Mind Maps: New Perspectives

1. Introduction

This article will describe the use of mind maps to promote an active learning mean that both language and culture professors can employ in their classes. More specifically, it will examine some applications and benefits of mind maps, both analogically and digitally, as well as the combination of Mind Mapping online and on paper, through a hybrid approach. This approach should compensate for the downsides of these two methods, while implementing the perks of both, thus enabling a richer learning experience. Furthermore, it will illustrate some examples and ideas of how mind maps can be adapted in the teaching of foreign languages and cultures. To different extents, theoretic foundations of these graphic diagrams can be found in the work of David Ausubel (1963), Rudolf Arnheim (1969), Howard Gardner (1983), Joseph Novak (1998) creator of concept maps, and Tony Buzan (1996) creator of mind maps. To date, there are also various academic articles that focus on the use of these graphic diagrams, and which compare them for different uses. However, none of these articles investigate their use in the foreign language and culture context, nor do they propose a hybrid approach that includes the digital component.

2. Mind Maps

Mind maps are graphic diagrams organized around a central image or key word. They can be used to take and make notes, to develop concepts, to organize pre-existing knowledge, and also to motivate and improve learning. Mind maps can also be used to learn materials *ex novo*, to review or to expand an already familiar topic. Because of all these reasons, both the student and the professor can use them, at home, in class, or both.

Mind maps are a specific form of organizing and representing knowledge graphically, similar to other tools, like concept maps, conceptual diagrams, spider-grams, or visual metaphors, but with their own rules and goals. These terms are often used synonymously, however, they differ significantly for composition and purpose. In particular, mind maps are very often mistaken for concept maps, not surprisingly since concept maps also represent ideas with nodes and lines that connect and establish relationships between these nodes.

However, these two types of graphic diagrams are profoundly different from each other. Rigorous concept maps have a structure that highlights relationships, as well as causality connections. Their aim is to answer to a specific key question, which will define precisely the theme and the limits of the map. Concept maps display a starting concept, positioned in the top center of a paper, from which all related concepts will be connected in a top-down fashion, from more general to more specific. Concepts are enclosed inside nodes, circles or boxes of some type, and linked to other concepts through a connecting line that also displays a word, which relates logically one concept to another. All nodes and connecting lines share the same look, without differences in color, size, or font. Concept maps work well to represent information in a rational and highly organized system. The driving principle of concept maps is based on connectivity and causality (e.g. see fig. 1).
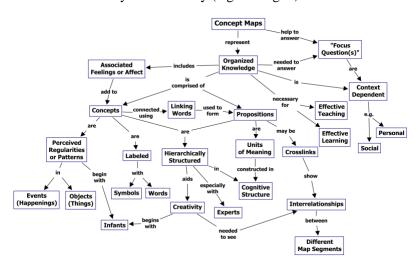

Fig. 4 Example of a concept map. Reproduced from Joseph Novak and Alberto J. Cañas, "Technical Report IHMC CmapTools 2006-01 Rev 2008-01," *The Theory Underlying Concept Maps and How to Construct and Use Them*, Institute for Human and Machine Cognition. http://cmap.ihmc.us/docs/theory-of-concept-maps.

Mind maps, on the other hand, are image centered radial diagrams that visualize information arranged around a central concept or theme, represented by an image or a keyword. Further ideas and concepts radiate from this central topic, arranged around it as annotated branches represented on thick lines. These branches may fork further into subordinated ideas and be portrayed on thinner lines. While central lines are thicker, as lines and words are drawn further from the center, they become thinner. Mind maps are keyword focused, hence they can be drawn quickly and easily and promote synthesis. The words that go on the map should be chosen carefully and written in capital letters, thus allowing the mind map to be viewed as a whole. According to Buzan, key words can and should be replaced or completed by a key image or a symbol whenever possible, in order to enhance memorization (Buzan 96).

