STRUCTURING INTERDISCIPLINARY LEARNING USING TBL THROUGH PBL IN CARDIOVASCULAR DISEASES CASE UNIVERSITY OF ALGIERS

Nasser Drareni
University of Blida02, Blida, Algeria
drareninacer@yahoo.fr

Abstract

The study aims to show how can add a wide dimension to interdisciplinary learning using team-based learning (TBL) through problem-based learning (PBL) and facilitate the process of integration for cardiovascular disease (CVD) courses. However, the use of team-based learning through PBL as a pedagogical strategy also served to deepen learners' understanding of CVD use real world problems in an undergraduate course of CVD. There were (60) preventive medicine learners who were selected and randomly divided into 2 groups: group 1 (n=30) with traditional teaching method and experimental group 2 (n=30) with team-based learning *through PBL teaching methodology. The results of questionnaire showed that more than (90%) of experimental group learners thought team-based learning through PBL teaching approach could help to improve learning interest, independent thinking, and team collaboration. The most of learners had a positive attitude towards using team-based learning through PBL. To further their explanation of a topic or problem that needs two or more disciplines to solve problems related to risk factors of CVD. Learners combine, determine and develop information, concepts, methodologies and procedures from two or more disciplines to obtain deep knowledge, interpretation, abilities, and very often also to diagnose or solve real world problems. The perceptions of the university*

members for introduction of interdisciplinary learning using team-based learning through PBL at University of medicine Algiers were positive and encouraging. However, more workshops, online learning and virtual presentations emphasizing more on practical demonstrations were the felt need for successful structure of interdisciplinary learning.

1. Introduction

Cardiovascular disease remains a major health concern in industrialized countries. For instance, in the worldwide, cardiovascular disease remains the leading cause of death by a large margin (Ge & Wang, 2012). The prevention of cardiovascular disease depends on the ability to identify at-risk individuals or communities short and long before the development of overt events of heart diseases or CVD and then to determine their level of risk. Hence, the improvement of the management strategies for the prevention of cardiovascular diseases are a high and first public health priority. The most serious challenge to be used such strategies in a cost-effective is the limited predictive value of current risk for CVD using risk assessment tools. The biomarkers of cardiovascular diseases are something in the body that can exhibit the presence or activity of a disease. Different diseases may have different biomarkers. Hence, identifying new risk markers for cardiovascular diseases have meaningful potential to improve the selection of individuals and communities for preventive management strategies. Further research is needed to identify new biomarkers to successfully arrange into social strata risk of cardiovascular diseases in low-moderate and high risk populations CVD events, as well as to test whether management strategies informed by biomarker testing are better than standard of care (Ge & Wang, 2012).

Interdisciplinary learning environment (IDL) is a form of knowledge production that is increasingly being embraced as an educational approach in medical education. Interdisciplinary education constitutes learning through the integration and synthesis of methods and knowledge from established disciplines. In doing so interdisciplinary programmes and modules promote learners to draw on broader knowledge, methods and skills than are typical of monodisciplinary equivalents. Since this breadth is a critical component of any post-graduation career pathway, interdisciplinary programme development has been actively evolving over many years. The role of the themes in risk factors for CVD is to enhance interdisciplinary learning and allows learners

to develop an awareness of the interconnectedness that exist amid the disciplines, Multidisciplines, Interdisciplines, Transdisciplines and between disciplines and the real-world application of knowledge. So, how team-based learning through problem-based learning could be used to facilitate the process for structuring of interdisciplinary integration learning environment related to risk factors for cardiovascular diseases. To integrate components of team-based learning through PBL into a risk factor for CVD to increase learners' responsibility for their own learning. In the final years, many medical schools adopted team based-learning in the delivery of basic sciences, clerkships and the residency programs (Seidel & Richards, 2001, pp. 533-534) and (Haidet, O"Malley & Richards, 2002, pp. 40-44). The learners usually learn individually in the team-based learning strategy (Harden & Davis, 1999, pp. 317-322). It propose a chance to increase the connection of clinical and laboratory theory learning to clinical and laboratory practice learning. We used team-based learning through PBL as an increasing the process of reasoning learning to make the connection between theoretical, clinical and laboratory reasoning and also to develop critical thinking and problem solving abilities skills that permit to learners to create new knowledge related to risk factors of cardiovascular diseases.

