USING CONCEPT MAPS IN CORONAVIRUS DISEASE COVID-19 TO ENHANCE MEANINGFUL LEARNING: EVIDENCE FROM AN ACTION RESEARCH PROCESS

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ABSTRACT

Given the characteristics of learning medical topics, this study discusses the advantages of using concept maps (CMs) through action research process (ARP) as a core component of an undergraduate curriculum in medical education. Precisely, it presents evidence from an action research process aimed at assessing the impact of concept maps as a powerful tool for promoting meaningful learning on medical learners enrolled on the COVID-2019 module. Thus, medical learners (30) studied in fourth year of medicine in Algiers were selected by simple sampling method and randomly assigned into experimental (20) and traditional group (10).The findings from the study suggested that an implementation of CMs through ARP have been effective, positive and powerful in meaningful learning for coronavirus disease 2019 (COVID-19). So the performance of learners improved from pre-test to post-test with the normalized gain (g) was 0.30, considered moderately effective.

KEYWORDS: Concept maps, Meaningful learning, Action research process, Coronaviruses, Coronavirus disease COVID-19.

JEL CLASSIFICATION : I20, I21

استخدام خرائط المفاهيم في الوباء كورونا فيروس COVID-19لتعزيز التعلم الهادف: الدليل من خلال عملية البحث الإجرائي

ملخص

بالنظر إلى خصائص تعلم المواضيع الطبية، تناقش هذه الدراسة مزايا استخدام خرائط المفاهيم (CMs) من خلال عملية البحث الإجرائي (ARP) كمكون أساسي في الطور الأول من التدرج في المناهج الطبية في المرحلة الجامعية. على وجه التحديد، يقدم دليلاً من عملية البحث الإجرائي التي تهدف إلى تقييم تأثير خرائط المفاهيم كأداة قوية لتعزيز التعلم الهادف على المتعلمين الطبيين المسجلين في وحدة مرض فيروس التاجي (COVID-2019). وهكذا،تم اختيار المتعلمين الطبيين (30) في السنة الرابعة للعلوم الطبية في الجزائر العاصمة بطريقة أخذ العينات البسيطة وتم تعيينهم عشوائيًا في المجموعة التجريبية (20) والمجموعة التقليدية (10). توصلت نتائج الدراسة إلى أن تنفيذ CMs من خلال ARP كان فعالًا وإيجابيًا وقويًا في التعلم الهادف في مرض فيروس التاجي 2019 (COVID-19). لذا تحسن أداء المتعلمين من الاختبار المسبق إلى الاختبار اللاحق مع الربح المكتسب (g) يقدر ب 0.30، يعتبر فعالًا إلى حد ما.

كلمات مفتاحية: خرائط المفاهيم، التعلم الهادف، عملية البحث الإجرائي، الفيروسات التاجية، مرض الفيروس التاجي الجديد COVID-19

تصنيف جال:I20, I21

UTILISATION DE CARTES CONCEPTUELLES POUR AMÉLIORER L'APPRENTISSAGE DE LA MALADIE A CORONAVIRUS COVID-19: PREUVES PROVENANT D'UN PROCESSUS DE RECHERCHE-ACTION

RÉSUMÉ

Cette étude examine les avantages de l'utilisation de cartes conceptuelles (CMs) par le biais du processus de recherche-action (ARP) en tant que composante centrale d'un programme de premier cycle en éducation médicale. Plus précisément, il présente un processus de recherche-action visant à évaluer l'impact des cartes conceptuelles en tant qu'outil puissant pour promouvoir un apprentissage significatif sur les étudiants en médecine inscrits au module COVID-2019. Ainsi, 30 étudiants en quatrième année de médecine à Alger ont été sélectionnés par une méthode d'échantillonnage simple et répartis au hasard en groupe expérimental (20) et traditionnel (10). Les résultats de l'étude suggèrent qu'une mise en œuvre des CMs par le biais de l'ARP a été efficace, positive et puissante dans un apprentissage significatif sur la maladie des coronavirus 2019 (COVID-19). Ainsi, les performances des apprenants se sont améliorées du pré-test au post-test avec un gain normalisé (g) de 0,30, considéré comme modérément efficace.

MOTS CLÉS : Cartes conceptuelles, Apprentissage significatif, Processus de recherche-action, Coronavirus, Nouvelle maladie à coronavirus COVID-19.

JEL classification : I20, I21

INTRODUCTION

Over recent decades, the chiefly objective of medical education should be to employ learners in meaningful, resourceful and critical learning, which happens when learners are making meaning (Novak and Cañas, 2008). In this regard, fostering learners' self-directed learning competence should be a principle attempt of formal education in many specific contents and contexts in our modern world (Arnold, 2015). Learning in the medical education depends to support learners to construct on prior knowledge and then create new knowledge. In addition, learning from theoretical, practical, clinical and laboratory reasoning need the development of an interpretation of interdisciplinary learning in order to be more useful. Each step in learning involves combining what you already know with what you need to know (Novak and Cañas, 2008).

