Virtual Learning Environments in the Light of Mind Maps and Flashcards: A Systematic Literature Review

Augusto Weiand, Francieli Motter Ludovico, Patrícia da Silva Campelo Costa Barcellos
Computer Science in Education (PPGIE/UFRGS), Brazil

Abstract

Mind Maps' and Flashcards' techniques are widely used in various sectors for different purposes. The use of Mind Maps focuses on the elaboration of physical models representing the neural connections between certain subjects, as well as for projects organization, for educational purposes or as a way of presenting content. Flashcards, on the other hand, propose a learning methodology based on key points of the approached content, commonly used for Foreign Language teaching and learning. Thus, this Systematic Literature Review proposes a theoretical and exploratory research on the application of Mind Maps and Flashcards in Virtual Learning Environments (VLE). Through the analyzed bibliography, approaches which connect Foreign Language teaching and learning with Flashcards were found and the studies proved this association to be feasible. However, neither VLE based on Mind Maps or Flashcards were found, nor theoretical evidence describing the implementation of both methodologies together.

Keywords: Virtual Learning Environments; Mind Maps; Flashcards; Systematic Literature Review.

1. Introduction

Virtual Learning Environments (VLE) are spaces increasingly accessed and discussed within the academy, highlighting Distance Education (DE) in the context of contemporary society as an appropriate education modality to the new educational demands, resulting from personal and professional changes currently experienced (Belloni, 2015). Historically, starting with semi-presential courses, these VLE developed rapidly, following the evolution of information and communication technologies, in order to add value to teaching and learning strategies (Maciel 2012; Pereira et al., 2007).

However, at this same rate, dropout rates are noticed in Brazil - especially in totally distance courses, which represent 25% - according to the Brazilian Association of Distance Education - ABED (Litto et al., 2017). Some studies (Tinto, 1975; Kampff et al., 2014; Belloni 2015; Silva et al., 2017; Mauricio and Schlemmer 2014) show that in addition to the justification for evasion due to the lack of time or dedication, the vague approach of content available in VLE interferes directly in this index.

The use of Flashcards and Mind Maps as an aid in classroom learning has been demonstrated by many authors over the years (Krause et al., 2014; Wazir et al., 2018; Shakouri and Mehrgan 2012; Rhama 2016; Eslahcar Komachali in TEFL and Khodareza in TEFL 2012; Nair and Farei, 2017) as a strong ally to learning and can help reduce dropout rates. A traditional Flashcard basically consists of a lined paper where important points for content memorization are noted, but the use focused on knowledge construction

is proposed in a different way. There are several ways to use Flashcards, and one of them consists in a question on one side of the paper and the answer on the opposite side. In addition, some individuals write key terms about the subject on one side and their explanation on the other (Wazir et al., 2018; Rhama 2016). Thus, after the time dedicated to the classes, Flashcards can be used to resume the studied content.

Mind Maps were developed by Tony Buzan in the late 1960's, and are often defined by the idiom: 'a picture is worth a thousand words'. Its purpose is to demonstrate that in a graphical representation information flows through neuronal cells in the same way as the human brain functions, thus seeking to be a 'brain friendly' tool, organizing and making learning more flexible (Barros and Silveira, 2013; Nair and Farei, 2017; Buzan and Buzan, 1993).

Flashcards are widely used in Foreign Language (FL) teaching and learning processes, so it is sought to find out if this methodology is feasible and if there is any study which associates the use of Mind Maps and Flashcards for teaching FL in VLE. This Systematic Literature Review (SLR) also aims to verify if there is any VLE that associates the use of Mind Maps and Flashcards for teaching Foreign Language.

For this, through a scientific investigation, identifying, evaluating and interpreting research related to this context in the literature, it becomes possible to incorporate a larger spectrum of relevant results instead of limiting the review to a few articles (Barros and Silveira, 2013).

This study is organized as follows: section 2 describes the SLR approach used, as well as its search string, bases, inclusion / exclusion criteria, among others; section 3 describes the results obtained through the searches performed; finally, in section 4, the conclusions are made, based on the reviewed works, proposing questions for future researches.

