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CONCEPT MAP TO SOLVE CLINICAL HEALTH CASES: HOW WE DO IT

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Abstract. We have used school-based case studies in the training of health professionals for a more enjoyable learning and to assemble a variety of content areas to produce knowledge, to foster decision making skills, and attitudes in agreement with the relevant listing, critical and ethical standards required for a health professional. Objective: Our main purpose in this study was to describe the use of Concept Maps (CM) as a strategy for undergraduate nursing students to solve clinical cases, as well as evaluate the performance and opinion of students about the use of CM as a tool to solve clinical cases. Method: This is a descriptive study of educational intervention with quantitative and qualitative analysis. The study was performed with undergraduate nursing students from the third period of nursing practice discipline of adult and elderly health at a public university in Sao Paulo. Results: Several groups have showed us that the strategy has helped them to learn, to make associations between the multidisciplinary content, to understand the clinical conditions and to develop clinical thinking. Groups, CM1 and CM2, had p=0.0008 and p =0.0222, respectively. Conclusion: The strategy has helped students to develop critical thinking, and there was a noticeable improvement in their ability to develop CM.
Keywords: Concept Mapping; Theory Development; Research Development; Critical Thinking

1 Introduction

Recently more discussions and actions have occurred related to educational technology in the field of health. The search for different strategies to teach is justified because it may give rise to dynamic and useful teaching situations to develop professionals with critical and reflexive thinking, clinical decision-making, and evidence-based practice skills (Leonello & Oliveira, 2008; Chambers, 2010).

Among the innovative teaching strategies, the Concept Maps (CM) has highlighted. Using student's backgrounds, educators can evaluate how students organize concepts. This tool also helps to identify the network relationship with multilinear characteristics, i.e., it is not restricted to Cartesian thinking (Cañas & Novak, 2008; Novak & Gowin, 2008). Based on this knowledge, we implemented Concept Maps strategy to solve clinical cases in the discipline of nursing practice of adult and elderly health at Universidade Federal de São Paulo - UNIFESP, mainly because this discipline involves theoretical lectures and a period of hospital practice training (De Domenico et al., 2008).

The case study method is widely used in health sciences teaching by enabling the development of reasoning and clinical judgment (Garvin, 2003; JE Thistlethwaite et al., 2012). The process of diagnosis, to identify patient ilness and provide appropriate treatments, is complex, it demands knowledge from different disciplines so the health professional can explain and predict what is happening and the consequences of different treatments. The clinical cases used were based upon real case scenarios involving medical diagnosis, signs and symptoms, results and tests, proposed treatments, psychological, social and cultural data of patients with cancer. We expected that students could find the relationship between concepts, find out relevant data, proper diagnosis, and also to make decisions to come up with different care interventions with efficiency and safety. These steps, closely related to clinical thinking, would become indexes to create a CM model, and to make the criteria for correction.

We have applied the strategy for three years. In the first year, 2008, we assessed the student's opinion based on the study done by De Domenico, et al (2008) about the exercise to solve a clinical case, the advantages and disadvantages to include CM in the discipline, and what kind of positive and negative issues a CM construction could bring. Using that method the CM promoted curiosity among students across all the academic world, and a willingness to investigate and combine relevant data. In addition, it stimulated them to find out more about scientific findings that could help them to innovate standard interventions (De Domenico et al, 2009).

Most of the students enjoyed creating the CM; however, the majority reported that it was difficult and required a great deal of work. After assessment, we realized that would be important to develop clinical thinking in undergraduate nursing students to continue to use and improve the CM strategy.

In the second and third years, 2009 and 2010, we created two CMs to get two different assessments. The first assessment after the theoretical class and other after hospital practice training. We detached the CM strategy into after and before the hospital practice, so we can assess the teaching contributions in to improve students' clinical thinking. this study was primarily driven by our desire to know what is the scope of this method and after that, to gather data to enhance the strategy application.

This experience lead us to the main question of this study: what is undergraduate nursing students' self-perception on their performance during class after hospital practice training with CM? What was student's performance in solving clinical cases through CM? **Objectives**: Our main purpose in this study was to describe the use of Concept Maps (CM) as a strategy for undergraduate nursing students to solve clinical cases, as well as evaluate the performance and opinion of students about the use of CM as a tool to solve clinical cases.