Compared to concept maps, mind maps allow more freedom, since a concept does not need to be represented as a consequence of another already on the map. Their flow is not strictly causal, but driven by mind associations, and does not need a specific order to follow. The aim of mind maps is not to create a tight, logical network of concepts, but rather an image, a network that can represent knowledge in an intuitive way. Because of this, mind maps can be drawn easily and instinctively, and can be easily adopted to introduce new topics, to review previous subjects, to encourage creativity, unexpected connections, participation and discussion among students. It can also be a simple and easy way to gather students' knowledge in a specific moment of the semester, as a classroom assessment technique (e.g. see fig. 2).

Fig. 5 Example of a mind map. Reproduced from John Budd, "Mind Maps as Classroom Exercises," *The Journal of Economic Education*, vol. 35, no.1, Winter 2004, p. 38.

Supported by the research conducted by Margaret Matlin (1989), when Buzan created and popularized mind mapping, he insisted on the importance of emphasis, "considered one of the major factors in improving memory and creativity" (Buzan 97). Because of this, it is crucial that these maps always use a central image, along with symbols and images throughout the diagram, as well as the use of three or more colors. However, as previously noted, "The Mind Map is based on the *logic of association*" (Buzan 87). Consequently, association plays a major role in mind mapping, because it is considered a crucial factor in improving memory and creativity. Because of this, and through the interconnection of colors, codes, and images, synesthesia is also strongly promoted by mind maps.

Mind mapping allows knowledge to be processed through a powerful subjective filter, which re-elaborates information together with the experiences and the associations of the learner. Furthermore, mind maps become an image themselves, graphically captivating and ideal for those students with a predominantly visual learning style. It is worth pointing out that mind maps' radial structure promotes a concept hierarchy and the association between different ideas, all while keeping all the information on only one page. The use of key words and images makes mind maps synthetic, easily and quickly accessible, while facilitating review. Because of these features, Mind maps allow the

learner to immediately distinguish with a glance the general points from the more specific ones, as well as the most important from the secondary ones, especially when compared with linear notes or bullet points.

3. Digital Mind Mapping: Possible Class Activities

Due to their popularity, the use of mind maps has fostered the creation of many programs that allow designing these diagrams online, either individually or collaboratively, even if mind mapping had been conceived to be performed on paper, as previously noted. While some features of rigorous mind mapping on paper are lost, when mind maps are transferred online, other perks can be achieved. Also, digital mind mapping does not necessarily exclude entirely the analogic approach on paper, but can instead promote a hybrid approach, well suited for a combined use in class and at home by the student. Among the many online programs available, this article will focus on the web application Mind Map Maker,[1] a software offered through Google drive that is not only free, but also readily accessible by any individual with a Gmail account. Furthermore, being a web application Mind Map Maker is not designed for a specific platform like Mac OS or Windows, but will work flawlessly with any operating system.

Mind Map Maker offers most of the features needed in a rigorous analogic mind map, such as different colors, sizes, and fonts, as well as the option to embed images, clips, and Internet links. Maps created with this software are highly customizable and resemble very closely those created on paper by hand. Mind Map Maker allows the user to create a neat, easy to read, and organized map, in which the smaller branches can be expanded or collapsed as needed.

When in class, with the use of an LCD projector or a smart board, the instructor can draw a map that is quick and easy to create, but also convenient to read by all the students, who can participate actively in the creation process and follow it live. Furthermore, Mind Map Maker allows the creation of a volley of radiant branches, which can be efficiently and quickly collapsed or expanded as needed, in order to keep the view of the whole easy and organized. The map created can be saved as a graphic file, for example as a PDF, or can be made accessible to all the students through an online link. In this latter case, the instructor can decide if the map can be enabled for edits or not.

