






Concept maps: A creative tool in university pedagogy

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ABSTRACT

Purpose: The aim of this study was to demonstrate the value of concept maps in the development of nursing students' learning.

Design/Methodology/Approach: We opted for the quantitative-descriptive approach. The research targeted 221 students on placement at the My Youssef Regional Hospital in Casablanca-Settat during the 2019 academic year. We then developed a learning test to determine the type of learning before the educational intervention and after the intervention.

Findings: This study showed that the level of learning before the pedagogical intervention was mainly surface learning (59.28%), while those who had strategic learning (9.95%) and those who had deep learning (30.77%). This shows the supremacy of the first type of learning. But after the intervention, the percentage of those with surface learning was only (28.05%), the percentage of those with strategic learning was (6.79%), and on the other hand, the percentage of those with deep learning was (65.16%).

Conclusion: This suggests that concept maps positively influence nursing students' learning approaches, promoting deeper understanding and engagement.

Practical Implications and Contribution to Literature: This study shows that the use of concept maps by student nurses as a learning tool influences their learning strategies, moving from surface learning to strategic and in-depth learning.

Keywords: *Clinical learning, Concept maps, Deep learning, Learning strategies, Nursing sciences, Surface learning.*

1. INTRODUCTION

Higher education institutions are a place for the development of knowledge. Student training is generally carried out through contact with this knowledge through teaching and research. This contact is necessary; however, it is not the guarantee of an effective subsequent mobilization of knowledge in an authentic, complex situation. According to several authors (Tardif, Borgès, & Malo, 2012), both disciplinary knowledge and professional knowledge are integral parts of the training of future health professionals. This knowledge is approached as an articulation and a construction going from theory to practice and vice versa. In this sense, Blunt and Karpicke (2014) add that learning is of better quality when students manage to make connections, create knowledge structures, and use deep learning strategies, allowing them to understand the contributions of teaching and to face real-life situations. Concept maps are a tool that encourages students to develop deeper learning by working at the final taxonomic level of the cognitive domain of Bloom's objective classification.

The courses of training in health sciences (whatever the option or the sector) are organized under theoretical teaching and clinical teaching carried out in a work-study program.

Clinical education occupies a large place in the training of students in the health sciences. Like any other teaching, it must be based on a clearly identified pedagogical approach, the principles of which must be adapted to this reality. Work in a clinical setting requires modern and active teaching methods aimed at building the skills of the student.

In the field of health sciences, students are able to memorize the clinical manifestations of diseases but are unable to solve a sick person's problem (Harouchi, 2010). In this sense, Darraj, Gourja, Faiq, and Belaaouad (2021) have demonstrated that there is a gap between nursing education goals aimed at learning and skill development in the nursing field and implementing this approach in educational settings. Darraj et al. (2021) also pointed out that, at best, young people are 'savants' when they leave school. They are not necessarily competent. In other words, many have not learned to mobilise their knowledge outside of examination situations, what some call dead knowledge or inert knowledge.

The assessment of learning techniques by clinical nursing students offers valuable insights into the learning processes employed by these students. This is the starting point of this research, which focuses on the learning strategies of nursing students in a clinical setting and their evaluation by concept maps.

This paper attempts to describe the impact of the use of concept maps on the development of learning strategies employed by nursing students following training using these maps and to monitor the development of these strategies during clinical placements.

1.1. Research Questions

The general question to which the study seeks to answer is stated as follows: "Does the use of concept maps contribute to the development of learning among nursing students in Morocco?"

From this general questioning, we have developed four specific questions:

- What learning strategies do nurse students use?
- Has the use of concept map improved nursing student learning?

1.2. Research Hypotheses

We began by formulating the primary hypothesis as follows: "We anticipate that employing concept maps will enhance both the learning and the utilization of learning strategies among nursing students." Based on this overarching hypothesis, we derived the subsequent specific hypotheses:

- The utilization of concept maps will yield a statistically significant impact, with a significance level of 0.05, on the development of learning in the clinical setting.
- The utilization of concept maps will result in a statistically significant impact, with a significance level of 0.05, on the extent to which nursing students employ learning strategies.