2 Method

2.1 Design

In order to analyze meaning expression, students perceptions and suggestions about their own performance, we proceed with a descriptive study of an educational intervention with a qualitative approach. Also, a quantitative analysis of grades was obtained from the two concepts mapping constructed by participants.

2.2 Participants

Nursing undergraduates attending the third period in 2009 and 2010 nursing practice of adult and eldery health classes at Escola Paulista de Enfermagem (School of Nursing) da Universidade Federal de São Paulo-UNIFESP, São Paulo, São Paulo, Brasil.

2.3 Gathering data

We have grouped students accordingly to age and previous experience in using computational technology. After the second CM assessment, the 2009's group, with ten students, gave us the qualitative sample. In the same year we created the Focus Group (FG) to apply a qualitative data collection technique connecting researcher and subjects. Such an approach allowed integration in the group and fomented discussion among participants. This technique consist of the formation of a group involved with a problem to be addressed by the participants that are grouped accordingly to eligibility criteria related to the study design, which could vary from 4 to 12 participants (Dilorio et al, 1994).

We included in this study those who concluded the CM1 and the CM2 construction. Firstly, we asked the participants to describe the experience of creating the CM1 and CM2, then their answers were recorded and transcribed. Qualitative data of students from 2009 and 2010 were obtained after the conclusion of the following steps.

2.4 Data analysis

We used the content analysis created by Bardin (2012) to analyze the data from the FG. The registering units and codes outcomes were gathered into categories, which were analyzed considering its references of effective learning and CM construction.

For quantitative analysis we divided the score into quartiles (0 to 100%) and measured it by means and standard deviation. We carried out with Shapiro-Wilk because the sample was less than 2.000. To inferential analysis using the analysis of variance (ANOVA) both groups from 2009 and 2010 presented similarity among scores of CM1 and CM2. The confidence level considered was 95%.

3 Results

3.1 Description of the educational plan

Firstly, for each year of the strategy application we created three phases: planning, action, and assessment.

a) Planning: a clinical case was elaborated with a few data in the CM1, such as: patient identification (gender, age, job position, housing, family constitution, religion/believes), companion identification, diagnostic, exams (laboratorial and imaging), treatments (clinical and surgical), emotional status. New data about previous problems evolutions were presented using the same clinical case in the CM2.

Figure 1 describes correction criteria for the CM1 and CM2. Scores are defined accordingly to the number of data acquired from clinical case, i.e., if there were 10 relevant data, the student needed to describe all of them in the CM to obtain these 2 points, or describe 5 to obtain 1.0 point.

Criteria for Correction of Concept Maps to Solve Clinical Case	Score
Selection of relevant data of the clinical case	High score: 2.0 score; 75%: 1.5 score; 50%: 1.0 score; 25%: 0.5 score; low: zero
Identification of Functional Change in Health Standards	High score: 2.0 score; 75%: 1.5 score; 50%: 1.0 score; 25%: 0.5 score; low: zero
Identification of Actual and Risk Nursing Diagnosis which defines characteristics and related facts (associations between biological concepts of clinical case in psychosocial and spiritual content).	High score: 2.0 score; 75%: 1.5 score; 50%: 1.0 score; 25%: 0.5 score; low: zero
Proposition of Focused Investigation from analysis of insufficient data: to form question	High score: 1.0 score; 75%: 0.75 score; 50%: 0.5 score; low: zero
Description of Nursing Outcomes: considering intervention planning and nursing evolution	High score: 1.0 score; 75%: 0.75 score; 50%: 0.5 score; low: zero
Proposition of Nursing Interventions: the action taken must be related to nursing diagnosis. The action should be based on scientific evidence, and reference citation provided.	High score: 2.0 score;75%: 1.25 score; 50%: 1.0 score; 25%: 0.5 score; low: zero
Total	10.0 (ten)

Figure 1: Criteria for correction of Concept Maps to solve clinical case.

b) Action: In the beginning of the theoretical module we taught the students how to proceed with the CM1 and set up a deadline, normally after 45 days, at the end of the module. As shown in Figure 2, we also provided a Nursing Process (NP) based model to help them to solve clinical cases using CM.