2. Systematic Literature Review

Systematic Literature Review (SLR) is a planned research methodology of scientific publications through which well-established steps and criteria are defined to identify, select and critically evaluate relevant studies about an issue (Ferreira et al. 2016, Barros and Silveira, 2013). These evaluations seek to highlight studies which address similar issues, as well as the ones not yet described (Rf and Mancini Mc, 2007).

The main phases of a SLR are: setting question(s) to be answered; defining search criteria and bases to be used; conducting the review and data collection; analysis and evaluation; results presentation (Sousa and Ribeiro, 2009). Thus, in the following subsections, these steps are described.

2.1. Research Questions

To guide this Systematic Literature Review, the following research questions were:

- RQ1 - Is the use of Mind Maps and Flashcards for Foreign Language teaching and learning feasible?
- RQ2 - Are there Virtual Learning Environments based on Mind Maps?
- RQ3 - Are there Virtual Learning Environments using Flashcards?
- RQ4 - Is there any study which associates the use of Mind Maps and Flashcards for teaching Foreign Language in Virtual Learning Environments?

2.2. *Research Criteria*

This research was developed using terms related to Mind Maps, Flashcards and Virtual Learning Environments, in Portuguese and English. Designing the following search string: (("flashcards" OR "cartões de resposta" OR "mapas mentais" OR "mind maps") AND ("distance education" OR "educacao a distância" OR "virtual environments" OR "virtual learning environments")).

The SLR was conducted manually from March to May of 2019, using the journal bases: *ACM Digital Library and IEEEXplore* and *ScienceDirect*. These bases were used due to their relevant publications on the area of informatics in education and the focus of this study. Also, based on the research questions, the inclusion and exclusion criteria were defined according to Table 1.

After selecting the works according to the described criteria, the following filtering steps were performed, based on Godtsfriedt et al. (2014), Barros and Silveira (2013) and Ferreira et al. (2016):

1. Reading title, abstract and keywords (if any);
2. Reading introduction and conclusion and exclusion of duplicate works;
3. Complete reading of the works and data extraction.

Table 1. Inclusion and Exclusion Criteria

Inclusion Criteria
IC1: the article must be written in Portuguese or English
IC2: articles from 2014 to June / 2019
IC3: all articles which describe some teaching and learning processes relating Mind Maps' or Flashcards' use in Virtual Learning Environments
Exclusion Criteria
EC1: the existence of a newer or more complete article on the same topic
EC2: articles describing Mind Maps' or Flashcards' use without focus on teaching and learning
EC3: articles not directly linked to the scope of teaching and learning, such as behavior and affectivity
EC4: works available in the form of summaries, presentations, interviews or secondary studies
EC5: articles which do not describe the use of Mind Maps or Flashcards

3. Results

The quantitative result obtained through the searches described in section 2 in each database is shown in Table 2. After the initial classification of the articles, they were read completely and, then, the relevant information was extracted, which is detailed below.

Table 2. Search Results

Database	Returned	Excluded	Repeated	Analyzed
ACM Digital Library	1	0	0	1
IEEEXplore	23	19	0	5
ScienceDirect	53	48	0	6
Manual Searches	10	0	0	10
TOTAL	87	65	0	25

Wazir and Yusof (2018) describe a theoretical study on the effectiveness of using digital Flashcards in learning English vocabulary by non-native students. The authors report that English is one of the most important languages these days, but the number of learners with a broad vocabulary is low, which directly affects their development. The study provides a technique for using Flashcards in vocabulary presentation in which students can benefit from the learning process in order to facilitate interaction and motivation. Thus, with the support of their research, the authors conclude that teachers should create interesting and innovative environments for their students to be interested in learning, trying to avoid traditional and mechanical repetition methods, making it meaningful for students.

Rhama (2016) developed her PhD thesis using Flashcards in order to improve the vocabulary of eighth grade students in 2016 and 2017. Using qualitative and quantitative methodologies, through interviews, observation form and tests (pretest and post-test), the author points out that the average evaluations went from 34.75 to 76.74 between tests, using her proposal. The justification used for the research is similar to that of Wazir and Yusof (2018), but Rhama (2016) does not use digital media.

Like the authors described above, Krause et al. (2014) describe a research that used web-enabled tools and resources so that they could provide formative feedback to students, aiming to improve the learning process. The application of Flashcards was carried out specifically through the Quizlet platform, which allows, in addition to making flashcards, tests and online games on the content addressed. Thus, the researchers sought to verify if there was an increase in student engagement and persistence in the proposed activities. The authors concluded that their approach brought several positive aspects, among them: it made teachers more reflective, motivated them to change their classroom practice, made their students more engaged, and helped teachers better understand their students.

Nair and Farei (2017) used Mind Maps as a tool for undergraduate and graduate students to successfully complete research-based assessment tasks. The motivation of the authors is based on the fact that, as previously described, Mind Maps seek to resemble the human brain structures, facilitating understanding and, consequently, learning. In addition, the authors cite other benefits such as memory and recall; learning process facilitation; group collaboration promotion; thoughts organization and association; improvement of writing skills; creativity and critical thinking; problem solution; among others. The authors used the tool Mind Maps with Computer Science students to highlight whether engagement in research activities would be greater. After their tests, they showed that the use of Mind Maps helped the students to understand the research process and its application.

Students use different techniques to study, and Difrancesca et. al. (2016) found through that when students perform self-regulated learning, flashcards and note cards are among the chosen techniques. This work showed that these study habits are consensus among students with higher grades.

Technology is not always used as a knowledge building tool in the classroom, as pointed out by Heitink et al. (2016). With the participation of 157 teachers, although the technology use is present in their daily lives, it is showed that there is a tendency to use it with practices based on the teacher-centered model as knowledge transfer and not as an active methodology. It was also discovered that the teachers used the technology due to particular appeal of certain technological tools, educational goals achievement and learning process facilitation. The study showed that Mind Maps and blogs, for example, are used by only 8% and 6% teachers respectively, unlike Office packages (such as Office, LibreOffice), which account for 45% of faculty choices, and those authors do not understand this as pedagogical use of technology.

Gladys and David (2015) describe some tools that can help 21st century students and educators to come up with great ideas, including Mind Maps. The authors explain that this approach allows a problem to be dissected into questions or concepts, allowing analyzes from different angles, assisting in its synthesis, and also allows the educator to use it as a means of evaluating activities, enabling the verification of the knowledge building process. In addition to this approach, the authors also cite the possibility of working concurrently in a cloud environment.

Zarzo (2015) exposes the use of a mind mapping software integrated with the VLE Moodle, with the purpose of developing a metacognitive knowledge organization approach. For this, several educational activities were developed following the mnemonic art classic rules, for high school students in the philosophy class. Although the authors do not report the number of research participants, they describe how it was evidenced that the figurative memory associated with the Mind Maps favorably contributed not only to the development of analytical and synthetic skills, but also to a significant improvement in critical capacity. They also describe that the glossaries and Mind Maps joint elaboration reinforced their ability to work collaboratively, contributing to a sense of individual responsibility awareness in the teaching and learning process.

Through a theoretical exploratory research, Popova, Popov and Karan-dey (2015) describe Mind Maps as auxiliary learning tools, acting under the contents memorization and not in their essence, informing that the method needs improvement to be used as a learning amplifier, especially in Distance Education. In their view, they suggest a practical approach integrated with the VLE Moodle of binary trees with questions and answers, in order to amplify students learning in this same modality.

Flashcards have been used for second language learning for some time now, and many scholars have tried to gauge whether their use is really effective. Seeking to answer this question, Shakouri and Mehrgan (2012) performed a test with 80 freshmen from Roudbar Islamic Azad University - 40 of them randomly selected, participating as a control group. The methodology used had two one-hour meetings, where 13 to 15 Flashcards were presented with words on one side and, on the other, the word contextualized with its corresponding synonym. At the end, they obtained satisfactory results, and the freshmen who used the Flashcards showed a significant increase in vocabulary, making it possible to answer the research question: yes, Flashcards help in the development of freshman vocabulary.

The use of Flashcards for Foreign Language vocabulary teaching was the research theme of Komachali and Khodareza (2012), in which the authors developed a study with 50 female pre-university participants from a public school in Iran. These participants were divided into two groups of 25 people each, in order to allow an experiment group and a control group. The authors attested that Flashcards for vocabulary learning were simple, rich and fun strategies as they enable learning in an engaging way with images and other visual resources. Tests were performed before and after Flashcard training in the experimental and control groups - however, in the post test only a placebo for the control group was provided, which received only routine instructions, unlike the study group that received the developed vocabulary Flashcards. In short, the difference between the tests was evident, and it was observed that in the control group the success rate remained the same, but in the experimental group, after Flashcard training, the indexes improved substantially. They concluded that the Flashcards practice had a significant impact on learning English vocabulary for the research audience compared to the traditional learning method.

Saatz and Kienle (2013) study proposes the use of e-Flashcards as an integrated approach to improve education quality in large-scale courses. The authors' proposed e-Flashcard approach translates into electronic ways of implementing traditional question-and-answer Flashcard models, but here all participants can develop, share, comment and rate the developed e-Flashcards. This approach was developed for mobile devices and integrated in a VLE. Initial tests were conducted in a summer class of 2012 with 13 students, resulting in significant interactions in the tool. This way, it was concluded that, based on the principle of Flashcards learning, active and self-directed learning, the experiment was successful due to the comments and evaluations made on the e-Flashcards.

Browder and Roberts (1993) present an initial, exploratory and theoretical research on a guide for Flashcard development. The authors define some items to make this methodology more effective in learning: a) Merge familiar: When presenting Flashcards, you should mix familiar items with new ones to encourage students; b) Use feedback to respond to hits and misses: Provide the student with positive responses in both cases, seeking to encourage them to try again or acknowledge their success; c) Use instructional arrangement selection: It should be conducive to enriching learning. For example, group work; d) Minimize errors: close all the items described.

Given the studies brought to this analysis it is possible to say that Flashcards' and Mind Maps' methodologies are used in order to improve the teaching and learning process. Wazir and Yusof (2018) point out that Flashcards in Foreign Language teaching are a way to promote student engagement. Similarly, the studies of Shakouri and Mehrgan (2012) and Komachali and Khodareza (2012) concluded that Flashcards assist in the development of FL vocabulary.

Many studies (Komachali and Khodareza, 2012; Shakouri and Mehrgan 2012; Krause et al., 2014; Rahma, 2016; Difrancesca et al., 2016; Wazir and Yusof; 2018) showed that the use of Flashcards was relevant and provided knowledge building and student engagement. Krause et al. (2014) exposed that Flashcard practice has also provided changes in teaching practice. At the work of Saatz and Kienle (2013) Flashcards methodology was integrated into a Virtual Learning Environment to attend distance learning courses, and their results demonstrate that it provided active learning and was successful. It is also

important to point out that most of the applied research related to Flashcards used digital versions, which is an evidence of the increasing technological integration in education.

Heitink et al. (2016) showed that when evaluating the use of technology for educational purposes, few teachers use Mind Maps, which according to Gladys and David (2015) is a technique that can assist students and educators. Zarzo's work (2015) exposes the use of a Mind Mapping software in an integrated way to the VLE and just as in the study by Nair and Farei (2017) various student skills were improved based on the Mind Maps use. Popova, Popov and Karan-dey (2015) make a criticism when they state that Mind Maps do not work the content in its essence, highlighting the need for adaptations, and thus suggest the association of Mind Maps with a VLE.

4. Conclusion

This Systematic Literature Review sought to answer the questions realized in section 2 related to Flashcards and Mind Maps. Thus, through the studies described above (in section 3) it was possible to find approaches that relate Foreign Language teaching and learning with Flashcards, which showed that the use of Flashcards for the teaching and learning of FL is feasible. However, no studies related to the Foreign Language teaching and learning with Mind Maps were found (RQ1). It is also noteworthy that some authors have described the implementation of Mind Maps plugins and Flashcards for VLE, seeking to assist the teaching and learning process (RQ2 and RQ3), but not relating them or for Foreign Language teaching (QP4).

In turn, the researches related to Flashcards, clearly demonstrate their effectiveness in learning new content, among other applications. In this same context, the use of Mind Maps is described by the authors as a strong ally in the development and learning of new content, mainly because the visual relationships between the contents are close to mental links.

Thus, considering the research performed and the answers obtained to the guiding questions of this Systematic Literature Review, some open issues are highlighted, which demonstrate potential for future research:

1. Can the Flashcards and Mind Maps approaches be combined in a way that favors the teaching and learning process?
2. Can a Virtual Learning Environment which implements Flashcards and Mind Maps be used to teach a course in a way that facilitates learning?
3. Do Flashcards created from the perspective of Mind Maps and shared among students help with learning?

Such questions reinforce the gap found in the present study where Flashcards and Mind Maps are described as promising approaches to learning - whether in Virtual Learning Environments or not. As already described, there is no evidence of their joint use in a VLE that would make it possible to ascertain its effectiveness. Thus, it is intended as future work to develop a VLE that addresses the approaches described, analyzing how they help in Foreign Language learning.

References

Barros, S. A. D. and Silveira, D. S. d. (2013). **Uma Revisão Sistemática Sobre Mapas Mentais Em Processos De Negócios**. XXIII Conic.

Belloni, M. L. (2015). **Educação A Distância**. Autores Associados, 7 edition.

Browder, D. M. and Roberts, M. L. (1993). **Guidelines for flash card instruction.** Journal of Behavioral Education, 3(3):235–245.

Buzan, T. and Buzan, B. (1993). **The Mind Map Handbook**. London BBC Books.

De Oliveira Fassbinder, A. G., Fassbinder, M., and Barbosa, E. F. (2015). **From flipped classroom theory to the personalized design of learning experiences in MOOCs**. In Proceedings - Frontiers in Education Conference, FIE, volume 2014.

DiFrancesca, D., Nietfeld, J. L., and Cao, L. (2016). **A comparison of high and low achieving students on self-regulated learning variables**. Learning and Individual Differences.

Eslahcar Komachali in TEFL, M. M. and Khodareza in TEFL, M. (2012). **The Effect of Using Vocabulary Flash Card on Iranian Pre-University Students**; Vocabulary Knowledge. International Education Studies, 5(3).

Ferreira, A. D. A., Werneck, V., and Santos, N. (2016). **Avaliação da Aprendizagem em Ambientes Educacionais: Uma Revisão Sistemática.** Anais do XXVII Simpósio Brasileiro de Informática na Educação (SBIE 2016), 1(Cbie):179.

Gladys, W. and David, H. (2015). **Embracing the Future: Empowering the 21st Century Educator.** Procedia - Social and Behavioral Sciences.

Godtsfriedt, J., Andrade, A., and Vasconcellos, D. I. C. (2014). **Treinamento mental no tênis: revisão sistemática da literatura.** Revista Brasileira de Ciências do Esporte, 36(2):577–586.

Heitink, M., Voogt, J., Verplanken, L., Van Braak, J., and Fisser, P. (2016). **Teachers' professional reasoning about their pedagogical use of technology. Computers and Education.**

Kampff, A. J. C., Ferreira, V. H., Reategui, E., De, J. V., and Lima (2014). **Identificação de Perfis de Evasão e Mau Desempenho para Geração de Alertas num Contexto de Educação a Distância**. Revista Latinoamericana de Tecnología Educativa, 13(2):1–16.