2. LITERATURE REVIEW

2.1. Using Concept Maps in Nursing Education

Kinchin (2015) highlights the evolution of concept maps through three distinct phases. The initial phase, spanning from 1992 to 1999, marked the inception of concept maps across various disciplines. The subsequent stage between 2000 and 2010 demonstrated their effectiveness in enhancing learning among diverse learners across various programs and within different educational contexts. The ongoing third phase, from 2011 to 2015, is challenging the traditional paradigms of educational delivery across multiple domains.

In the context of nursing education, the development of concept maps mirrors these three phases, but with unique nuances. The emergent phase witnessed the introduction of concept maps in various nursing fields (Daley, Shaw, Balistrieri, Glasenapp, & Piacentine, 1999). Subsequently, the expansion and adaptation phase involved the incorporation and utilization of these maps among different populations and nursing training institutions. During this expansion phase, adaptation also occurred, altering the original concept map's intended purpose. The aforementioned modification seems to exhibit a deficiency in its theoretical grounding in the conceptual framework of idea maps. Various visual organization systems were examined and classified as concept maps; nonetheless, they were found to be deficient in terms of the fundamental conceptual components. Finally, research on concept mapping in nursing education has progressed to a stage of widespread adoption and practical application (Atay & Karabacak, 2012).

2.2. Using Concept Mapping in Therapeutic Patient Education

In the context of therapeutic education, patients are regarded as learners who must acquire the necessary knowledge and skills to effectively manage and live with their disease. Many studies emphasize the importance of commencing with a central concept and constructing a concept map based on the learner's input, devoid of any pre-established structure. During one-on-one patients interviews, researchers or nurses typically create concept maps. This process can take anywhere between 10 and 1 hour 40 minutes, with an average of 30 minutes (Giacomo, 2012).

The authors draw attention to a problem that investigators, whether they are educators or researchers, may face when they unintentionally influence the creation of concept maps during interviews (Michaud, Marchand, Pignat, & Ruiz, 2008). The challenge lies in encouraging patients to freely express their knowledge without undue influence. Unfortunately, the techniques employed in these interviews to create the concept map are seldom described. Alternative methods have also been explored. In one study, an educator used the concept map to summarize the information collected during the patient interview (in their absence) (Person & Beaumont, 2014). However, this practice is noted to be challenging in current therapeutic patient education due to the significant time investment it requires.

In the Michaud et al. (2008) study, concept maps were constructed based on discussions among patients during therapeutic patient education group meetings. The authors demonstrate how the social-cognitive conflict that arises during these sessions allows participants to express their knowledge effectively. When used in this manner, concept maps facilitate negotiations of knowledge between patients and educators. Nevertheless, the authors emphasize that the presence of educators can potentially limit interactions between participants, suggesting that it is best to avoid exclusive group participation. However, this approach necessitates that participants have sufficient time to learn the technique.

Concept maps find utility in every phase of the therapeutic patient education process (D'Ivernois & Gagnayre, 2008), including educational needs assessment, contract negotiation, instructional techniques, patient knowledge assessment, and patient monitoring. They are also employed to identify disparities and commonalities in needs, priorities, and perspectives among different participants, including patients and carers, and to express emotions. As an assessment tool, concept maps gauge how learners organize and prioritize their knowledge in ways that other tests cannot (Marchand, D'Ivernois, Assal, Slama, & Hivon, 2002). Their relevance and content validity have been acknowledged for training and diagnostic evaluations (Demeester, Vanpee, Marchand, & Eymard, 2010).

2.3. Why do Students use Surface, Deep or Strategic Learning Strategies?

To enhance students' learning quality, it's crucial to gain insight into their learning processes. These processes can be examined through the lens of cognitive or behavioral theories, but it's equally important to take into account their experiences within the learning environment. Consequently, learning can be conceptualized as the process of behavior modification through experiential learning. How learners modify their intentions, behavior, and learning practices in response to how they perceive the learning task can distinguish between learning approaches. Within this framework, learning methodologies fall into three categories: deep, surface, and strategic.