Digital mind maps and analogic mind maps can be used and combined in many different ways. A possible course of action would be to present and introduce students to the use of mind maps and purpose of them, both on paper and digitally, and to train them to their use. This

first stage can be performed and demonstrated by the instructor in class: an easy option to do this is by asking students to recall all the words related to a topic, for example "verbs," "food," "on vacation," or "Italian holidays." This can be done to review previously acquired knowledge, to practice recently learned words, or a combination of the two, in which the new vocabulary items are connected to prior knowledge. In both cases, the mind mapping associative nature stimulates students to link concepts and ideas to their memories and experiences, thus activating the schemata and lowering their affective filter. This context is ideal, because the main actor in the activity is the student, while the instructor can simply act as a facilitator and a motivator, by helping students to keep on track, or showing different connections, without taking away their responsibility from learning. As a matter of fact, the instructor in this context scaffolds knowledge as well as the learner's prior knowledge, thus promoting learning.[2]

After this first stage in class, similar to a brainstorming activity, students will start to develop their own personal style, and should feel more familiar when asked to mind map on their own as an assignment. As homework, this first stage can be performed again individually, on paper or digitally, or by editing a map initially designed in class. As previously mentioned, maps developed with Mind Map Maker can be saved and edited multiple times, giving the students the option to review, modify, and add new materials, for example after having studied a new grammar point or vocabulary theme. Also, digital maps can be saved in a folder, thus giving the students the option to access them later in the term to review their notes. All the steps taken so far can be easily adapted for an online course, especially since Mind Map Maker offers the option to work collaboratively, thus representing an additional tool for the instructor of this type of class.

For the traditional classroom, it is possible to build further on this first brainstorming stage, by using a hybrid approach that mixes together digital and analogic mind mapping. The instructor, in fact, can give the students a printed handout of the mind map that was previously created digitally, but only with its major branches, that is to say, stripped of all the minor connections. The students will be asked to complete the map individually, following their memory and their mind associations. After this step has been completed, it is possible to ask students to switch their maps: each student will face a mind map that is similar to the one she created, but not exactly the same. This potentially allows students to see words they did not know or did not recall, as well as associations within and outside major branches they had not thought of, thus offering

different perspectives on the same topic. At this point students are encouraged to work further on the map of their peer, adding new words, and creating more connections, and more associations, before handing back the map to the owner (e.g. see fig. 3).
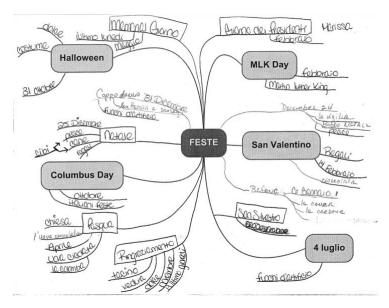

Fig. 3 A mind map created with Mind Map Maker first, and then completed by two different students.

This additional step, which can also be conducted in small groups instead of pairs, not only proves useful to stimulate the student to review and recall her prior knowledge, but also to activate the recognition process, in a playful and self-managed context. The whole activity, while extremely simple and straightforward, can be very beneficial for students because of its active and collaborative nature, based on the active learning exercise "think-pair-share," popularized by Millis and Cottell (72-78), and readapted by John Budd in "think-rap-map" (Budd 44). Figure 3 shows an example of this activity, which was performed by community college students enrolled in their second semester of Italian (ITAL 1020), aimed at revising the vocabulary of the holidays, which were previously introduced through the class textbook. Students worked individually first, and then collaboratively on a mind map created with Mind Map Maker. Students were already familiar with both the topic and the map, and could collaborate together to recreate the

diagram of their own learning, taking advantage of each other's mental associations.

While brainstorming is the most intuitive activity that can take advantage of both analogic and digital mind mapping, it is certainly not the only one. Mind maps allow students to organize, prioritize, and integrate different materials offered in a course; because of this, they can be used for vocabulary acquisition, but also to lead a listening comprehension or a reading comprehension exercise. Furthermore, they can be used to review pronunciation rules but also to organize the structure of an essay, proving to be a very flexible tool.