Moreover, Novak & Gowin (1984) agreed that meaningful learning involves more than rote memorization special effort to relate new knowledge to what is already known. In other words, learners must make a special effort to relate new knowledge with that they already know. In addition, Novak et al. (1984), in general, learning is meaningful when the knowledge starts to make sense to learn and practice for learners in any given situation in the future. In this way, concept mapping is thought to be a useful tool in reinforcing meaningful learning (Novak, 2002). Similarly, in concept mapping, in an endeavour to assist learners to reduce the gap between theoretical, practical, clinical (McGaghie, et al., 2000 and Schuster, 2003), and laboratory reasoning and also to enhance their meaningful learning, concept maps through action research process were used as a learning tool in coronavirus disease COVID-19 at the University of medicine Algiers, Algeria.

However, Morris (2019) stated that such instructional experience may promote repetitive behavior, rather than promoting a spiral in learner growth through their life course. While, Johnson (2003) noticed that action research (AR) is also a type of investigation that is preplanned, organized, and can be shared with others. Therefore, (Novak & Cañas, 2008) showed that concept maps strategy is used to

organize key concepts, main ideas and represent knowledge using keywords, tree structures and network diagrams, colors, and images. So according to (Novak and Cañas, 2008) pointed out the importance of using concept maps in learning and teaching that combines semantic understanding and creativity, and it involves thinking in terms of graphic representations. Indeed, in concept mapping, one identifies the important concepts from a subject and describes the relationship between those concepts with linking words (Novak et al., 1984). For this reason, concept maps are also used to see how broad concepts are integrated, and as a guide for deciding what is important to understand (Novak et al., 1984). In this regard, (Harpaz et al., 2004) highlighted that linear thinkers may be disadvantaged; however concept mapping may be a strategy to push the linear thinkers to a higher level of thinking especially in the complex field as nursing. And also (Kathol et al., 1998) indicated that concept maps can be a powerful tool for identifying and clarifying misunderstandings before new learning is constructed on incorrect beliefs.

Furthermore, Schuster (2003) has studied and used concept maps extensively in the clinical setting with great success. In this opinion, CMs through ARP encourage learners to develop the ability to identify, organize, relate, construct and process knowledge in the theoretical, practical, clinical and laboratory reasoning, aiding them to learn and to think critically and meaningfully in any given situations (Novak & Gowin, 1984; Castellino and Schuster, 2002; Johnson, 2003; Harpaz et al. 2004 and Ingole et al., 2016). As such, this interpretation about meaningful learning is also in line with Jonassen, et al., (2003) who confirmed that meaningful learning happens within knowledge construction, not reproduction. Thus, Jonassen, et al., (2003) and Howland et al., (2012) demonstrated there are the five attributes of meaningful learning that are active; constructive; intentional; authentic; and cooperative.

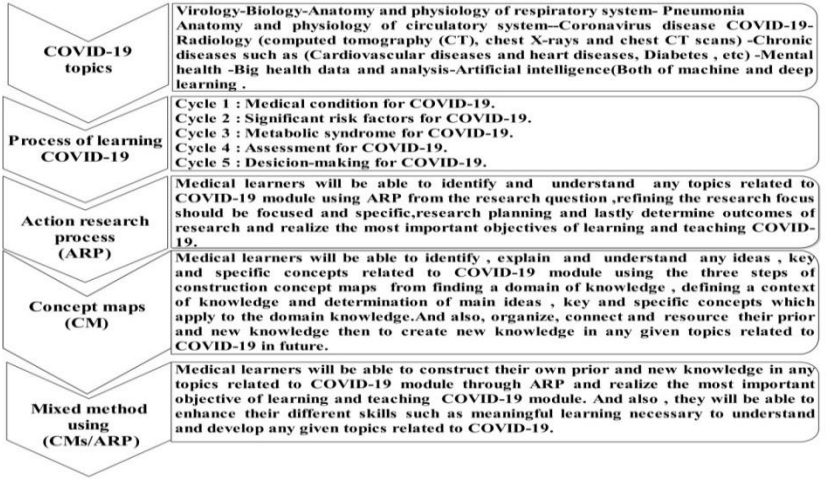
Finally, this study was conducted to evaluate the effect of concept maps (CMs) through ARP on meaningful learning skills, increasing understanding of the coronavirus disease COVID-19 pandemic and to examine if there is an encouraging effect on meaningful learning in

the coronavirus disease COVID-19 module at the University of medicine Algiers, Algeria and knowledge among undergraduate medicine learners.

1- MATERIALS AND METHODS

The chosen materials in the coronavirus disease (COVID-19) were taught by CMs strategy through ARP for the experimental group while in the traditional lecturing method was used. In this view, medical learners (30) studied in fourth year of the University of Medicine Algiers were selected by simple sampling method and randomly assigned into experimental (20) and traditional group (10). In this way, the degree of meaningful learning achieved by both programmes was assessed by comparing pre- and post-test results.

