From a pedagogical perspective, collaborative and dynamic learning occurs in group activities when students share their own understanding of an issue and its implications (Haugwitz et al. 2010). It is a powerful teaching strategy, as learners are forced to think about a hierarchy of relationships, rather than only one concept. Martínez et al. (2013) reported an 18–20% increase in the scores of students who used concepts maps in a general physics college class. This result supports the previous finding that, compared to reading a textbook or listening to a lecture, concept maps require students to more deeply process the meaning of concepts and the relationships between them (Nesbit and Adesope 2006).

As a method of presenting knowledge of an issue, showing concepts and their connections in a graph was found to be more effective than written descriptions (Erdoğan 2016). In a classroom environment with students from different cultures and backgrounds, expressing one's understanding of a phenomenon through drawing could be easier than trying to find appropriate words to describe it. While writing requires semantic processing and grammar decisions, concept mapping allows students to focus more on learning goals via graphical, rather than verbal, representation of knowledge (Haugwitz, Nesbit, and Sandmann 2010; Nesbit and Adesope 2006).

Watkins and Earnhardt (2015) noted the effectiveness of concept maps for creating a holistic picture of the interrelated concepts in a system. This systematic approach shows learners that conceptual links exist in all disciplines.

Study sample

As the purpose of this study was to analyze the knowledge map of students in a particular course, the sample included all students in four sections of the traditional face-to-face undergraduate strategic management capstone course. The sample size was 54 for individual maps and 19 for group assignments. Although not large enough to generalize the findings, this sample size is sufficient for drawing valid inferences, and it minimized sampling error as all students were included in the project representing a typical population (Marshall 1996; Sandelowski 2000).

Method

Strategic management capstone courses serve as the culmination of student learning in a business program (Bailey, Oliver, and Townsend 2007). Thus, to assess student learning, a project is assigned that involves an application of students' ability to put pieces from different subject areas together while analyzing a business situation and developing a strategy. However, a novel approach to assessing student learning could utilize a concept map method. One powerful use of

concept maps is as "an evaluation tool … encouraging students to use meaningful-mode learning patterns" (Novak and Cañas 2006, 5). A pattern can demonstrate what strategic management areas a student remembers and how they connect those areas in a meaningful way. Therefore, concept mapping was used to evaluate student's holistic understanding of strategic management.

Collecting data

The concept map assignment was used at the end of three semesters (Fall 2015, Fall 2016, and Spring 2017) to assess students' development of holistic understanding of strategic management. In two semesters (Fall 2016 and Spring 2017), individuals from two sections of the undergraduate strategic management course were required to create their own concept maps, while in two other class sections of the course (Fall 2015), this was a group exercise. Before being assigned the task, students attended a brief lecture on concept maps, which presented an example of a concept map and explained how to prepare one, so as to introduce this type of visual representation of concepts. Students were then asked to create a concept map answering the question, "What is strategic management?" This type of open-ended question is appropriate for qualitative research (Sandelowski 2000) and meets the needs of this study.

After collecting the completed concept maps from all students, the data were entered into an Excel worksheet for further analysis. The first column listed all the unique concepts presented by students in their concept maps. The first row listed maps by their numbers (Map 1, Map 2, Map 3, and so on). The intersection of a row and a column showed which map had that particular node (concept). This design helped to calculate both the number of concepts on each map and the number of the most commonly used concepts. Table 1 presents a summary of the results. It should be noted that Table 1 lists the total number of unique and individual nodes presented by students. For this study, each concept map was analyzed, and all nodes on every one of the 73 maps were calculated and listed. The average number of unique nodes per map is not the same as the statistical average, as some nodes were repeated in different maps. For example, statistically, the average number of nodes per a concept map in the Spring 2017 semester should be $181/28 = 6.46$, but Table 1 shows 12 as some of the strategic management elements shown in the nodes were used across different maps.

Following Ruiz-Primo (2004), phrases describing concepts in two nodes and a line between those modes, were selected as the level of analysis, as these are useful to compare and contrast broad-based concepts in a particular community (in this case, a class section of a capstone course). This method also allows researchers to compare texts with regard to shared meanings (Carley 1993).

Results and discussion

Two approaches were employed to review the concept maps: content analysis and map analysis. Content analysis focuses on counting the number of times a particular concept is used in a given text. Those numbers are compared across texts to identify similarities or differences between their contents. Map analysis progresses one step further by concentrating on "networks consisting of connected concepts rather than counts of concepts" (Carley 1993, 78).