In the case of a listening comprehension exercise, the instructor can ask the students to prepare collaboratively a digital mind map at home, on the same theme as the listening activity that will be performed in class, for example "shopping in Italy," as is the case in figure 4. Once in class, the instructor can review the map created at home to introduce the activity and give a printed handout of the same map that was created at home, stripped of the subordinate branches but completed with some connections added by the instructor, which are related to the listening comprehension. The students, already familiar with the map on the handout that has been given to them, will be asked to complete the map with all the information they can grasp from the audio played in class. The map will help with listening comprehension for the students, thanks to the prior knowledge built at home and reactivated in class before the practice (see fig. 4). In figure 4 it is possible to see the map resulting from this activity, which was performed in the third semester of Italian course (ITAL 2010) by community college students. While the class had already been introduced to this area of vocabulary through the textbook, they had not yet been engaged in a listening exercise related to it. Through the listening activity and mind mapping, it was possible to involve students in a collaborative activity that included different skills, such as listening, comprehension, vocabulary recognition, and vocabulary recall.
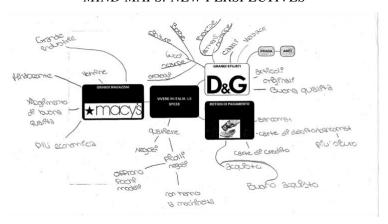
Fig. 4 An example of a mind map to guide a listening comprehension exercise.

Additionally, the instructor can add branches to the map that are specific to the listening activity, in order to help further the comprehension of specific information and scaffold learning. Alternatively, for any of the activities proposed up to this point, the instructor can provide the students with a word bank of suggested vocabulary items or concepts that the learner can consider adding to the existing map, resulting in something similar to what Novak defines as an "expert skeleton map" (Novak, "Learning" 27). According to Novak these kinds of maps "help learners begin the process of meaningful learning in a given domain, and they can also serve […] as organizers to facilitate integration of new concepts and ideas with the learner's existing relevant knowledge" (Novak, "Learning" 27).[3]

Naturally, this can also be done individually at first, and then collaboratively in pairs or in small groups. Regardless of the chosen format, the instructor offers a content-based activity, in which students activate their prior knowledge, built with the digital mind map, but at the same time they acquire new knowledge thanks to the listening activity, which is processed with a cooperative and active learning task. Furthermore, the map provides students with a structure that can reduce their affective filter while listening. A further step to this activity can be made by providing the students with the script of the audio, thus transitioning to reading comprehension, and asking them to add more details to the map, with the information that they had not been able to gather from the listening activity. This provides the students with a global view of all the information that they have already gathered, which acts as an aid to further understanding. Moreover, the work of this activity can be used to create the layout for a written composition or for a speech.

As a matter of fact, in this context the hybrid approach of digital and paper mind mapping provides the instructor with the chance to scaffold the learner's listening and reading comprehension, but also her speaking and written production, as pointed out by Judit Kormos and Anne Smith, who state: "The use of mind mapping techniques is particularly useful […] so that they can plan out an entire essay or even a project quite quickly, and use the mind maps as a framework, working on the parts they feel most comfortable with" (Kormos and Smith 112).

Another option to use mind mapping, and this hybrid approach that combines digital and analogical mind maps, is to help students recognize and review Italian pronunciation patterns. For example, a map can be created to display the different pronunciation of the consonants c and g, when combined with the vowels A, E, I, O, U, and with the consonant H, and link each of these sounds to a specific word, giving the student an overview of the system at a glance (see fig. 5). Figure 5 shows the map that resulted from performing this activity with a community college class of absolute beginners who were taking the first semester of Italian (ITAL 1010). As expected, some students struggled to learn and remember the basic rules of Italian pronunciation, so mind mapping offered them not only a different approach to recognize and revise pronunciation patters, but also a collaborative approach.
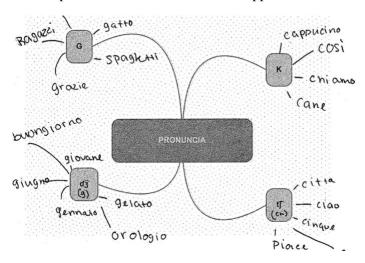

Fig. 5 Example of a mind map of different sounds in Italian

Mind maps enable the organization and prioritization of knowledge and information, but at the same time facilitate association and memorization, therefore, their use can prove to be successful in order to match graphemes with their corresponding phonemes. A digital map can be created in class, to help the students visualize, compare and contrast the different sounds. Regularly, the instructor can ask the students to review the map to recall the phonic rules, or can hand out mind maps with phonic categories, with a list of written or spoken words to be inserted in the right space. Alternatively, or in addition, students can make their own mind maps, either digitally or analogically, completing them with words related to each phoneme-grapheme. This way, learners not only recall and review the rules, but also update their own vocabulary map with the new items learned. Digital mind maps created with Mind Map Maker can be updated regularly, and students can continue to add words and categorize them for phonic rules. Mind maps can also be created *ex novo* during or after reading texts, or during vocabulary lessons, and can be easily kept in an online folder.