Figure 1. Procedures and conceptual framework of learning and teaching COVID-19 using concept maps through action research process



Source: Prepared by the author

Accurately, this study displays to answer the following question: What is the effect of using concept maps through action research process on the virology of knowledge structures? So given the precondition of excellent teacher, educator, instructor and experts

dependability, the study hypothesized that more complex CMs/ARP in different reasoning skills represented deeper modality of meaningful learning in COVID-19 module (figure 6 in the appendix one).

1.1- Sample and Data collected

The study was conducted during a 5-week period in January 2020. Learners were briefed about the purpose of the study .A pretest was conducted by giving 10 questions of general understanding about CMs and ARP and 10 questions regarding coronaviruses and COVID-19 pandemic. Two sessions each week of integrated learning and teaching was organized to teach the topic. Integrated teaching module was taken by all learners. After completion of integrated teaching that has appeared as a key pedagogical strategy to enhance learner learning and development (Kennedy et al. , 2015), a post-test was conducted using multiple choice questions (MCQs), thinking questions (TQs) and problem-based question (PBQs) related to COVID-19 module was taken to evaluate their prior and new knowledge.

1.2- Subjects

Generally, medical learners recognize virology as a difficult subject, and more so in teaching and learning coronavirus disease COVID-19, this is because of the difficulty of changing habits of thinking, including learning styles and linear to matrix thinking, is particularly difficult (table 1). So changing their thinking from linear to matrix in an attempt to treat and provide solutions to the disease through drugs or vaccines, but with regard to the vaccine, it is necessary to wait for several tests to be approved. The study is done to assess the existing level of prior and new knowledge given to medical learners about coronavirus disease COVID-19 through traditional methods or by use of CMs through ARP. Nevertheless, educators and specialists continue to debate the effectiveness of organizing knowledge into disciplinary and interdisciplinary perspectives, as well as the definitions of, and boundaries between, these disciplines (Klein & Newell, 1997 and Burton, 2001). As such, pointed that by (McDaniel et al., 2005) the use of concept maps can

also be a tool to create interdisciplinary activities that integrate multiple concepts from different courses.

Table 1. Procedure of application activities using concept maps through action research process in COVID-19

Topics	Criteria of learning skills	Outcomes
Virology Biology Anatomy and physiology of respiratory system Anatomy and physiology of circulatory system Pneumonia Coronavirus disease COVID-19 Radiology Chronic diseases Mental health Big health data Artificial intelligence	1) Using different resources to construct their prior and new knowledge 2) Identify main ideas ,key and specific concepts 3) Link and resource different concepts; 4) Build their prior and new knowledge; 5) Think critically, resourcefully and meaningfully in learning and teaching each cycle of the process of learning COVID-19 using mixed method such as CMs/ARP.	Learners will be able to diagnose different types of significant risk factors for COVID-19 and provide useful treatment for those diseases as soon as in any given situation. And also be able to construct their prior and new knowledge using CMs through ARP with several application activities of concept maps in COVID-19 disease necessary to promote meaningful learning and become more than meaningfully, resourcefully and critically in any given situations.

Source: Prepared by the author.

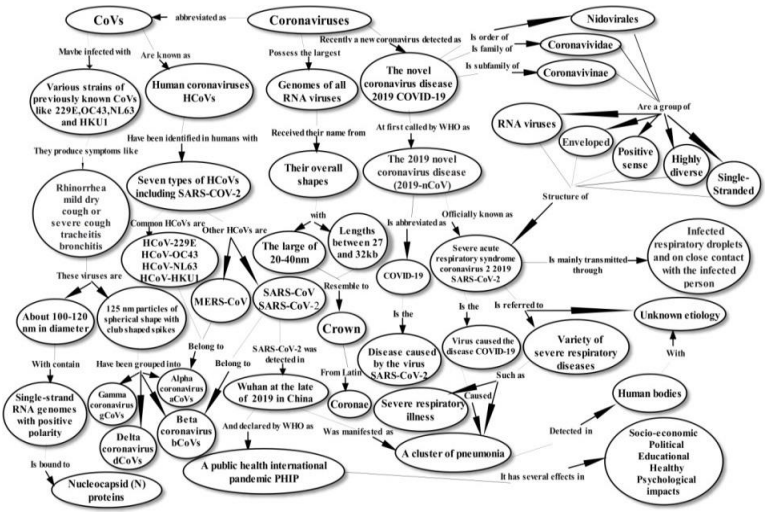
1.3- Procedures of study

Generally, medical learners in COVID-19 topics show difficulties in applying what they have learned in theoretical, practical, clinical and laboratory settings. So there is a large gap between prior and new knowledge and doing. In this way, Novak and Cañas (2008) suggest that the starting point should be a domain that is familiar to the learners and that this is best constructed as a focus question. The next step is to identify 15-25 concepts that are key to this domain and rank them from most general at the top to least general at the bottom. The research methodology adopted in this study consists of using CMs through an ARP based on Arnold's model (2015) and articulated the COVID-19 topics into four steps and using different free COVID-19 resource centre online to construct their own prior and new knowledge related to COVID-19.