According to Sandelowski (2000), qualitative data can be arranged in several ways, including sorting from the most-prevalent to the least-prevalent themes. Using this approach, concepts were arranged by themes.

As Table 1 shows, in comparing the individual and group maps, there was little difference in the average number of nodes (concepts) per concept map, but significant disparity in the number of repeated concepts. The group concept maps used four identical concepts—"strategy," "mission," "objective," and "scanning" – in Section A on four maps out of nine maps drawn by students, while Section B used another four concepts: "strategy formulation," "evaluation,""implementation," and "mission" but also on the same number of maps (four) but out of ten group maps.

Individual maps collected from two sections of the same course showed different results: Students of Section A featured five or more similar concepts on

Table 1. Results of the data collected over three semesters.

	Section A Individual Maps Spring 2017	Section B Individual Maps Fall 2016	Section A Group Maps Fall 2015	Section B Group Maps Fall 2015
Number of maps	28	26	9	10
Total number of nodes	191	173	80	69
Average number of nodes per map	12	16	12	13
Average number of links per map	12	16	14	15

ten out of 28 maps, while students of the other section of the same course used five or more similar concepts on 20 out of 26 concept maps. Based on the individual concept maps, strategic management was understood by students as a plan to grow and be successful in achieving the goals set by an organization; in this regard, the organization's financial situation and business analysis of strengths, weaknesses, opportunities, and threats must be considered, while employees need to be organized and their performance evaluated. In their maps, the groups emphasized four concepts: develop a mission; formulate a strategy; implement it; and evaluate its effectiveness. Although both the individual and group maps seem to depict the basic framework of strategic management, group representations of strategic management offer a richer picture. While students seemed to remember the main elements of strategic management, they appeared less able to identify the connections between the main concepts. In this regard, nine of the 54 individual maps (16.67%) showed how strategic concepts are interconnected, while seven of the 19 group maps (36.84%) did so, demonstrating superior performance when students tackled this assignment in groups. Figure 1 illustrates one of the individual concept maps, while Figure 2 shows an example of a group concept map.

It could be inferred that students working in groups discussed not only the main concepts but also the connections between them, whereas, in individual assignments, students tended to focus on presenting a decision tree or clusters of concepts, rather than a broader overview of interlinked concepts. It appears that, in approaching the assignment, students were focused on presenting concepts when working individually but tended to analyze connections between concepts when working in groups.

Following dos Santos et al. (2017), the course instructor created an expert concept map, which served as a benchmark against which to compare the student concept maps collected for the study. This method has been validated by previous research (Croasdell et al. 2003; Stoddart et al. 2000; Wang et al. 2011). Content analysis involved comparing students' maps to the instructor-created concept map. Review of the students' graphical representation of strategic management concept revealed whether students had correctly or incorrectly depicted the relationships between concepts. Results of this review helped to evaluate the accuracy of their perceptions (Coleman 1998; Stoddart et al. 2000). Each individual concept map was reviewed and the number of correct and incorrect statements calculated as percentages.

Qualitative analysis was used to compare students' graphical representation of strategic management against their overall performance in the class, and for evaluating teaching effectiveness. Evaluation of 54 individual maps showed that quality of concept maps created by three students was better than their final grades for the course, while 12 students showed worse performance on the map exercise than their final grades for the course, and 39 students demonstrated that their grades correctly reflected their knowledge of the concept. Caution must be exercised in generalizing these results. As the study was conducted at the end of the semester, some students might have felt that