4. Pedagogical Benefits

The benefits of traditional mind mapping have already been proven, as demonstrated by a study entitled "The Efficacy of the 'Mind Map' Study Technique" by Paul Farrand, Fearzana Hussain, and Enid Hennessy (2002). Specifically, the authors tested the recall of factual material at the London School of Medicine and Dentistry on a pool of fifty students, divided in two groups. One group could use the study technique of preference, while the other group was given a thirty minutes lesson in the mind map technique. Some important conclusions that the scholars drew were:

> Analysis of the data indicates that, as a strategy to improve memory for written information, the mind map technique has the potential for an in important improvement in efficacy. With the mind map technique there is an estimated increase of 10% […] the mind map technique resulted in correct recall of a statistically significantly higher number of items than the self-selected study technique […] Importantly, the recall advantage with the mind map technique was robust over a week, resulting in a 24% proportional increase in correct recall when compared with baseline score […] it is likely that mind maps encourage a deeper level of processing than that obtained with the other, more conventional study technique adopted in the self-selected study technique. (429-30)

In addition, Farrand et al. state that "the increased use of mind maps, and the emergence of educational materials supporting the use of mind maps […] should be cautiously welcomed" (Farrand 430). Mind maps, both analogic and digital, are not necessarily a tool superior to others for taking or making notes, nor to other class activities. However, they can be an additional tool for the foreign language and culture teacher, as well as of other disciplines, like literature and cinema. The reasons for this are many. To begin with, both analogic and digital mind maps are very versatile, they can be used in both forms separately or in combination, individually or paired, at home or in class. Mind maps can be used to brainstorm, to introduce and to review vocabulary, to scaffold pronunciation rules, or to lead a listening or a reading comprehension activity. Outside of the second language context, for example in a culture, cinema, or literature class, they can be used to review concepts, themes, or historic periods and their characteristics, and to keep all the information on one single page, quickly and easily readable, thus promoting review. According to Jeanne McCarten, "organizing vocabulary in meaningful ways makes it easier to learn," (21) and mind maps can fulfill perfectly the purpose of organization.

Moreover, mind maps promote active and collaborative learning, when created *in plenum* with the whole classroom, with the aid of a smart board or a projector, as well as in pairs or in small groups, as outlined by Budd (42). Additionally, digital mind maps provide easy online access to the students that want to review at home the maps created in class, giving the option to tailor them further according to their specific needs, maybe before a test or a presentation.

For these very same reasons, mind maps have recently been underscored to aid and promote learning in students with Specific Learning Difficulties (SpLD), such as dyslexia, dysgraphia, etc. In this respect, according to Joanna Nijakowska, mind maps prove to be helpful not only because they provide conditions to improve memorization, but also because they can help SpLD students to review the vocabulary (Nijakowska 149). Furthermore, digital mind maps not only provide the chance to study collaboratively in class, but also to review and edit before and after class, thus helping the instructor to emphasize the importance of repetition, as well as to promote a healthy habit of daily study, as pointed out by Cecil Mercer. Both these elements, important for any type of student, are crucial to SpLD students.