The study aimed to assess the effect of the strategies for structuring interdisciplinary learning of the cardiovascular diseases module on both learner satisfaction and performance at the University of medicine Algiers, Algeria using team-based learning through PBL. So the study is organized as follows. We begin giving the main tools of active learning specifically team-based learning and PBL because these tools are essential to construct interdisciplinary learning in risk factors for CVD, which are explained in the second point using our data and results methodology. Lastly, conclusions and future researches are left to the last point.

2. Literature Review

The scholarship of (Newell, 1992 & Klein, 2010) was the result of their experiences and work to establish interdisciplinary studies at their respective institutions-Miami University of Ohio and Wayne State University respectively. Amid the programs described in essays collected by (Augsburg & Henry, 2009), three are recognized as leaders in IDS-University without Walls/University of Massachusetts at Amherst, Appalachian State University, and San Francisco State University. According to (Klein, 1990, p.55) noted growth of interdisciplinarity in development of "area studies" focused on shared themes or problems. Additionally, (Holley, 2009b), reform of undergraduate curriculum early in the twentieth century led to a more cohesive

curriculum that included emphasis on integrative learning and elements of interdisciplinarity. However, (Vacca & Vacca, 2005) affirm that learners from interdisciplinary educational settings prevail in the application of real-world skills. In environmental education, Staples (2005) notes that the integration of interdisciplinary studies offers learners "critical thinking skills that lead to discovery and real-world problem solving". So global problems and complex problems require individuals to apply multiple aspects of their knowledge to uncover solutions, highlighting the importance of linking individual subject areas and developing learners' collaborative and critical thinking aptitudes. The team-based learning through PBL and interdisciplinary learning also encourage collaborative learning among learners.

According to (Smith & MacGregor, 1992), the collaborative learning is a comprehensive concept applicable to several educational situations, and involves the combined intellectual effort of learners or learners and teachers. During collaborative learning learners work mostly in small groups for understanding phenomena or facts, finding solutions or exploring topics, understanding or creating products. However, (Koenig, 2011) finds that, in collaborative learning contexts, assessment must address cognitive skills, interpersonal skills and intrapersonal skills. So the PBL clearly acts as a vehicle for the development of a 'community of colleagues' (Hargreaves & Fullan, 2000). Hence team-based learning through PBL involves a weaving of interdependence and individual accountability.

Moreover, to solve immense complex health-related problems, there has been a progressive movement towards interdisciplinary learning teams. The team-based learning and problem-based learning are an important popular interdisciplinary learning tool. According to (Tan, 2003) there is evidence that interdisciplinary learning through team-based learning and problem-based learning are a constructive method which focuses on learners learning through facilitated problem solving and also encourages self-directed learning, develops learners' lifelong learning characteristics and the interdisciplinary learning tool combination with team-based learning and problem-based learning approaches have many advantages, such as: 1) According to (Hmelo-Silver, 2004) show that IDL develops the personal ability in problem solving, critical reasoning communication and social skills; then (Michaelsen et al.,2008) indicate that 2) the IDL increases the learner's successful to work in small groups; and 3) fosters self-directed and lifelong learning; while (Barrows & Kelson,1995) mention that 4) the PBL learners become effective collaborators; and 5) increase intrinsically motivated learning.