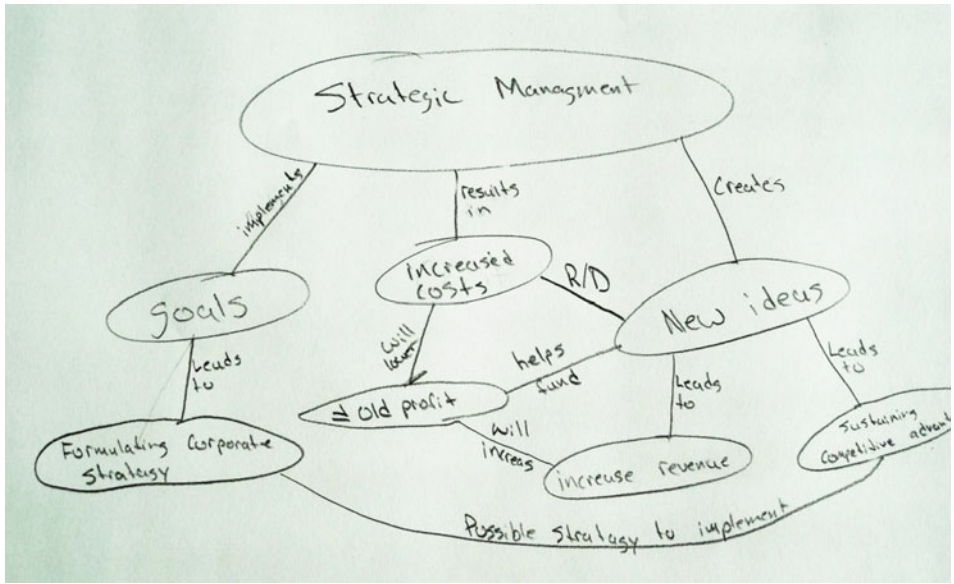

Figure 1. Example of an individual concept map.

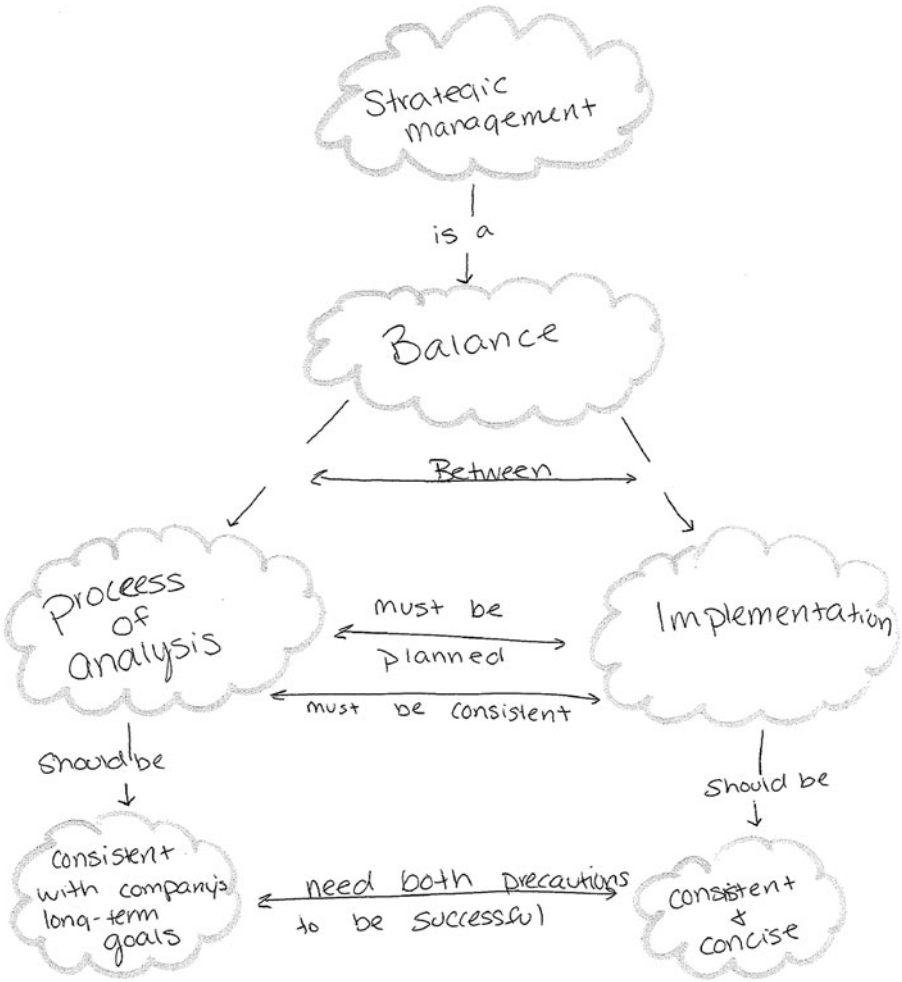

Figure 2. Example of a concept map created by a group of students.

as the course was over, this exercise did not warrant serious effort. Findings from the group concept maps were mostly used to analyze what learners did not understand in the course and to reorganize class structure and learning activities for future terms.