1.3. 1: Identification of the problem

The specific questions causing the problem turn out to be concept maps related to some of the key concepts of the COVID-19, which as such represent the pillars of the module's content of COVID-19. What the problems require to be solved and what question needs to be answered. So the problems with their medical condition, significant risk factors, diagnosis and decision making are always stated in the form of a question related to COVID-19. Of course, for their assistance with the task, learners were asked to use a variety of questions using ARP with its four steps to construct their prior and new knowledge (figure 2), for example: What are coronaviruses? What is the difference between SARS-CoV-2 and COVID-19? Next, the learners were asked to determine a domain of knowledge using different sources of text for COVID-19 online. After that, the learners will be able to identify the main ideas with key and specific concepts related to SARS-CoV-2 and connected with different disciplines. Finally, a concept map of their understanding of COVID-19 module.

Figure 2. Concept maps of the structure of epidemiology of coronaviruses



Sources: Medical experimental group with modification by the teacher using different free COVID-19 resource centre online such as: WHO, CDCs, ECDC, Elsevier, Lancet, BMJ, Springer nature and Wiley.

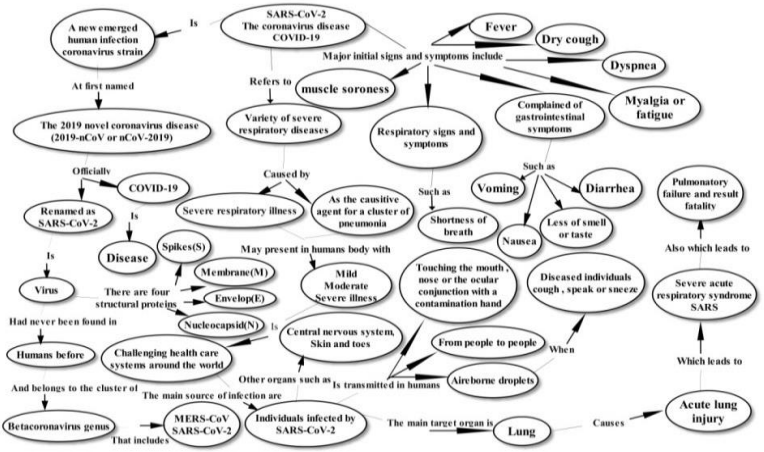
For instance, learners usually find difficult to differentiate between the viruses, and the diseases they cause, often have different names. For example, SARS-Cov-2 is the virus that causes coronavirus disease 2019 (COVID-19) (WHO and ICTV, 2020).As the concept map (figure 2) above, there are different processes, and purposes, for naming viruses and diseases. Viruses are named based on their genetic structure to facilitate the development of diagnostic tests, vaccines and medicines. Virologists and the wider scientific community do this work, so viruses are named by the international committee on taxonomy of viruses (ICTV, 2020). By doing consequently, the study prepared to assist them evolve a pedagogy such as CMs through ARP for learning meaningfully, resourcefully and critically.

1.3.2: Refining the research focus

All researchers believed that meaningful learning can only occur when the learner chooses to actively participate in the process of understanding the relationship between new concepts and those already present in their knowledge (Novak, 2002 and Ballester, 2011) .In this context, teachers (instructors and experts) play a fundamental role to stimulate the activation of prior knowledge by learners then to assist them to build their new knowledge in any given topics related to COVID-19(figure 6 in the appendix one). Of course, for their assistance with the refining the research focus using CMs/ARP (figure 2), learners were asked to use a variety of COVID-19 resource centre online and questions using ARP with its four steps to construct their prior and new knowledge, for example: What are the most important features of COVID-19? For instance, learners usually find difficult to distinguish between the SARS-CoV and SARS-CoV-2. Human coronaviruses (HCoVs) were first identified in the 1960s, seven viruses, including seven types are HCoV 229E, HCoV OC43, HCoVNL63, HCoV HKU1, severe acute respiratory syndrome coronavirus (SARS-CoV), Middle East respiratory syndrome coronavirus (MERS-CoV) and SARS-CoV-2 have been recognized as

causative agents of a broad range of respiratory infections which leads to pulmonary failure and result in fatality (Chen et al., 2020 and Zhu et al., 2020). The novel virus is classified as a CoV and bears significant resemblance to SARS-CoV and SARS-CoV-2 is a member of the coronavirus family, named for the crown-like appearance of spikes on the virus surface (CDC, 2020). The source of confusion lies in the fact that learners often know the name of a disease, but not the name of the virus that causes it. In this context, the teacher (expert and instructor) plays a major role to catalyze the activation and construction of prior and new knowledge by learners using CMs through ARP (figure 3).

Figure 3. Concept maps of the characteristics of the virus severe acute respiratory syndrome coronavirus 2019 SARS-CoV-2



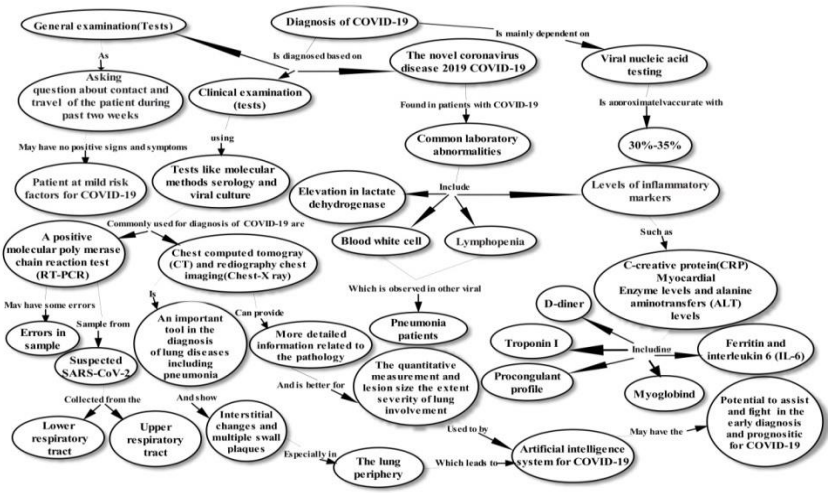
Sources: Medical experimental group with modification by the teacher using different free COVID-19 resource centre online such as: WHO, CDCs, ECDC, Elsevier, Lancet, BMJ, Springer nature and Wiley.

1.3.3. Research planning

For meaningful learning and understanding to happen it is the learners that should be expressing what main ideas, key and specific concepts they think will assist them to answer the focus question. According to the literature on concept maps through ARP does not discuss applications of concept mapping tools in COVID-19. The three

most important stages in preparing concept maps through ARP in COVID-19 are domain of knowledge, identify 30 concepts and key to this domain and rank them from the top into the bottom then presented as a final proposition. Furthermore, Novak (2010) opined that each learner must deliberately relate new knowledge to that which they already know. So according to the theory, practice, clinic and laboratory, there are five characteristics of this disease : a public health emergency of international, a cluster of pneumonia unknown, there is no drugs or vaccines, significant risk factors, diagnose and common signs and symptoms and treatment, prevention, prediction, management and investigation. Of course, for their assistance with the research planning using CMs/ARP, learners were asked to use a variety of resources and questions using ARP with its four steps to identify key concepts and then construct their prior and new knowledge related to different methods used to diagnose COVID-19, for example: How is COVID-19 diagnosed? And what are the most important methods used in this?

Figure 4 . Concept maps of diagnosis of coronavirus disease 2019 (COVID-19)



Sources: Medical experimental group with modification by the teacher using different free COVID-19 resource centre online such as: WHO, CDCs, ECDC, Elsevier, Lancet, BMJ, Springer nature and Wiley.

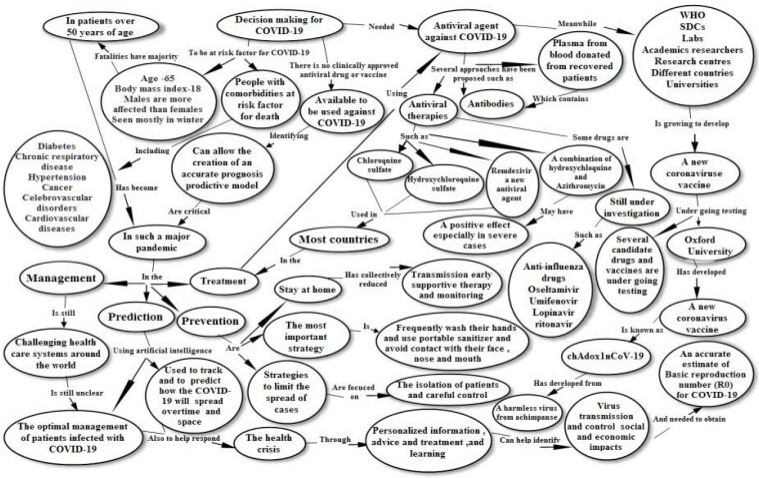
As the concept map (figure 4) above allows the learners to see relationships, the more the background knowledge the learner possesses, the more they are able to explain a complex answer to the tutorial question. In this direction, drawing the CMs through ARP empowered all of the learners in the experimental group in the same way.