Similarly, Kormos and Smith emphasize how mind maps can be helpful, because "just like other language learners, students with an

SpLD also learn vocabulary better if words are presented in a context and not in isolation, because this aids anchoring words to the mental image of the situation in which they were encountered" (Kormos and Smith 133). In this respect mind maps can also be helpful by providing a context, such as "national holidays," "vacation," or "free time." This not only helps to activate the schemata, but also offers the possibility to anchor it to a specific and subjective image. Furthermore, because of their multi-sensory approach, both digital and traditional mind maps help to connect with learners with diverse learning styles, especially because of their use of branches and colors, important aspects known to boost learning and recall (Driscoll 200). In fact, because of their nature, and thanks to a hybrid, customizable and combinable approach, both analogic and digital, mind maps offer a strong multi-sensory context: tactile with paper and pen, visual and aural through the use of colors, movie and audio clips, photographs, and drawings.[4] This context, which helps in presenting and eliciting information and concepts with a multi-sensory approach, while useful to any kind of student, is paramount for students with SpLD. Additionally, the use of digital mind maps can help further the learning of SpLD students, because thanks to the use of a computer it can offer them a better and clearer organization of the information, along with the possibility to check the orthography of the words included in the map. Specifically, Gilroy and Miles suggest that the use of a basic word processor eliminates preoccupation regarding the neatness of handwriting, and enables easier organization of ideas; concurrently, the correct spelling leads to higher self-esteem and greater confidence (quoted in Kormos and Smith 108). According to Chris Singleton, "these positive effects of using a computer improve motivation and determination in students who may previously have had negative experiences in the language classroom" (quoted in Kormos and Smith 108). Moreover, in Cecil Mercer's opinion, it proves helpful to provide students a graphic organizer, like a mind map, because it "helps students listen for key information and see the relationships among concepts and related information" (Mercer). Additionally, digital mind maps can double up to simultaneously combine verbal and visual information, where verbal information can be provided with visual displays, like on a smart board (Mercer).

5. *Conclusions*

Mind maps, both analogic and digital, allow introducing, visualizing, and reviewing a variety of topics related to vocabulary, culture, and history, among others. Moreover, they can also guide the comprehension of

reading or listening activities, as well as facilitate revision of notes previously taken. More specifically, the use of digital mind maps, and of the software Mind Map Maker, provides instructors and students with a tool even more flexible, which grants an intuitive software environment to use, as well as a clean and easy-to-read map.

The activities outlined in this article were tested in a community college context, with students who were in their first (ITAL 1010), second (ITAL 1020), or third (ITAL 2010) semester of Italian. Students' reactions to the use of mind maps were always positive, not only because they broke the daily routine, but also because they provided the class the opportunity to realize what they knew and what they still had to work on in a ludic way. Students could participate *in plenum*, thus feeling they were collaborating to the knowledge of the whole class, but they could also participate individually and in pairs, accommodating different personalities and levels of confidence. It was not possible to conduct an exhaustive, rigorous experiment on quizzes or exams, however, anecdotal data showed that the use of these activities did increase the students' proficiency in targeted areas of vocabulary. Similarly, on an anecdotal level, it is possible to say that students who used mind maps at home, in class, on paper, and online through Mind Map Maker felt that these activities helped them to learn and memorize vocabulary.

The maps created with Mind Map Maker will benefit its users by offering not only a quick organization, but also the possibility to add clips, pictures, and web links, as well as the opportunity to create a folder of maps that can be accessed again in the future. While mind mapping is not per se a communicative activity, its use can constitute an important grounding point to prepare for a more complex communicative activity that will follow, for example by introducing a topic, strengthening the vocabulary of the target language, or re-activating previously acquired knowledge. In particular, it is possible to say that mind maps encourage and develop a "related" type of knowledge, rather than an "isolated" type of knowledge. As suggested by Christine Hogan, and by Joy Jacobs-Lawson and Douglas Hershey, mind maps and concept maps can also be used as an alternative assessment tool in college courses.[5] In particular, Hogan explains how the students were introduced to the method and told that a mind map would appear on the exam. The grading rubric created to evaluate it takes into consideration the contents of the map by looking at the breadth and depth of its associations, as well as mind mapping strategies, such as colors, symbols, and arrows. Hogan adds: "we believe that Mind Mapping is a strategy that can be used to encourage 'deep' rather than 'surface' learning" (quoted in Buzan 228).

While mind maps are not a tool superior to others, they have their own place in the Italian language and culture-teaching context for various reasons. To begin with, they help the instructor to scaffold knowledge, following the aforementioned Wood, Bruner, and Ross' metaphor and, in so doing, they enhance the instructor as a motivator, a mediator, a model, and a facilitator.