Student feedback on this project was requested during the follow-up session. All the students noted the novelty of the exercise, which was the first time they had been required to produce a drawing to answer a question. Another common comment was that this activity forced students to review the entire semester of lectures and develop a summary that could be presented on one page. Students were somewhat surprised to discover that they could communicate complex ideas by drawing nodes and links. To answer the assigned question, students were required to actively filter, critically evaluate, organize, and re-organize the concepts. These comments support Morsi, Ibrahim, and Williams (2007), who stated that concept maps help to move learning "from memorization and repetition to reflection and critical thinking" (T3H-19).

Usability of concept maps

Over the years, concept maps have been used in a variety of subjects, including physics, literature (Stoddart et al. 2000), information systems (Siau and Tan 2008), biology (Schwendimann and Linn 2016), psychology (Jacobs-Lawson and Hershey, 2002), economics (Burdina 2015), engineering (Darmofal et al. 2002), computer sciences (dos Santos et al. 2017), and pathophysiology (Rendas et al. 2006).

Moreover, academic (Watkins and Earnhardt, 2015) and social programs (Trochim 1989) have utilized this method for a variety of purposes. For example, concept maps were found effective in reviewing (Morsi et al. 2007) or developing a program curriculum (Lozano and Lozano 2014). Since concept maps use graphical structures that are easy to understand (dos Santos et al. 2017), they help to provide an overview of student knowledge and identify any gaps in learning activities. The purpose of concept maps is to show relationships between concepts (Davies 2011); hence, a gap in the relationships depicted by students

can indicate a weak area in teaching on which the instructor needs to focus more attention.

For students, concept maps present a meaningful way to learn by engaging in analyzing their own knowledge (Davies 2011), requiring them to organize what they have learned in a structured depiction of concepts and their relationships. Drawing a concept map could be used in one of three ways, either alone or in combination:

- as a stand-alone exercise to test understanding of one complex concept;
- an assignment at the end of the week to depict connections between the lecture topics;
- or as a review of the course at the end of the semester, presenting a precise way of summarizing the course material.

In addition to teaching and learning, concept maps are used to evaluate and share knowledge (dos Santos et al. 2017). An innovative way to use this method is in bridging research and practice (Souza 2017), or in brainstorming ideas and developing new strategies or processes for businesses. This could help to close the existing gap between academia and the business world, while also better preparing students for their careers.

Limitations and future research

Since this study was based on the principles of qualitative research, in which a typical outcome is a "straight descriptive summary of the informational contents of data" (Sandelowski 2000, 338), its limitations are characteristic of any qualitative research: a small sample size that restricts generalization of the findings.

Concept mapping generates a comprehensible output that is more condensed than a text description (Erdoğan 2016). However, it should be noted that, before they can effectively use concept mapping, students must first gain knowledge of concepts and then put those concepts in one picture. Traditional lectures provide students with definitions, explanations, and examples, but might fail to show how concepts relate to one another. Thus, lectures, class activities, and concept maps are complementary (Burdina 2015).

Many previous studies have found concept maps, as an active method of learning, to impact positively on academic learning outcomes, such as "recall, problem solving, concept learning, repairing previous erroneous conceptualizations and developing critical thinking skills" (Erdoğan 2016, 2). It would be interesting to run the same concept mapping exercise (posing the same question) before and after a course to evaluate how effectively students are learning. Comparing and contrasting the two maps would indicate the extent of a student's understanding of a concept and how this has developed through the course.

Conclusion

Most cognitive theories postulate that knowledge in memory is structured according to schemas or small semantic units of interrelated concepts (Ruiz-Primo and Shavelson 1996; Wang et al. 2011). This cognitive structure can be visually represented using a graph that explicitly depicts the relationships between semantic units (Ruiz-Primo and Shavelson 1996). Researchers have taken different approaches to visualizing this structure, including conceptual diagrams, which are usually based on theoretical models (e.g., Michael Porter's Five Forces Model in management), or visual metaphors (e.g., an iceberg metaphor of culture and its visible and invisible elements; Eppler 2006). Concept mapping differs from these approaches in that maps can more comprehensively display intellectual processes (Wang et al. 2011, 30). Maps help educators to understand whether students grasp the course material and can form meaningful connections. Where gaps in students' learning are thereby identified, professors can revise their lesson plans and lectures to ensure that either the sequence of presenting concepts or the depth of coverage is suitable to maximize students' learning.

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