1.3 4. Outcomes of research

Addressing such complexities in learning COVID-19 is important to take a combination of multiple-choice questions, discussion questions-answers and meaningful questions as a way of measuring the achievement of the intended module's learning outcomes and then to enhance their meaningful learning (tables 2, 3). Using CMs through ARP encourage active learning, independent learning, and conceptual learning with critically and meaningfully thinking in any given situation in the future. Of course, for their assistance with the outcomes of research using CMs/ARP, learners were asked to use a variety of resources and questions using ARP with its four steps to realize the most important objectives of learning and teaching COVID-19. In doing consequently, using mixed method CMs/ARP has provided the foundation for measuring the quality of meaningful learning (figure 5). For example: What are the most important available strategies to fight treatment, prediction, prevention, management and investigation for new coronavirus vaccines for COVID-19? For example, to answering the question How to fight COVID-19 using artificial intelligence (both machine and deep learning)? Learners will be able to realize the most important goals obtained using CMs/ARP in the treatment, prevention, prediction, management and investigation**.** Especially, understand meaningfully, resourcefully and critically in any subjects related to COVID-19 and then to assist them to create their new outcomes of research in any subjects connected to artificial intelligence to fight COVID-19 and can in principle be used to track and to predict how the COVID-19 disease will spread over time and space. Additionally, they will be able to describe, explain and understand the most important main ideas; key

and specific concepts in COVID-19 related to big health data and artificial intelligence to fight COVID-19 (Bullock et al., 2020).

Figure 5. Concept maps of medical decision-making in patients with COVID-19



Sources: Medical experimental group with modification by the teacher using different free COVID-19 resource centre online such as: WHO, CDCs, ECDC, Elsevier, Lancet, BMJ, Springer nature and Wiley.

2. REVIEW AND TEST SETTINGS

These findings are consistent with learners' responses and previous studies (Novak and Cañas , 2008; Ingole et al. 2006; Vink et al. 2015 ;Daley et al. 2016 ; Khine et al. 2019; Dosani et al. 2019; Slieman et al. 2019 and Drareni , 2020).

2.1 A questionnaire to assess the learners' meaningful learning

At the end of the semester, learners were assessed using questionnaire of a 5-item on various skills associated with conducting CMs through ARP in COVID-19 which were formed by the teachers and with other colleagues in the department of cardiovascular diseases (CVD).

Table 2. Learners' Responses about using concept maps through action research process to enhance meaningful learning in COVID-19

N	Statements	SD	D	N	S	SA
1	Using concept maps through action research process was a meaningful learning pedagogy to assist medical learners	5 (1)	0 (0)	0 (0)	0 (0)	95 (19)
2	Using concept maps and action research process were useful learning activity in defining key concepts	0 (0)	5 (1)	5 (1)	0 (0)	90 (18)
3	Using concept maps through action research process aided to integrate basic and specific prior and create new knowledge related to COVID-19.	5 (1)	10 (2)	10 (2)	5 (1)	70 (14)
4	Using concept maps through action research process facilitated to determine and achieve of outcomes of goals of learning COVID-19.	5 (1)	5 (1)	5 (1)	0 (0)	85 (17)
5	Would you continue to use concept maps through action research process with complex health problems in COVID-19?	0 (0)	0 (0)	5 (1)	0 (0)	95 (19)

Source: Prepared and calculated by the author using SPSS 21 version software. From learners' answers: SD: strongly disagree, D: disagree, N: neutral, A: agree, SA: strongly agree. The answers were written down on a typical five-level Likert scale (1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, 5 = strongly agree). ( ): Numbers in parentheses indicate the number of learners' answers and Numbers indicate percentage

2.2 A multiple choice to assess the learners' meaningful learning

These pretests and protests scores were taken to control acquire in three rubrics at first constructing prior and new knowledge at second using action research process and at third using mixed method following the CMs/ARP sessions on the topic of COVID-19. A statistically meaningful improvement was noticed in the posttest scores for all the medical learners (tables 3, 4,5,7 in the appendix) using the average normalized gain(g) that Hake (1998) developed it as a way to normalize average gain scores in terms of how much gain could have been realized.

Table 3. Post-test of significance between marks obtained by learners using concept maps through action research process and traditional lecture

N	Rubrics	Statements	Experimental group		Traditional group	
			Mean	SD	Mean	SD
1	Constructin	Contain core concepts	16,90	1,48	12,2	3.11
2	g prior and	Hierarchy levels				
3	new	Linking of main , key and				
	knowledge	specific concepts				
4	using	Adequacy of content				
	concept	integration				
	maps CMs					
5	Action	Research problem and				
	research	question				
6	process	Refining research problem				
7	(ARP)	Research planning				
8		Outcomes of research problem				
9	Mixed	Identifying, linking,				
	method	resourcing and understanding				
	CMs/ARP	meaningfully and critically				
		main ideas, key and specific				
		concepts among different				
		interdisciplinary perspectives				
		in COVID-19				
	Total	Total marks obtained				

Source: Prepared and calculated by the author using SPSS 21 version software.
The scoring system of the meaning learning: two levels of scoring for questions were as follows: correct answer scored (1) and don't know or incorrect answer scored (0). It also using excel and SPSS 21 software to extract data and analyze descriptive statistics.

As seen in the table 3, the mean score for the traditional group post-test was 12, 2 and standard deviation was 3.11983, while the mean score of the experimental group was 16, 90 and standard deviation 1, 48324. Consequently, medical learners participating in CMs through ARP were assessed on various skills associated with conducting action research process based on a pre-test and post-test format. So the performance of learners improved from pre-test to post-test using normalized gain (g).The normalized gain (g) in the experimental group was found to be 0.30 (or 30%) and thus was considered moderately effective (table 7 in the appendix).

3- FINDINGS

3.1- Results

Related to meaningful learning in understanding any topics for COVID-19 using CMs/ARP, 95% were opined that it was a meaningful learning pedagogy to assist learners in identifying main ideas, key and specific concepts and interconnecting with specific concepts among the interdisciplinary perspectives in COVID-19. Regarding learning activity in defining key concepts, linking them with a quick understanding for COVID-19 using CMs/ARP, more than 90% were opined that it was sufficient and good. Overall 70% learners agreed on the point that CMs/ARP pedagogy aided them to integrate basic, key and specific prior and create new knowledge related to COVID-19 and also it is more useful, positive and meaningfully learning than traditional lecture method. 85% learners were satisfied and facilitated to determine and achieve of outcomes of objectives of learning related to COVID-19 with mixed method such as CMs/ARP. Concerning reflection of learners about mixed method CMs/ARP over traditional lecture method it was noticed that 95% learners opined that it was simpler, useful, collaborative , concise, positive and powerful mixed method and they would like to learn by it frequently in the future in their careers. As such, the result of post-test showed significant increase in marks in experimental group as compare to traditional group, suggesting CMs/ARP as a potential tool for better meaningful , resourceful and critical understanding in learning and teaching COVID-19 module (tables 3 ,5 ,7 in the appendix). The mean scores of post-test, between experimental and traditional groups, were significantly different (4.7). Accordingly, the mean of post-test scores in experimental group was higher than the mean of post-test scores in traditional group.

3.2- Discussion

In general, learners approved to having accomplished diverse skills in organizing research learning through CMs and ARP in COVID-19 with good consensus posttest scores and also accepted to a strong need to implement them in community based medical

education with other active learning such as team-based and problem-based learning in order to enhance their meaningful learning, critical thinking and problem solving in COVID-19 module. Although the findings are not amenable to generalizations, they bring to the fore main arguments as follows. The first one is that female learners tend to benefit more than male learners from CMs through ARP. This gender issue is consistent with the findings of previous studies, which have demonstrated that female learners on average produce more complex maps than male learners, whether working individually or in groups (Gerstner & Bogner, 2009). The second one is that CMs through ARP are recognized as a useful and powerful pedagogy, as they facilitate learners' engagement through individual and group discussion and increase their oral effective communication skills and also to assist them to think critically, resourcefully and meaningfully in any given subjects related to COVID-19 in different types of reasoning from theoretical, practical, clinical to laboratory. These findings are consistent with previous studies, which have demonstrated that utilizing CMs through ARP (Ingole et al., 2016 and Drareni, 2020) in medical education supplies more chances for all learners to strongly, participate in class activities, thus augmenting their competence to recognize relationships among the key concepts within a given discipline (Cañas et al., 2016). The third one is that CMs through ARP are impressive in helping learners understand the subject matter, thus clarifying initial misconceptions. This affirms that, in line with previous studies, activating prior knowledge is the precondition to assist learners to learn deeply,critically,resourcefully and meaningfully, albeit not the only relevant factor. Thus, the fourth one is that CMs through ARP are impressive in changing the learners' learning style. As a result, learners engaged in CMs through ARP as a powerful and useful pedagogy to acquire data, information, knowledge and immediate feedback on preparing their exams and also to activate their prior knowledge and link it with new knowledge in any topics related to COVID-19 using free COVID-19 resource centre online.

4- CONCLUSIONS AND RECOMMENDATIONS

The outcomes of the study concluded that CMs through ARP is one of the successful strategies that can be used to teach and learn coronavirus disease 2019 (COVID-19) in medical education at the university of medicine Algiers, Algeria. Hence, they provided main and specific ideas for medical university staff on the application and incorporation of them in teaching and learning and as a core component of curriculum development at the department of medicine with new and complex topics such as COVID-19. Therefore, integrating CMs through ARP in undergraduate medical education at the University of medicine Algiers is the need of the day to enhance community based medical education in Algeria that may have involvements for understanding meaningfully how CMs through ARP can help them in growing and organizing theoretical ,practical clinical and laboratory reasoning processes in learners future doctors.

Moreover, medical learners require practicing to create effective CMs through ARP for the big health data using artificial intelligence to be meaningful to predict significant risk factors for COVID-19. So it should also be noticed that it can be challenging to present nuanced and complex information in a visually appealing and readily understandable graphic. In this way, using CMs/ARP could demand a significant amount of teacher, academic and expert analysis just in the construction of topics alone. In this View, a large numbers of main ideas, key and specific concepts are reduced to a workable level by the teachers and learners. This also means that in some cases, teachers comprise main ideas that they think to be important even though the learners themselves never mentioned it.

Thus, this further suggests the useful ways for both the educators and the learners in concept maps application with other active learning methods such as problem-based and team-based learning and scaffolding that work in ways within medical education by boosting self-directed learning, by designing critical thinking skills and by leading assessment of learning and performance. Finally, the study considered that further research into the application and implementation of concept maps through team-based and problem-

based learning and scaffolding in the theoretical, practical, clinical and laboratory setting contents, medical critical thinking skills and diagnostic errors in clinical and laboratory practice is also needed in medical education related to COVID-19 module necessary to develop their traits, talents and skills in any given situations in the future.

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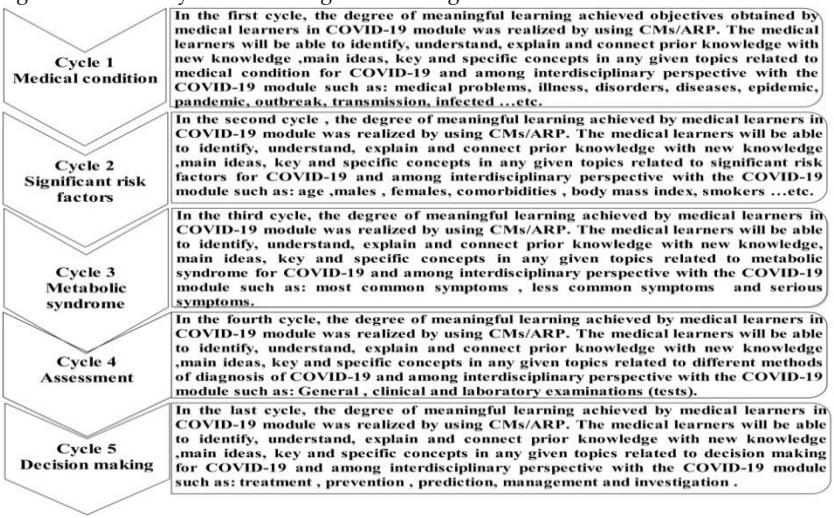
Appendix

Appendix one: Process of learning and teaching COVID-19 module using mixed method such as concept maps through action research process.

Figure 6. The five cycles of learning and teaching COVID-19 module



Source: Prepared by the author.

Appendix two: Calculate using SPSS 21 pre and post-test score of the experimental and traditional group with the normalized gain (g) for the experimental group.

Table 4. Pre-test score of the experimental group

N		Experimental group pre-test score					
		Frequency	Percentage %	Mini	Maxi	M	SD
1	Poor less 50%	4	20	10	16	12, 8	2,80
2	Fair 50%	4	20				
3	Good 60%	4	20				
4	Very good70%	8	40				
5	Excellent 80 %	0	0				

Source: Prepared and calculated by the author using SPSS 21 software.

Table 5. Pos-test score of the experimental group

N		Experimental group post-test score					
		Frequency	Percentage%	Mini	Maxi	M	SD
1	Poor less 50%	0	0	14	19	16,	1,48
2	Fair 50%	0	0			90	324
3	Good 60%	4	20			0	
4	Verygood70%	8	40				
5	Excellent 80 %	8	40				

Source: Prepared and calculated by the author using SPSS 21 software.

Table 6. Post-test score of the traditional group

N		Post-test score of the traditional learners					
		Frequency	Percentage%	Mini	Maxi	M	SD
1	Poor 50%	3	30	8	16	12	3.11
2	Fair 50%	1	10			,20	983
3	Good 60%	3	30			00	
4	Very good70%	3	30				
5	Excellent 80 %	0	0				

Source: Prepared and calculated by the author using SPSS 21 software.

Table 7. Pre and post-test score of the experimental learners group and normalized gain (g)

Total average gain score (The normalized gain g) equal to .30 (or 30% learning gain for entire experimental learners group on average) g = (post-test %–pre-test %) / (100-pre-test %).

N	Pre and post-test score of the experimental group				
	Pos-test %	Pre-test %	Total	100 -pre-test	Learners gain
1	75	40	100	60	0,5833333
2	80	45	100	55	0,63636363
3	85	55	100	45	0,66666666
4	90	60	100	40	0,75
5	95	40	100	60	0,91666666
6	85	75	100	25	0,4
7	85	70	100	30	0 ,5
8	70	80	100	20	-0,5
9	70	50	100	50	0,4
10	75	55	100	45	0,44444444
11	80	65	100	35	0,42858571
12	85	70	100	30	0,5
13	90	45	100	55	0,81818181
14	90	75	100	25	0,6
15	95	80	100	20	0,75
16	90	80	100	20	0,5

17	85	75	100	25	0,4
18	90	75	100	25	0,6
19	85	70	100	30	0,5
20	90	75	100	25	0,6
				Total	6, 04119769

Source: Prepared and calculated by the author using SPSS 21 version software.