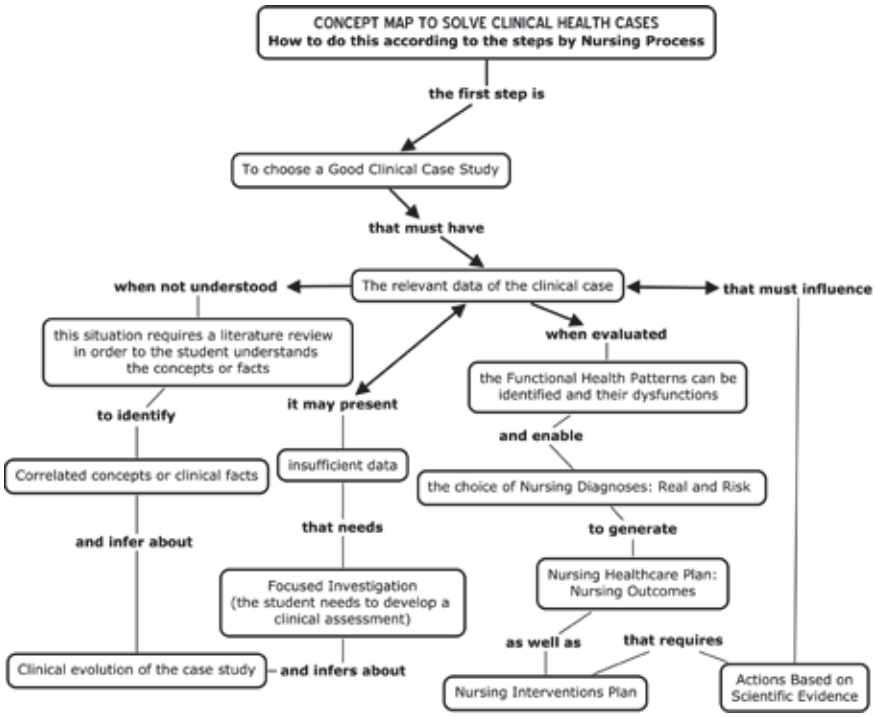

Figure 2: Model to solve a clinical health case using the MC, according to the Nursing Process.

Students were encouraged to ask questions to erase any doubts during the practice. Most doubts were related to the resolution of the clinical case and about CmapTools software, a program required for the task. In 2009, we gave printed handouts about the software to the students, which evolved into stored USB files in 2010. After correction of the CM1 a score of 0 to 10 was given and the students were instructed to proceed with CM2 considering the same clinical case and the CM1 corrections. They presented the results in the last week of hospital practice training.

c) Assessment: Figure 1 shows the criteria used to correct both CM. In addition, we added comment to help students to think about their choices and how to conduct the case in CM2. We used the tool "comment" in CmapTools software to give suggestions and to clarify mistakes. We also told students their individual CM score and final grade score.

3.2 Performance results and the students' opinion

We gathered data from the FG in July 2009 after the students take part in a informed consent, which lasted 70 minutes. All participants were women aged 19 to 22 years who claimed to have had experience with computer for schooling and entertainment purpose, but did not know the CM strategy.
We asked students about the experience of creating CMs (1 and 2) and their testimonials gave us analytical categories showing enhancement and development of clinical thinking. It also showed us some challenges the participants faced during practice. Students were tagged as "S" (S1, S2…).

We obtained 2 categories from the FG discussions: CM enabled multidisciplinary studies and relationship between content, but it required hard work (Figure 3) and CM to support clinical conditions understanding and to develop clinical thinking.

Testimonial	**Inferential Analysis**
"(...) *to create a CM impelled me to seek more knowledge in some subjects, correlated subjects."* (S3, 2009) "*I thought this exercise was good mainly because it enabled me to link knowledge, because* (...) *during undergraduate* (...) *contents are separated throughout the years* (…). *The Concept Maps puts everything together.*" (S7, 2009) *"(...) in the beginning it was not easy (...), specially nursing, which required to build a diagnosis and interventions."* (S4, 2009)	- Motivate studying - Satisfaction because it correlated multidisciplinary data - Hard to do, mainly clinical decision-making.

Figure 3: Category 1: CM enabled the study and link of multidisciplinary contents, but it required hard work

Regarding the period in hospital settings, which integrates the discipline of nursing practice of adult and elderly health, students reported enlarged their sense and meaning of clinical thinking, besides the satisfaction with the final result of the CM2 (Figure 4).