According to Biggs and Tang (2007), surface learning methods entail adhering to the task requirements. In other words, these approaches are characterized by students who believe they can complete the task with ease (Biggs & Tang, 2007). In essence, surface learning is task-oriented (Biggs, 2001) and can be seen as a reflection of extrinsic motivation (Curzon, 2004). Students view the task as an obstacle to overcome, thus investing minimal time and effort in low-level cognitive activities (Biggs & Tang, 2007). Consequently, during their study sessions, students focus solely on identifying key points. They tackle the assignment in a piecemeal fashion, emphasizing rote memorization without a comprehensive understanding of the material (Biggs, 2001). This passive acquisition of knowledge occurs without substantial practice.

On the other hand, intrinsic motivation, which results from people's innate desire to engage with tasks meaningfully and effectively, is what drives deep learning methods (Curzon, 2004). Consequently, students employing deep learning methods strive to utilize the most appropriate cognitive processes when completing tasks. Deep learners naturally gravitate towards grasping underlying implications, core concepts, problems, principles, and effective strategies. Rather than fixate on minutiae unsupported by overarching concepts, they concentrate on main ideas, themes, and principles (Biggs, 2001). This approach compels students to employ various learning strategies in exploring the rationale and implications of the subject matter while investigating its finer details. They may develop and test hypotheses, seeking connections within the context of comprehending the logical underpinnings of the subject matter (Curzon, 2004). Throughout this process, students apply metacognitive skills such as self-assessment, self-inquiry, error detection, error correction, handling extreme data, and contemplating different ideas alongside their limitations (Chin & Brown, 2000).

Additionally, the work of Entwistle (1995) demonstrates that strategic learning methods revolve around the judicious use of either deep or surface learning methods, contingent upon the cognitive processes deemed necessary to master a learning task. In essence, students' perceptions of assessment methods determine whether they want to seek a deep understanding or simply memorize facts, highlighting a similar assessment-centric perspective.

A more sociable, strategic approach encourages students to aspire to excel academically and gain recognition from their peers and instructors as "exemplary students." Strategic methods entail effective time management, an understanding of

each teacher's assessment criteria, and the ability to adapt one's approach according to the specific learning task, whether it necessitates comprehension or memorization.

3. METHODOLOGY

3.1. Research Design

The nature of our study was quantitative, using a quasi-experimental design with multiple pre-test and post-test groups to find the effect of independent variables (concept maps) on dependent variables (nursing students' learning styles). The descriptive analytical model is used to describe and analyze previous studies related to the subject and area of research and its variables to prepare the theoretical framework of the research and its tools, and then analyze the results.

In this research program, a group of subjects will be assessed before (pre-test) and after (post-test) an educational intervention (concept map use training). This type of research estimate makes it possible to know whether the change in a dependent variable before and after the educational intervention occurs only during this period and not during other periods of time.

In our study, we asked students to develop concept maps of educational concepts of diabetes treatment before and after training in the use of concept maps one month apart, and we compared the maps developed by the students.

3.2. Sample and Data Collection

The experiment took place from February 1, 2022, to July 30, 2022 at My Youssef Regional Hospital in the Casablanca region.

The study involved nursing students in semester four. This choice is dictated by the fact that, in our eyes, it is from this semester of studies that nursing students must initiate and implement educational and preventive care by ensuring the activities of nurses (information, education and communication) with patients of various pathologies. All students in semester four who agreed to participate in our study were trained in the development of health-related concept maps. The type of sampling was voluntary and not probabilistic, because our choice of participants was not a matter of chance but of those who were interested in participating.

3.3. Analyzing of Data

Several writings also underline the importance of having a reference map (criterion map) drawn up by one or more "experts" in the field in order to gauge the degree of mastery of resources reached by students. In this regard, we asked two health executives and trainers, working in the My Youssef hospital, to develop a conceptual reference map on the therapeutic education of a diabetic patient. For this purpose, we used the Campstools software.

The method of calculating the complexity of the maps is the one proposed by [Barras and Dayer \(2017\)](#), which divides the number of concepts presented on the map by the number of links:

Complexity index (CI) = concepts or links.

- If CI is equal to 1, the learning type is strategic.
- If CI is greater than 1, the learning type is deep.
- If CI is less than 1, the learning type is surface.

Next, we performed an inference analysis of the components of the first and second maps created by the students using the Mann-Whitney U test to determine differences in learning levels between pre-tests and post-tests. The assumed significance level was $p < 0.05$.

4. RESULTS

The sample consisted of 221 participants, 184 of whom are female and 37 are male. The age of the participants varied between 20-21 years with a number of (113), followed by those between 18-19 years with a number of (85), and finally those whose age is over 21 years with a number of (23).

4.1. Results of the Effect of Concept Maps on Learning Development

First, we assessed the students' level of learning based on the results of the pre-test and post-test, and then we calculated the impact of the use of concept maps on learning development.

Table 1. Type of learning before and after the educational intervention (N = 221).

Test	Learning type	Frequency	Percentage	Medium	Standard
Pre-internship maps	Surface learning	131	59.28	0.75	<1
	Strategic learning	22	9.95	1.00	=1
	Deep learning	68	30.77	1.39	>1
	Total	221	100.00	0.97	<1
Post-internship maps	Surface learning	62	28.05	0.84	<1
	Strategic learning	15	6.79	1.00	=1
	Deep learning	144	65.16	1.49	>1
	Total	221	100.00	1.27	>1

As can be seen from Table 1, the learning level of pre-test students is mainly surface learning (59.28%), with an average of (0.75), while those who had strategic learning were (9.95%) with an average of (1), and with a deep learning were (30.77%) with an average of (1.39). The calculation of the overall mean of the total sample indicates a value of (0.97). This shows that they have surface learning. But in the post-test, the percentage of those with surface learning was only (28.05%), with an average of (0.84), the percentage of those with strategic learning was (6.79%), with an average of (1), on the other hand, the percentage of those with deep learning was (65.16%) with an average of (1.45).

Figure 1 illustrates the percentages for type and level of learning (N = 221).

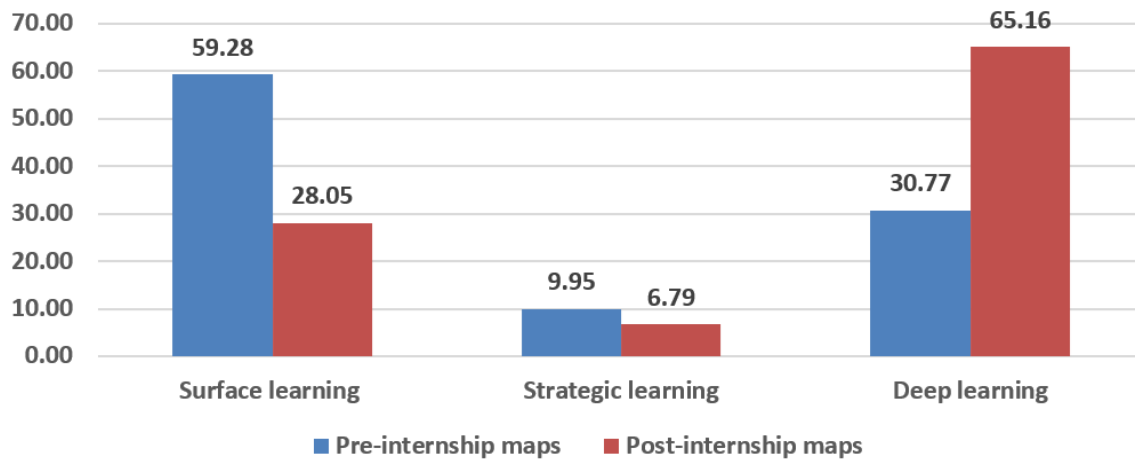


Figure 1. Percentages for type and level of learning (N = 221).

We notice in the graph above that for all types of learning, there is a clear difference between the pre-test and post-test measures. To determine the impact of concept maps on learning development, we used the Mann Whitney U test and we obtained the following results:

Table 2. Mann Whitney U test to identify differences in learning level between pre-test and post-test (N = 221).

TEST	Concept maps	Number	Average rank	Z	Sig. asymptotic (Bilateral)	Effect size
Concepts	Pre-internship maps	221	185.47	6,009	0.000	0.33
	Post-internship maps	221	257.53			
Levels	Pre-internship maps	221	114.22	17,906	0.000	0.97
	Post-internship maps	221	328.78			
Links	Pre-internship maps	221	168.44	8,755	0.000	0.48
	Post-internship maps	221	274.56			
Complexity index	Pre-internship maps	221	173.64	7.882	0.000	0.43
	Post-internship maps	221	269.36			

The Table 2 shows that:

- For the concepts, there is a statistically significant difference of (0.05) between the pre-test mean rank (185.47) and the post-test mean rank (257.53), where the Z value at (6.009) is the significance level (0.000). Which is lower than the moral significance ($p = 0.05$), indicating that concept maps had an impact on concept development in nursing students, with an effect of (0, 33).
- In terms of levels, there is a statistically significant difference (0.05) between the pre-test mean rank (114.22) and the post-test mean rank (328.78), where the value of Z (17.906) is at the level of significance (0.000). This is below the significance level ($p = 0.05$), indicating that concept maps have an impact on the ability development of nursing students with an impact of (0.97).
- There are statistically significant differences of (0.05) between the mean ranks for the pre-test (168.44) and the mean ranks for the post-test (274.56) for 'links', where the value of Z value (8.755) was at the significance level (0.000). This is below significance ($p = 0.05$), indicating that the concept maps had an effect on the development of linkages among the nursing students, with an impact factor of (0.48).
- There are statistically significant differences at the significance level (0.05) between the mean ranks for the pre-test (173.64) and the mean ranks for the post-test (269.36) with regard to "complexity cues", where the Z value was (7.882) at the significance level (0.000). This is below the moral significance level ($p = 0.05$), indicating that the concept maps had an impact on the development of complexity cues in the nursing students.

In conclusion, concept maps had an impact on the learning development of nursing students who benefited from the use of these maps during training. The following figure illustrates this result:

Figure 2 illustrates the differences in learning levels before and after the test (N = 221).

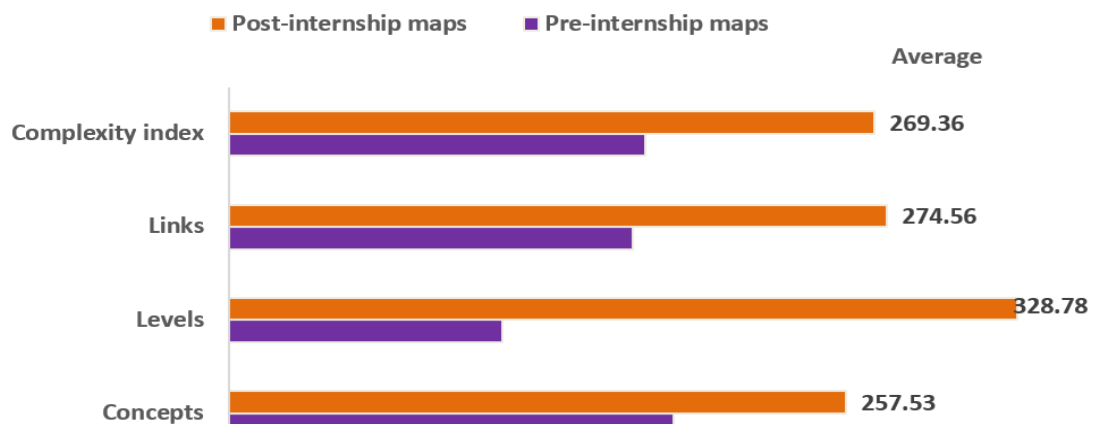


Figure 2. Differences in Learning levels before and after the test (N = 221).

5. DISCUSSION

From the above, we find that the result achieved is consistent with a group of previous studies. Therefore, our results are supported by Marchand et al. (2002), who showed interest in concept map techniques as a support in a study on concept maps for health training. Guidance and formative assessments that help learners engage in meaningful and in-depth learning.