3. Methods

We used a mixed teaching and learning method of integrating an interdisciplinary learning of risk factors for CVD using team-based learning through problem-based learning approaches as the basis for our study. The integrated team-based learning with PBL approach was an effective teaching strategy for creating lifelong learning qualities of fourth year medical learners at University of medicine Algiers in Algeria. In implementing interdisciplinary learning through TBL and PBL, teachers turn facilitators, helping learners to turn self-directed learning, and through co-operative learning working to share their prior and new knowledge with others learners' teams. The practice of these activities can vary in potential and complexity, depending upon educational means available online learning. In accordance with Lam (2018) confirmed that, encourage learners to do many activities online using different technologies to learn different perspective disciplines into one topic then move into more topics were supportive, practical, flexible, and suitable in aiding them to understand, have deep learning and reinforce their objectives learning in the future. The figure 1 illustrates the relationship between interdisciplinary learning of risk factors for CVD and TBL through PBL.
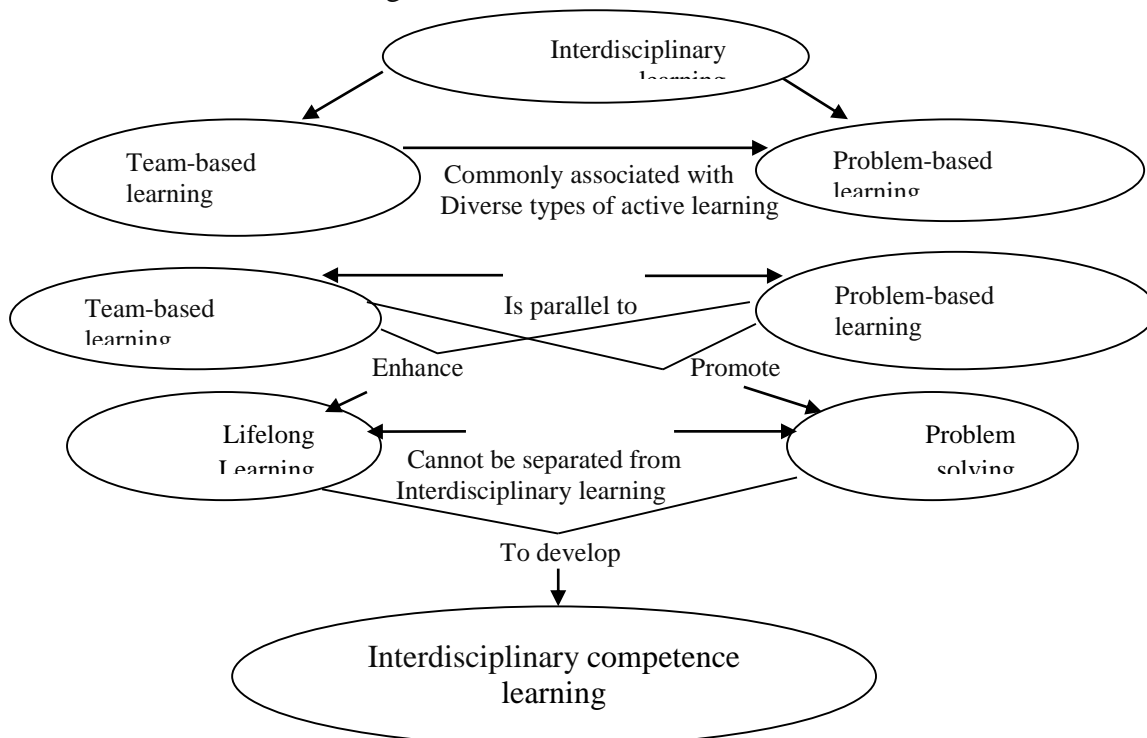

Figure 1: *Map of Interdisciplinary Learning of Risk Factors for Cardiovascular Diseases using Team-Based Learning (TBL) through Problem-Based Learning (PBL)*

3.1. Course Description of Cardiovascular Diseases Risk Factors

The figure 2 illustrates the interdisciplinary learning of risk factors for cardiovascular diseases.
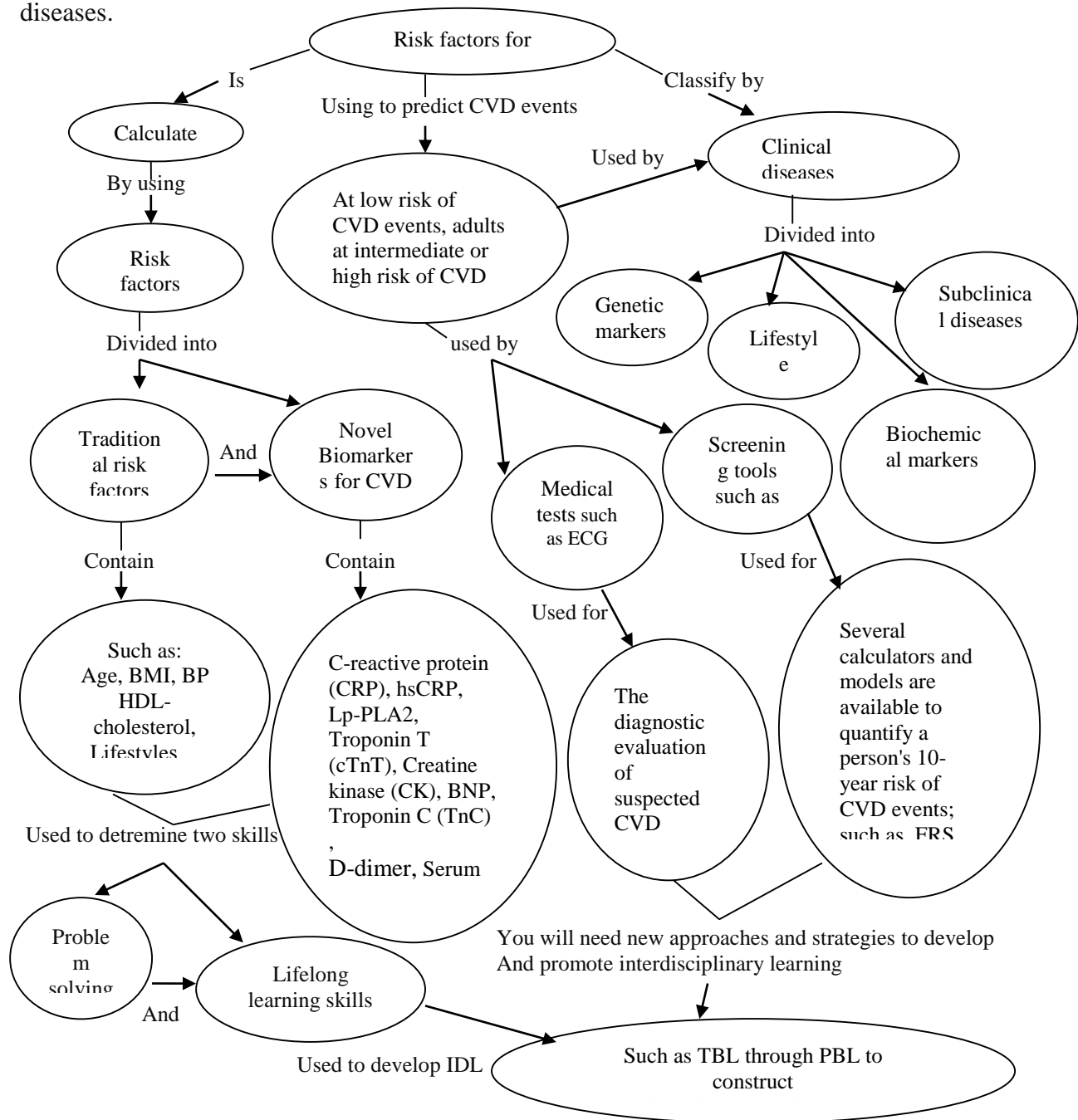

Figure 2: *Interdisciplinary learning of risk factors for cardiovascular diseases using team-based through problem-based learning. With abbreviations CVD: Cardiovascular Diseases, RF: Risk Factors, IDL: Interdisciplinary Learning, TBL: Team-Based Learning, PBL: Problem-Based Learning, FRS: Framingham Risk Score, ECG: Electrocardiogram, BP: Blood Pressure, BMI: Body Max Index*

This course included basic sciences (Anatomy, Physiology, Biochemistry, Pathology, Pharmacology, Medicine, Cardiology and cardiovascular diseases risk factors) as well as the clinical sciences (Patient interviewing, Physical examination, Patient safety, clinical and laboratory skills and Psychology). Interdisciplinary learning entails helping medicine learners to know how disciplinary perspectives are connected together. The interdisciplinary learning using team-based learning through PBL develops creativity and connected with higher-order thinking skills.

The team-based learning through PBL covers a variety of cardiovascular disease risk factors. The topics, in the form of a clinical problem learning, were set for each week of the four weeks of the module of CVD. These topics were chosen with the help of the relevant clinician and according to the commonality throughout the module objectives. The chosen topics were heart failure, ischemic heart diseases, angina pectoris, myocardial infarction, lipid disorders, hypertension and electrocardiogram (ECG), risk factors for CVD and markers for cardiovascular diseases.

Although many factors such as modifiable and non-modifiable risk factors and new risk factors, emerging or novel risk markers for cardiovascular diseases, inflammatory markers for cardiovascular diseases and classical and novel biomarkers for cardiovascular diseases that guide to this most common disease such as high blood pressure (BP), cholesterol, C-Reactive Protein, Total Creatine Kinase , lipids disorders and diabetes have been drawn, it became obvious that the most important driver is aging of blood vessels. Cardiovascular diseases (CVD) are any disease of the circulatory system (CS). Most of the deaths from CVD relate to coronary heart disease (CHD), stroke and other diseases of the circulatory system including heart failure and diseases of the arteries. Smoking use, physical inactivity, lifestyles, obesity, hypertension, high blood cholesterol, and diabetes are known as conventional modifiable risk factors for CVD. In team-based learning through PBL activity exercises, a primary objective is to go beyond simply covering content and focus on ensuring that medicine learners have the chance to practice using course concepts and to solve more complex problems. The most of learning activity exercises time should be spent on group activities, where learners are given examples to work through and apply what they have learned, and lastly group activities allow learners to improve learning and develop self-managed learning teams over time such that the small group learns the strengths of each team member.

3.2. Learning Objectives of Risk Factors for Cardiovascular

The course relied on clinical and real-patient cases that varied from heart diseases to cardiovascular diseases as well as other common diseases of cardiovascular. The course design was guided by a desire to make learners better able to meet the following learning objectives: 1) develop interests in risk factors for cardiovascular diseases and better understand risk factors for cardiovascular; 2) improve ability to assess common cardiovascular diseases and manage cardiovascular emergencies using different screening tests such as an electrocardiogram (ECG) and risk assessment tools such as framingham risk score (FRS) (Bhatia, Bouck, Iverset al.,2017) reported that low-risk patients who received an ECG also had a higher likelihood of further cardiac tests, procedures, and cardiologist consultations; and 3) cultivate learners' learning ability to better prepare for their future roles in clinical work. The learners were divided into two cooperative teams that consisted of several small groups with five learners and a teacher. Informed oral consent was obtained from each learner, teacher, and real patient in this study. The figure 3 illustrates the interdisciplinary learning approach with different perspective disciplines of risk factors for cardiovascular diseases.
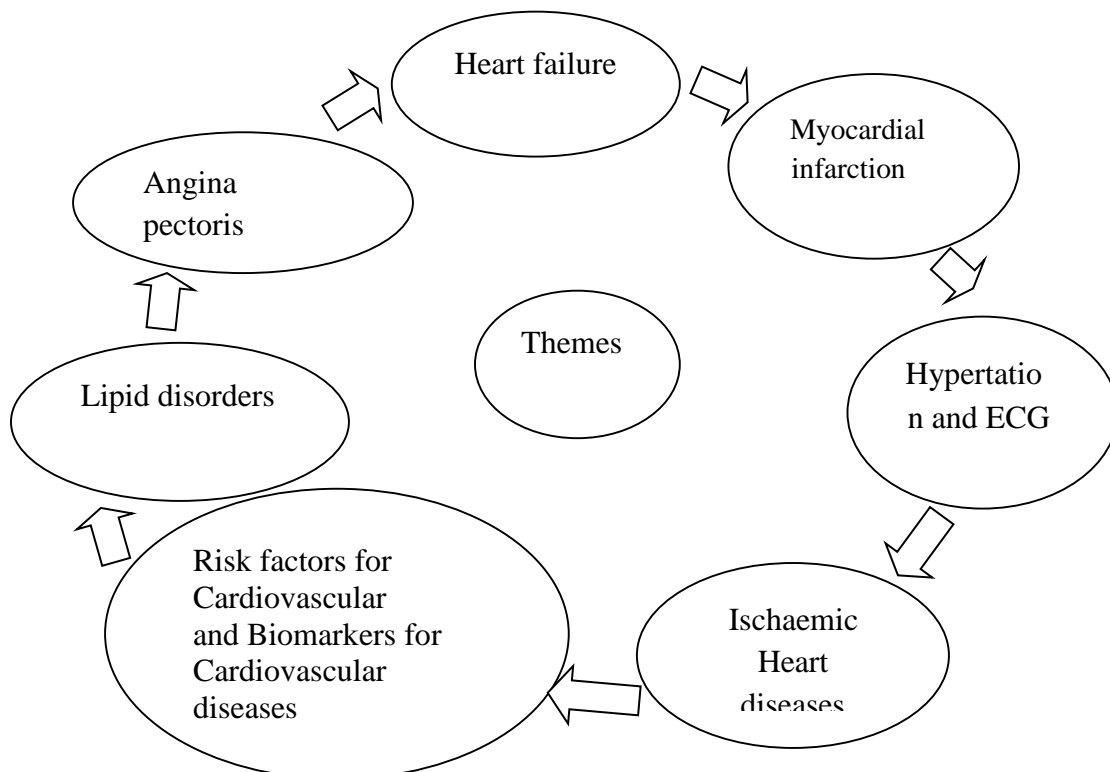

Figure 3: *The Interdisciplinary Learning Approach of Risk Factors for Cardiovascular Diseases using Team-Based Learning (TBL) through Problem-Based Learning (PBL)*

The learners are learning the interdisciplinary skills of clinical problems of risk factors for cardiovascular diseases using different approaches such as team-based learning and problem-based learning and different disciplinary perspectives to reflect on the relationships between sets of knowledge related to ECG and risk factors for CVD are a useful way into a broader appreciation of how knowledge frontiers can be crossed to allow new understandings (heart failure, atherosclerosis and ischaemic heart diseases, angina pectoris, myocardial infarction, lipid disorders, hypertension and electrocardiogram, risk factors for cardiovascular diseases and biomarkers for cardiovascular diseases). The teacher also focuses on deep ideas in the concepts of heart diseases, myocardial infarction, hypertension and ECG and risk factors for CVD. These concepts transfer to other lessons beyond, risk factors, emerging or novel risk markers for cardiovascular disease, inflammatory markers for cardiovascular diseases and biomarkers for cardiovascular diseases; therefore, the lesson develops a higher level of thinking than if medicine learners simply focused on the risk factors and CVD. Team-based learning combining with PBL can also be used to foster and develop interdisciplinary learning understanding of scientific concepts related to risk factors for cardiovascular diseases in different disciplines of CVD, link understanding of science and clinical concepts, and interprofessional understanding of teams and their relational functions for clinical care.

3.3. Strategies for Structuring Interdisciplinary Learning

The full class (n=30) was divided into five groups of nearly the same size. The learners had worked in these groups previously in ECG and risk factors for CVD. According to (Michaelsen & Sweet,2008) and (Clark, Nguyen, