

# SOFTWARE CMAP TOOLS® TO BUILD CONCEPT MAPS: AN EVALUATION BY NURSING STUDENTS\*

ORIGINAL ARTICLE

SOFTWARE CMAP TOOLS® PARA A CONSTRUÇÃO DE MAPAS CONCEITUAIS: A AVALIAÇÃO DOS ESTUDANTES DE ENFERMAGEM

SOFTWARE CMAP TOOLS® PARA LA CONSTRUCCIÓN DE MAPAS CONCEPTUALES: EVALUACIÓN DE ESTUDIANTES DE ENFERMERÍA

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## ABSTRACT

Concept mapping (CM) is a teaching strategy that can be used to solve clinical cases, but the maps are difficult to write. The objective of this study was to describe the challenges and contributions of the Cmap Tools® software in building concept maps to solve clinical cases. To do this, a descriptive and qualitative method was used with junior nursing students from the Federal University of São Paulo. The teaching strategy was applied and the data were collected using the focal group technique. The results showed that the software facilitates and guarantees the organization, visualization, and correlation of the data, but there are difficulties related to the handling of its tools initially. In conclusion, the formatting and auto formatting resources of Cmap Tools® facilitated the construction of concept maps; however, orientation strategies should be implemented for the initial stage of the software utilization.

## DESCRIPTORS

Education, nursing  
Educational technology  
Maps  
Software

## RESUMO

O mapeamento conceitual (MC) é uma estratégia de ensino que pode ser utilizada para resoluções de casos clínicos, porém de trabalhosa execução manuscrita. O estudo teve por objetivos descrever os desafios e as contribuições do software Cmap Tools® para a construção de mapas conceituais para resolução de caso clínico. Para isso, utilizou-se método descritivo, qualitativo, com estudantes da 3ª série de Graduação em Enfermagem da Universidade Federal de São Paulo. A estratégia de ensino foi aplicada e os dados foram coletados pela técnica do grupo focal. Os resultados evidenciaram que o software facilita e garante a organização, visualização e correlação dos dados, porém com dificuldades iniciais relacionadas ao manejo das ferramentas que dispõe. Concluiu-se que o software Cmap Tools® favoreceu a construção dos MC por seus recursos de formatação e autoformatação e que estratégias de orientação deveriam ser implantadas para a fase inicial de utilização.

## DESCRITORES

Educação em enfermagem  
Tecnologia educacional  
Mapas  
Software

## RESUMEN

El mapeo conceptual (MC) es una estrategia de enseñanza que puede utilizarse para resolución de casos clínicos, más allá de su trabajosa ejecución manual. Se objetivó describir los desafíos y contribuciones del software CMAP TOOLS® para la construcción de mapas conceptuales enfocados a resolución de casos clínicos. Metodología descriptiva, cuantitativa, con estudiantes de tercer año de Enfermería de la Universidad Federal de São Paulo. Se aplicó estrategia de enseñanza, datos recolectados mediante técnica del grupo focal. Los resultados evidenciaron que el software facilita y garantiza la organización, visualización y correlación de datos, aunque con dificultades iniciales relacionadas al manejo de las herramientas de las que dispone. Se concluye en que el software CMAP TOOLS® facilitó la construcción de MC por sus recursos de formateo y auto-formateo, y que deberían implantarse estrategias de orientación para la fase inicial de utilización.