According to these two authors, the concept map presents different interests: it promotes learning by making it more meaningful for the learner, it constitutes for teachers a means of reflection for the planning of their teaching, and it makes it possible to assess the way including a learner integrates and organizes his knowledge. It can be used at the start or at the end of the apprenticeship (Darraj et al., 2019). In another study on the use of mind mapping for meaningful learning, Akinsanya and Williams (2004) used the mind map to promote deep learning. According to them, concept maps allow understanding of a central concept to be seen through the way the concepts are presented in a web of relationships rather than in isolation. The map thus provides a schematic summary of the learning that has taken place. The learner is therefore better able to become aware of the existing links between the concepts and thus carry out in-depth learning.

The concept map is a tool more and more used in the school context. Thus, this simple, accessible, and flexible tool (Ritchhart, Turner, & Hadar, 2009) is now used from the elementary to the university level, in many ways and for various

reasons. Several studies (Basque & Pudelko, 2003; Dansereau, 2005; Novak, 2002) show that the use of the concept map by learners adds depth to learning.

Regarding the use of concept maps in medical and paramedical education, several authors describe the value of concept maps in helping students plan for care delivery. In this case, it is suggested that nursing students develop concept maps from a complex clinical case (clinical concept mapping) (Hicks-Moore, 2005). Important information is identified, prioritized, and linked explicitly by the students. For this author, this technique develops in learners their metacognitive capacity, gives meaning to their learning, and trains them to develop a more global vision of the patients in their care.

In an educational experiment, led by Marchand et al. (2002), the technique of concept maps was introduced for learning the concept of metacognition, with trainers of health professionals. A group of participants with health professional educators (nurse educators, midwives, doctors, dentists, etc.) taking the University Diploma in Health Education was suggested to create concept maps of three metacognitive concepts, 5 months apart. According to this study, the development of a concept map for 4 participants showed a true assimilation of the concept, with enrichment and progressive organization of knowledge (increase and clarification of concepts and links, links in areas of knowledge). If the participants experienced difficulties during the elaboration of the first map, all expressed their satisfaction with regard to the benefits acquired at the end of the experience. Therefore, concept mapping is an interesting technique for learning new concepts in self-study activities, as it encourages metacognitive reflection while developing.

In an exploratory study by Kwas and Ghédira (2017) on the use of concept maps in teaching during internships, the study aimed to determine the contribution of medical interns to learning (14 students at the same time) using the concept map method. The interns are divided into two groups (A and B). The results of this study showed that the development of knowledge accuracy in the post-test was more pronounced in the intern group taught using the concept map approach.

The concept map is therefore an excellent educational tool to promote and stimulate active learning. Hence the need to use this tool in medical and paramedical training, at the faculty of medicine, at nursing training institutes, and also in training places (hospitals).

6. CONCLUSION

In this study, we found that concept maps have a significant impact on the development of learning in nursing students who have been trained in the use of these maps. Thus, the level of learning of the students in the pre-test was mostly surface learning, but in the post-test, the vast majority had deep learning. This means that there was an increase in the respondents' level of learning from surface learning to deep learning.

When it comes to higher education and learning in depth, many think that students have all the tools in hand to be able to learn meaningfully. But the high percentage of failures and dropouts at university leads us to believe that students arrive less equipped than some believe. In order to help prevent certain learning difficulties in students, we recommend:

- To attach great importance to the teaching of learning strategies at the level of training institutions for nursing students. This teaching must be done in a natural and authentic context, is to say within the usual courses and by carrying out the real activities of these courses.
- To promote in the student a work of reflection on the strategies that he uses spontaneously. In this regard, we propose to teach the student to recognize the strategies he uses by recording them on a grid. This teaching can lead the student to see the usefulness of continuing to apply certain strategies in certain situations, of adjusting the strategies that he uses in other situations, of using known strategies in other situations and of " increasing its repertoire of strategies if necessary.

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INSTITUTIONAL REVIEW BOARD STATEMENT

The Ethical Committee of the Hassan II University, Casablanca, Morocco has granted approval for this study.

TRANSPARENCY

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

COMPETING INTERESTS

The authors declare that they have no competing interests.

AUTHORS' CONTRIBUTIONS

All authors contributed equally to the conception and design of the study. All authors have read and agreed to the published version of the manuscript.

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