Additionally, mind maps can be helpful to boost vocabulary retention with any student, as proved by Farrand et al. This could be particularly true for SpLD students, as pointed out by Kormos, who states: "special visual organizers called mind maps, which combine visual and verbal elements and represent information in a holistic way, also facilitate vocabulary acquisition for dyslexics" (Kormos and Smith 111). Furthermore, it is important to point out that mind maps allow the instructor to move beyond the typical professor-centered classroom, while promoting a more student-centered approach, thus also avoiding the old-school "chalk-and-talk" teaching style. It is also worth repeating that digital and analogic mind maps promote not only an active learning environment, but also a collaborative learning context, in which students work together through the process of "rap-map-share."

Overall, it is possible to say that mind maps provide the instructor with a range of options and activities with many benefits. It is worth adding that through analogic mind maps on paper, as well as through digital mind maps with Mind Map Maker, mind mapping covers at least five of Arthur Chickering and Zelda Gamson's "Seven Principles of Good Teaching Practices."[6] In particular, these activities "develop reciprocity and cooperation among students," "encourages active learning," "give prompt feedback," "emphasize time on task," and "respect diverse talents and ways of learning" (Chickering and Gamson 1). When both analogic and digital mind maps were used as an assignment or in a class-activity, students always suggested appreciating their use, as well as displayed a positive attitude to this technique. Future research could analyze empirically the outcomes of mind mapping activities on memory retention, with specific regard to the foreign language and culture classroom context. However, regardless of their effect on memory, mind maps and Mind Map Maker represent an additional tool for the foreign language teacher, because not only do they promote active and collaborative learning, but they also help connecting with students with diverse learning styles.

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ENDNOTES

[1] Mind Map Maker can be accessed directly from the website http://www.mindmapmaker.org/ or through Google drive (http://drive.google.com) which is supported natively by Mind Map Maker.

[2] Scaffolding is a term promoted by David Wood, Jerome S. Bruner, and Gail Ross, and described as a "process that enables a child or novice to solve a problem, carry out a task or achieve a goal which would be beyond his unassisted efforts. This scaffolding consists essentially of the adult 'controlling' those elements of the task that are initially beyond the learner's capacity, thus permitting him to concentrate upon and complete only those elements that are within his range of competence" (90).

[3] When Novak talks about "expert skeleton maps," he is referring to concept maps "prepared by an expert in the knowledge domain to guide and 'scaffold' learning," created to serve as a starting point to the learner (Novak, "Learning" 27). While concept maps are different from mind maps, the same theory can be applied to the activities proposed in this article.

[4] In specific regards to drawing, a recent article written by Jeffrey Wammes et al., the authors conducted seven free-recall experiments to determine if drawing could be considered an effective strategy for enhancing retention and memory. Their conclusion is that "together these experiments indicate that drawing enhances memory relative to writing, across settings, instructions, and alternate encoding strategies, both within—and between—participants […] We propose that drawing improves memory by encouraging a seamless integration of semantic, visual, and motor aspects of a memory trace" (1752).

[5] Jacobs-Lawson and Hershey's research refers to concept maps, however, the same principles and findings could also be applied to mind maps. In particular, they state: "We evaluated the usefulness of concept maps at the beginning (pretest) and end (posttest) of the semester […] A comparison of the two maps reveals appreciably more nodes in the posttest map, a pretest-posttest increase in the number of psychological terms used, and an increase in the proportion of valid psychological concepts […] the pretest-posttest evaluation of this technique provides empirical support for the notion that concept maps are a valid means of assessing change in introductory psychology students' course related knowledge" (27-28).

[6] According to Chickering and Gamson, "Good practice in Undergraduate education: 1. Encourages contact between students and faculty; 2. Develops reciprocity and cooperation among students; 3. encourages active learning; 4. Gives prompt feedback; 5. Emphasizes time on task; 6. Communicates high expectations; 7. respects diverse talents and ways of learning" (1).

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