## DESCRIPTORES

Educación en enfermería  
Tecnología educacional  
Mapas  
Programas informáticos

\*Extracted from the end-of-course monograph "Software CMAP TOOLS® para a construção de mapas conceituais: a avaliação dos estudantes de enfermagem", Escola Paulista de Enfermagem, Federal University of São Paulo, 2009. <sup>1</sup>Graduate of the Oncology Nursing Program, Escola Paulista de Enfermagem, Federal University of São Paulo, São Paulo, SP, Brazil. paulabarreto.enf@gmail.com <sup>2</sup>RN. Professor of the Clinical and Surgical Nursing Department, Escola Paulista de Enfermagem, Federal University of São Paulo, São Paulo, SP, Brazil. cibellicohrs@unifesp.br <sup>3</sup>Adjunct Professor of the Clinical and Surgical Nursing Department, Escola Paulista de Enfermagem, Federal University of São Paulo, São Paulo, SP, Brazil. Study adviser. domenico.edvane@unifesp.br

## INTRODUCTION

Today, healthcare professionals, including nurses, are required to show creativity, flexibility, contextual view, intellectual curiosity, and, above all, competencies based on sound knowledge that assure they are capable of managing people and resources at the same time<sup>(1)</sup>.

The starting point for this competence standard is for Nursing Undergraduate courses to include classes with theoretical, theoretical-practical (laboratories) and practical (public and hospital healthcare services) contents, with a view to help improve the development of knowledge and skills<sup>(2)</sup>.

Thus, nursing students should know and relate contents from different fields that comprise the knowledge of the profession, interpret the existing relationships among those contents, and make decisions considering patients' and relatives' opinions<sup>(1,3)</sup>.

However, the teaching-learning conditions offered to students do not always favor critical thinking and clinical reasoning, i.e., environments based on evidence-based practice and effective communication.

When the environment is inadequate, the student may be induced to automatically reproduce routine behaviors they observed in other professionals, apply outdated techniques, and, thus, compromise the development of the required competencies for nursing practice.

Therefore, saving clinical reasoning and decision-making tasks for the real care environments, where the practical internships take place, can cause anxiety and insecurity in the students, besides the risk of compromising patient safety<sup>(4)</sup>.

Concept Mapping (CM) is one of the available teaching strategies that work with concepts and facts together and have been proven to be methodologically positive for interdisciplinary and individual knowledge development. CM permits students to elaborate concepts and organize them in their cognitive structure, in a network of relationships with multilinear characteristics, which are not restricted to Cartesian thinking, which is essential for teaching clinical reasoning<sup>(5)</sup>.

The CM theory was developed in the 1970s, by the North-American researcher Joseph Novak and his collaborators at Cornell University, in the United States<sup>(6)</sup>. This teaching strategy consists of a tool to practice the meaningful learning theory, based on the David Ausubel's psychology of learning<sup>(6)</sup>. In this perspective, students reconstruct and re-elaborate knowledge itself, in an individualized process, in which the assimilation of new concepts is supported by other pre-established ones.

In order to teach the clinical competency in nursing, the CM structure was adapted to generate researchers' solution to clinical cases<sup>(7)</sup>, which inspired a group of students from a public university of the state of São Paulo, Brazil, to develop an educational project that included the CM as a teaching strategy in the field of Clinical Nursing, in the class Adult and Elderly Nursing, which was launched in 2008 and remains in activity.

In this project, students create the CM based on a pre-established clinical case, elaborated by the student group according to the determined correction criteria. The description of the clinical case must be based on the students' experience and prior knowledge, through bibliographic surveys and with mediation of a trained professor to help them understand, elaborate and structure an organized critical thought<sup>(7)</sup>.

The possibility of creating a CM using Cmap Tools<sup>®</sup> was introduced on the second year of development of the referred project, in 2009, with the purpose to facilitate text editing. Cmap Tools<sup>®</sup> is developed by the Institute for Human Cognition (IHMC) at University of West Florida, under the supervision of Alberto J. Cañas, and may be obtained at no cost on the website of the Institute for Human and Machine Cognition, IHMC (<http://cmap.ihmc.us/conceptmap.html>).

Because of the positive comments from the students, all CM were created using Cmap Tools<sup>®</sup>, which allowed us to create the following research questions: How does the Cmap Tools<sup>®</sup> contribute with solving the clinical case? What challenges do the students perceive regarding the utilization of this software?

The objectives were to describe the contribution of the Cmap Tools<sup>®</sup> to solve the clinical case, and identify the challenges of using the Cmap Tools<sup>®</sup>, from the students' perspective.

## METHOD

### *Type of study*

This is a descriptive, qualitative study as it considers the interpreted meaning of the study objectives, i.e., the meanings assigned by the individuals. Because it addresses the utilization of a teaching strategy, the qualitative analysis of the data was based on the description of the Concept Map teaching strategy, applied to solve clinical cases, and on the operational features regarding the utilization of Cmap Tools<sup>®</sup>.

### *Subjects*

The subjects were eight junior nursing students from the School of Nursing *Escola Paulista de Enfermagem* at

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Federal University of São Paulo, who met the following inclusion criteria: agree to participate in the focal group, having solved the case study individually, and having used Cmap Tools®.

**Authorization from the Research Ethics Committee**

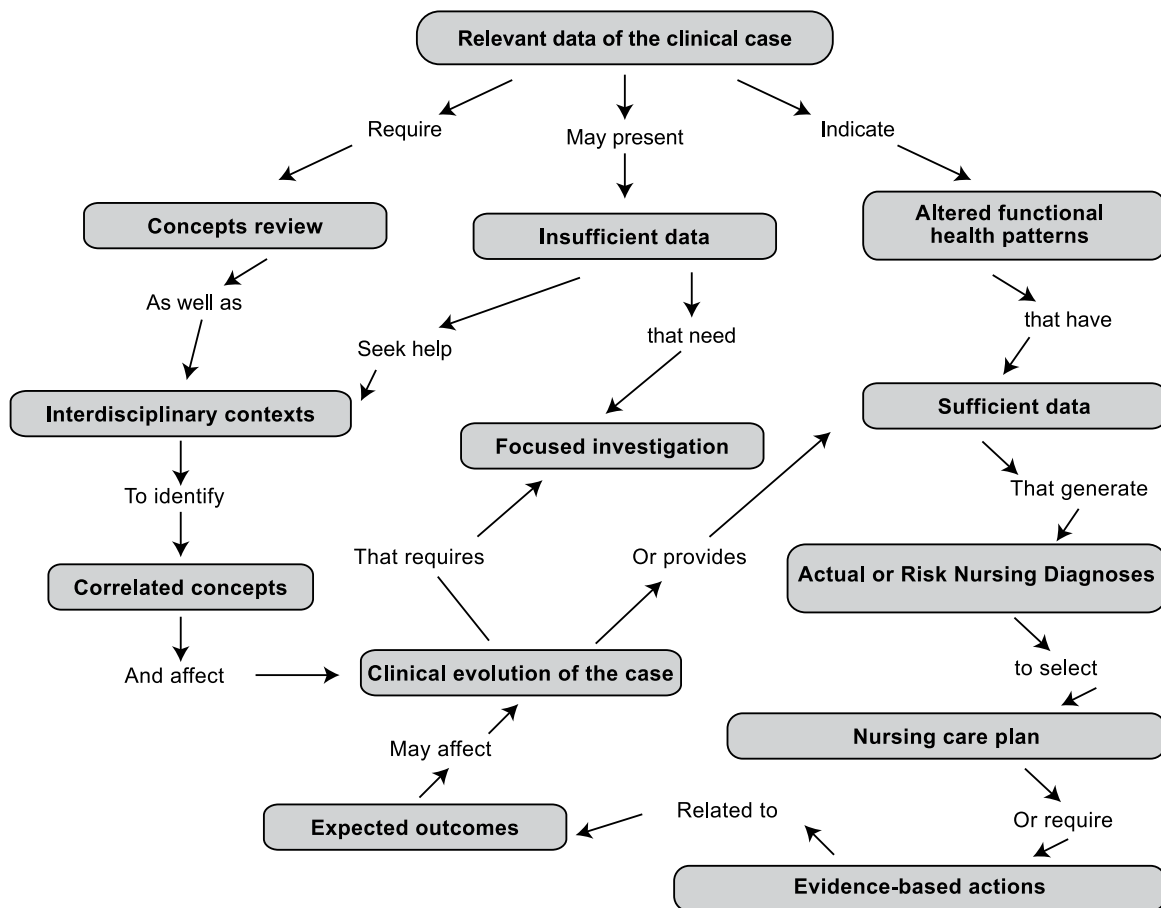
The project regarding the use of the CM strategy was approved by the Institutional Research Ethics Committee at Federal University of São Paulo (CEP 010/08), and the data were collected after the participants signed the Free and Informed Consent Form (FICF).

**Operational steps for applying the teaching strategy**

The teaching strategy consisted of solving a case study using CM through Cmap Tools®, in the period corresponding to the theoretical classes of the Adult and Elderly Nursing class. The referred class counts with theoretical (67h) and hospital practice (100h) classes, i.e., after learn-

ing the theoretical foundations in class, students develop practical activities in the hospital. These activities consist of performing a clinical evaluation of patients, performing nursing procedures, and providing education for health promotion, among other nursing activities for the care of patients, their caregiver and/or relative.

The activity of making the CM-clinical case was guided in three meetings with the students in the classroom. On the first meeting, the students were explained about the data of the clinical case, regarding a patient with Non-Hodgkin Lymphoma; how to create a CM (according to the model represented in Figure 1), and how to use the Cmap Tools® (version v 4.18), and it was suggested they read a manual available on the Internet<sup>(w)</sup>. On the second and third meetings, the students solved any doubts they had regarding the activity, particularly those concerning the content of the clinical case and how to organize the contents on the CM. The students were asked to submit a printed version of the CM for correction.



Source: Extracted from De Domenico et al.<sup>(7)</sup>.

**Figure 1-** Graphic representation of a clinical case solved using a concept map

**Data collection**

Because the study questions referred to identifying the students' experience in using Cmap Tools® to solve a

clinical case, the authors chose to create a Focal Group. The characterization of the subjects was comprised by the

following data: age, gender, number of times taking the Adult and Elderly Nursing class and their level of experience or skill with computers.

### Focal Group (FG)

The technique consists of forming a group of participants involved with the case study and selected according to the eligibility criteria pertinent to the study design and number of participants ranging between four and ten, although some authors recommend six to ten participants, and inviting 20% more to cover absences<sup>(8-9)</sup>. In the present study, the focal group was comprised by the researchers and participants who signed the FICF, and lasted one hour.

One researcher was assigned the moderator role, and she opened the meeting with the central question: Describe your experience with creating the CM using Cmap Tools® to solve the clinical case. All participants stated their opinions. The statements were recorded on a digital device and transcribed afterwards.

### Data analysis

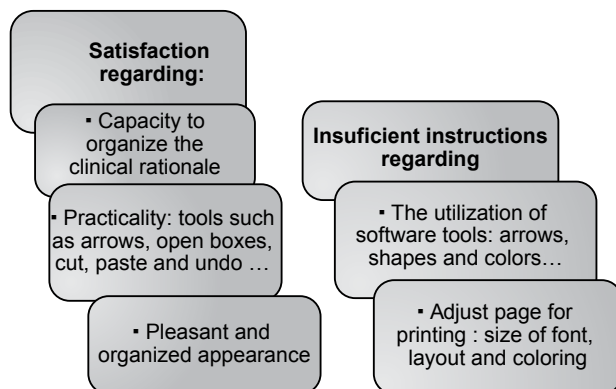
The data obtained in the Focal Group were analyzed using Content Analysis<sup>(10)</sup>. Bardin's technique was used because in addition to describing the meanings assigned to the use of the Cmap Tools®, it permitted the study to generate objective contributions to improve the use of this teaching strategy. According to the technique, the data were described, interpreted, classified and categorized. Next, the data were analyzed based on the didactic-pedagogic characteristics of the teaching strategy, including the concepts regarding the resources that help observe the cognitive structure of the student and the process of acquiring new knowledge and meanings of the learned content, in this case, mediated by developing the proposed teaching strategy and Cmap Tools® resources.

## RESULTS

The participants were female, of ages between 19 and 22 years, and were first-time students of the Adult and Elderly Nursing class. They all reported using the computer for schoolwork and entertainment.

When asked about their personal experiences with creating the CM using the Cmap Tools® regarding the aspects that helped complete the task or hindered following the steps (Figure 2)<sup>(11)</sup>.

It was possible to synthesize the positive aspects to creating the CM using Cmap Tools® into a feeling of satisfaction. However, as a negative aspect, the students reported that the little information they received regarding how to handle the Cmap Tools®, increased the initial difficulty in creating the CM.



**Figure 2** – Graphic representation of the students' utilization of Cmap tools® to create Concept Maps - São Paulo, 2009

(...) My difficulty was also in the beginning. The lack of instructions and having to find out how to move the link in the box to the left, to the right, and organize. Sometimes there was a box in the middle and you wanted to relate it to the ones (boxes) that were farther, and it was difficult (...) (E7).

Furthermore, some participants stated their difficulty to develop a task using software they did not master. They observed that, many times, the number of available choices on the program, such as the use of arrows, text areas, and others, were elements that complicated their completion of the task.

(...) Yeah, I also thought we needed more instructions about how to use it. Because, sometimes you don't want the connection word. And then you have to discover how to not select it (...). And also to bend the arrow a bit (...) (E5).

Another important factor was the configuration, because there were disagreements between the configuration of the virtual and the printed CM. On the screen, the font was always larger than on the printed map, and the colors chosen for the boxes were also stronger when printed, which made it difficult to read the texts in the boxes.

(...) Visually (on-screen configuration), it looks as if the font is appropriate and then when I print it, it's much smaller, it's tiny and on the screen it was great (...) (E2).

(...) the printing, and also the color. Because we chose a color that looked good on the screen on every computer. But when we printed it, the color was expected to be lighter. It didn't work (...) right with darker colors (...) (E4).

However, all the participants classified the software as a facilitator in the creation of CM, as it reduced the time invested to format the map, and recognized the stimulus that its use provides in the creation process. For the participants, adding an idea or complementing existing ideas using the software tools eventually became a simple task. Other reported advantages were the self-format and history of the performed activities.

(...) I agree that the fact that just by pulling an arrow makes a square appear for you to write the connection word and to include a box (...), so you can write what is related to the connection box, it makes it a lot easier (...) (E2).

(...) It helps to optimize time use, because in case you change your mind, you don't lose what has already been done right (...) (E6)

Unanimously, all subjects classified that the practicality of Cmap tools® is incomparable to doing the task manually.

(...) I think that in terms of organization you can't compare with the manual work. Cmap Tools® is much better, it makes it a lot easier (...) (E3).

Some participants pointed out that the organization and practicality to connect the data, information and concepts in the boxes made the CM organized and boosted the connectivity of the concepts, which translated into fluent and articulate development of the clinical rationale.

(...) Also regarding education, I think it makes it a lot easier for you to think quickly. I think it's interesting (...) (E3).

All the participants informed they used the computer for schoolwork in primary and secondary schools as well as in their undergraduate studies. Furthermore, they emphasized the fact that they used the computer and other software for schoolwork as well as for entertainment. The group of data that value the utilization of the referred software is presented in Figure 3.

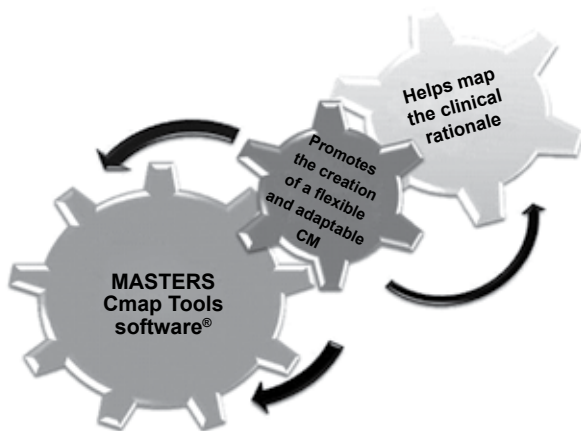


Figure 3 – Graphic representing the advantages of using Cmap tools® - São Paulo, 2009

It is observed that the software helped in the operational process of mapping the clinical rationale.

(...)Cmap Tools® was really very specific for the concept map (...) (E1).

(...) I mentioned the point (MS-Power Point®) because I've already tried to do some schoolwork using the boxes on the point and linking with those arrows and it was hard work. It wasn't a concept map so complex that required so much clinical reasoning, but (...) (E7).

The participants stated that they would use the Cmap Tools® again and said that after overcoming the first difficulties regarding the utilization of the, it made the CM creation process easier.

(...) I would, in fact, use it to have a broader view of a patient case (...) (E1,E4).

## DISCUSSION

Although the students were used to using computer resources, and stated that Cmap Tools® was a friendly software, they identified that the software resources require proper introduction, and, if possible, their utilization should be explained to new users. New teaching strategies require an adaptation period from students, which should be considered when planning the course hours <sup>(12)</sup>.

Despite the fact that specialist literature and some participants pointed out that the software has a friendly interface, the present study found there is a need to familiarize users with the program so there is better use of the uncountable tools available.

In this project, the students made a negative evaluation of the instructions that the faculty provided in the class in the beginning of the task regarding the utilization of the software, as well as the reading of the manual online, and they stated that the lack of instructions was accountable for their delay in performing the activity.

Knowledge regarding the use of computer resources does not dismiss the use of manual devices for those beginning to use Cmap Tools®, because, in all its different versions, it does not have self-explanatory tools. Despite its negative evaluation, the use of manuals and the creation of virtual environments are analyzed as positive for promoting forums and debates to improve the conceptual meaning of the functioning of any software <sup>(13)</sup>.

The students showed that the software promotes the creation of a CM with a pleasant look and free from excessive information. The students highlighted the possibility of organizing the information while creating the CM as extremely important. The facilitating attribute of the software has already been defined by its idealizers, as well as users of different educational levels <sup>(14)</sup>.

Hence, it is evidenced that the study subjects appreciate and are capacitated for teaching that combines computer technology and contents of professional training. In the didactic field, however, there are but a few innovation projects that move university teaching from the traditional ways to computer-based learning or other education technology <sup>(12-13)</sup>.

The positive attitude demonstrated by the participants when asked if they would use the CM teaching strategy again is certainly an indicator of their satisfaction with the association between CM and Cmap Tools® i.e., the



subjects demonstrate how productive the partnerships between learning strategies and computer technologies are. Furthermore, it points to a fertile field that is being underexplored in the didactics of higher education.

## CONCLUSION

Today, technology offers fast accessibility to a large volume of information, and the Internet is a trustworthy example of this fact. The possibility of benefitting from a software with multi-modal interfaces, that provides users with partial solutions to operationalize a teaching

strategy, such as that developed by the Institute for Human and Machine Cognition ([www.ihmc.us](http://www.ihmc.us)), has been preponderant for faculty and students to overcome the barriers of traditional education centered on the transmitter-receiver relationship and see the real meaning of learning to learn.

The results evidenced how using Cmap Tools<sup>®</sup> enriched the process of creating a CM, because it facilitates the inclusion and exclusion of information, their distribution, concentrating them on a single page, that is, it promotes a dynamic involvement of students in the task, thus making the process easier and saving time.

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