Krause, S., Maass, S., Chan, C., Waters, C., Carberry, A., and Koretsky, M (2014). **Web-enabled formative feedback and learning resources for enhancing student attitude, achievement, and persistence**. In 2014 IEEE Frontiers in Education Conference (FIE) Proceedings, pages 1–8. IEEE.

Litto, F. M., Longo, C. R. J., Loyolla, W. P. D. d. C., Staa, B. V., Ribeiro, A. T., Marthos, B. R., Pio, A., Vasconcelos, A. P., Aguiar, M., and Silva, O. d. (2017). **Censo EAD Brasil 2016 Relatório Analítico de Aprendizagem a Distância no Brasil**. Editora Inter-saberes, São Paulo, Brasil, 1 edition.

Maciel, C. (2012). **Educação a Distância: Ambientes Virtuais de Aprendizagem. Virtuais de Aprendizagem**, EdUFMT, v. 1, pages 259.

Maurício, W. P. D. and Schlemmer, E. (2014). **Educação a distância : As causas da evasão, os não lugares e suas manifestações**. In XI Congresso Brasileiro de Ensino Superior a Distância.

Minaei, N. (2014). **Do modes of transportation and GPS affect cognitive maps of Londoners?** Transportation Research Part A: Policy and Practice. Elsevier, v. 70. pages 162—180.

Nair, S. S. K. and Farei, K. A. (2017). **A brain friendly tool to facilitate research-teaching nexus: Mind maps**. In 2017 8th International Conference on Information and Communication Systems (ICICS), pages 82–85. IEEE.

Ouadoud, M., Nejjari, A., Chkouri, M. Y., and El Kadiri, K. E. (2018). **Educational modeling of a learning management system**. Proceedings of 2017 International Conference on Electrical and Information Technologies, ICEIT 2017, 2018-January:1–6.

Pereira, A. T. C., Schmitt, V., and Dias, M. R. A. C. (2007). **Ambientes virtuais de aprendizagem**. In: Alice Theresinha Cybis Pereira. (Org.). Ambientes Virtuais de Aprendizagem em Diferentes Contextos. Rio de Janeiro: Ciência Moderna, 2007, v. , p. 2-22

Popova, O., Popov, B., and Karandey, V. (2015). **Intelligence Amplification in Distance Learning through the Binary Tree of Question-answer System**. Procedia - Social and Behavioral Sciences, 214:75–85.

Rhama, M. A. (2016). **Improving Grade Eight Students' Vocabulary Mastery Using Flashcards At Mtsn Godean In The Academic Year Of 2016/2017**. PhD thesis, Yogyakarta.

Rf, S. and Mancini Mc, E. (2007). **Revisão Sistemática**. Revista Brasileira de fisioterapia, pages 83–89.

Saatz Inga, , and Kienle, A. (2013). **Increasing Quality in large scale University Courses**. Eleed, 9(1).

Shakouri, N. and Mehrgan, K. (2012). **The Impact of Using Flash Cards on Promoting University Students' Knowledge of Vocabulary**. Advances in English Linguistics (AEL), 1(2):47–55.

Silva, D. R. D., Martins, S. D. L., and MacIel, C. (2017). **Identification and systematization of indicatives and data mining techniques for detecting evasion in distance education**. In 12th Latin American Conference on Learning Objects and Technologies, LACLO 2017.

Sousa, M. R. d. and Ribeiro, A. L. P. (2009). **Revisão sistemática e meta-análise de estudos de diagnóstico e prognóstico:** um tutorial. Arquivos Brasileiros de Cardiologia, 92(3):241–251.

Tinto, V. (1975). **Dropout from Higher Education:** A Theoretical Synthesis of Recent Research. Review of Educational Research.

Wazir, H. B., Othman, A., and Yusof, Y. M. (2018). **Vocabulary Flashcard in Learning English as Second Language for non-native Learners**. In SMMTC Postgraduate Symposium 2018, page 280.

Zarzo, E. (2015). **The Art of Memory in the Digital Age**. Procedia - Social and Behavioral Sciences, 178:222–226.