Testimonial	**Inferential Analysis**
"*The CM helped me during my internship* (...) *Many things I studied during practice I have already learned in the CM1, particularly on physiology and diagnostic test.*" (S5, 2009) "*The internship helped me to understand better the second map, because you do not learn only by theoretical lectures, but acting in real situations. This experience helps you to think critically and it even improves your ability to make nursing diagnosis.*" (S4, 2009)	-CM1 solving helped to understand pathophysiological aspects of the clinic -Practice experience helped in CM2 construction -There was a development in critical analysis and clinical thinking in CM2.

Figure 4: Category 2: CM as a facilitator to clinical conditions comprehension and to develop clinical thinking.

We organized the students from both years to gather solid data to assess student's performance. We have a total of 97 students with age ranging from 19 to 23. All participants had declared to have computer literacy. Participants who had completed both Concept Maps were included. Thus, grades of 56 students from 2009 group and 41 students from the 2010 group were obtained.

Table 1 shows normality tests and the analysis of grades from the 2009 group with variable quartiles, mean and standard deviation.

Table 1: Distribution of grades of the CM1 and the CM2 of 2009 group for quartiles and central tendency

Variables	n	0%	25%	50%	75%	100%	Mean (DP)	S-W
Grades of CM1	56	0	3.5	4.75	6.5	10	5.0 (2.3)	0.2863*
Grades of CM2	56	3	5.6	7.75	8.4	10	7.2 (1.7)	0.0048
Differences of grades in CM1 and CM2	56	0	0	1.6	4	7.5	2.1 (2.2)	<0.0001
Mean	56	2.25	5	6	7.5	10	6.1 (1.7)	0.6043*

S-W: Shapiro-Wilk test for normality * Sample came from normal distribution

Table 2 presents results from the 2010 group.

Table 2: Distribution of grades of the CM1 and the CM2 of 2010 group for quartiles and central tendency

Variables	n	0%	25%	50%	75%	100%	Mean (DP)	S-W
Grades of CM1	41	3	4	5	6	8	5.1 (1.2)	0.1399*
Grades of CM2	41	4.5	6.75	7	8.75	10	7.3 (1.5)	0.0131
Differences of grades in CM1 and CM2	41	0.5	1	2	3.5	5.5	2.2 (1.5)	0.0014
Mean	41	4	6	6.25	7	8.5	6.2 (1.1)	0.0082

S-W: Shapiro-Wilk test for normality * Sample came from normal distribution

Variables of grades in CM1 and the mean in the 2009 group had normal distribution. In the 2010 group only the variables of grades in CM1 had normal distribution, for this reason, we used the Wilcoxon test/Kruskal-Wallis test to compare samples. We used ANOVA for numerical variables analysis. Data from the 2009 group had significant statistical differences ($F=12.5121$, $p=0.0008$) among grades of the CM1 and the CM2, being grades higher in the CM2. The same happened in the 2010 group ($F=5.6702$, $p=0.0222$) in the CM2.

The box-plot in figure 5 presents the comparative analysis of groups from the 2009 and the 2010 groups about the students' performance in the CM1 and the CM2 construction.

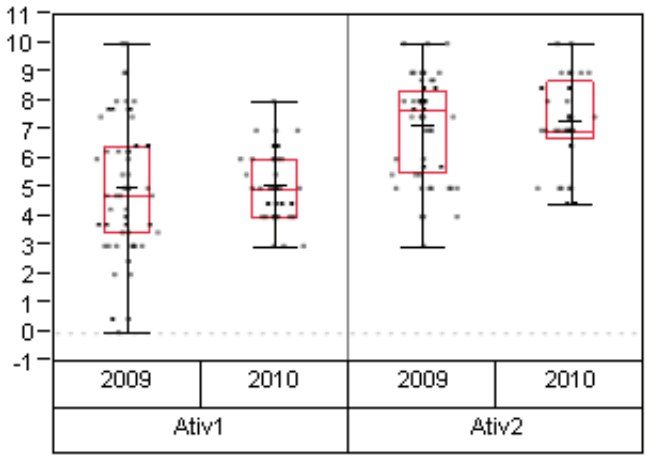

Figure 5: Box-Plot showing variability of grades of the CM1 and the CM2 in 2009 and 2010.

4 Discussion

Discussion in the FG about the experience of creating Concept maps shows us that CM strategy is a good initiative which helps students to connect multidisciplinary content, as well as understand clinical condition and develop clinical thinking. Our results were similar to other studies that used CM in health sciences (Kathol et al, 1988; Daley, 2004).

Despite the opportunities mentioned above, there were some complaints due to the complexity of CM construction. Defining nursing diagnosis over identification of relevant clinical data with posterior analysis to choose suitable intervention gave rise to doubts and obstacles to build the CM. Such problems were mainly seen in the first CM, because students at that time did not have experience in hospital settings. Students clinical skills should be developed due to nursing learning process, continuous scientific knowledge development focused on quality stages and the ability to turntheoretical knowledge into practice (Daley et al, 1999; Ironside, 2003).

Hence, the difficultly to develop consecutive stages of clinical decision-making (nursing process) without previous hospital experience may be considered a result of few attributions of information meanings in a clinical case. The criteria defined for correction of CM pointed out the relationship between critical thinking, clinical competence from a descriptive knowledge, quality of inferences, investigations focused on specific problems, abstractions and generalizations that require the student to consolidate formal knowledge with clinical experience, which depends on cognitive, psychomotor, and professional affective knowledge (De Domenico et al, 2009). Students get in touch with hospital environment only during the third and fourth years of nursing college at our institution, therefore, the difficulty faced by students during CM construction is justified because they do not have practice with real life situations.

However, other testimonials revealed that the second map was easier after the practice experience at the hospital units. An improvement in performance in both groups from 2009 and 2010 was observed regarding the development of stages of clinical decision-making, specially the ability to make clinical choices. The mean scores also showed a positive result. CM1 and the CM2 had 5.0 ±2.3 (2009) and 5.1 ± 2.1 (2010), and 7.2 ±1.7 (2009) and 7.3 ±1.5 (2010), respectively.

In general, data collected in interviews suggested a positive assessment in the use of this strategy, particularly because it enhanced the need to connect different concepts and facts studied during the undergraduate period that was not properly correlated in theoretical modules before practice in a hospital environment.

Despite the positive results, the mean score of grades were low in both groups performing the CM1. Based on the correction criteria (Figure 1) most students had the scores around 5.0, an insufficient performance according to the attribution of descriptive concepts. However, some students had excellent performance in both groups achieving the highest score also in CM2 as described in figure 5. In the CM2 performance analysis, 50% of students achieved scores above 7.0, a good score above the minimum required in the institution where the study was done.

However, during the years where CM strategy was applied 25% of students had scored under 7.0 for CM2, pointing out that more research related to this group has to be undertaken to assess intervenient factors not covered in our investigation. In the literature most of the studies usually report users having difficulties to use this strategy (Derbentseva & Safayeni, 2008; Daley, 2004). Some of the most relevant difficulties are : little reflexive thinking style with contemplative characteristic about disciplinary contents; little experience with teaching strategies, requiring data search and interpretation process that establish links among them, which ends up resulting in decision-making. Results suggest CM helped to promote the habit of continuous reflection based on theory from a practical point of view.

Students concerned with knowledge acquisition develop more skills and are capable of adapting to any setting and proceed with ethical and innovative behavior when needed (Domínguez-Marrufo & Manzano-Caudillo, 2012; Cordeiro et al, 2012).

5 Conclusion

Students' performance and comparative analysis evaluation from the first and second CM seemed to enhance their ability to solve clinical cases during hospital practice experience. Surely, the experience acquired plus the theoretical basis improved the students' ability to think clinically because it enabled the development of subsumers, which is the final goal of this strategy.

Other factor indicated as intervenient to get the skills to create the CM2 was the opportunity to sistematically analyze the relationship between different contents of several disciplines. It was also favored by the relevant data found, the nursing diagnosis and the perception of interventions.

Although, few students in both groups achieved an excellent score using the CM strategy, almost all participants agreed that it motivated them positively to develop clinical decision making skills. Despite the results of this investigation being positive, further work is required to improve the operational stages, other than those described here. Our strategy may enhance satisfaction level and help students to achieve better scores in exercises. This research suggests the importance of using concepts accordingly to the students' background before applying the first CM for clinical case correction, also the importance of delaying the use of strategies to solve clinical cases after hospital practice.

6 Study limitations

We lacked the quantification and discrimination of stages done during the strategy. Now we need a study to quantify the greatest difficulties faced in each stage part of the correction criteria. A challenge our research team has to overcome.

7 Future possibilities

Nowadays, we are developing an application software to help teachers to elaborate Clinical Cases and the Criteria for correction of Concept Maps. Our final goal is to provide the automatic correction, using the CmapTools^{R} in a new innovative way.

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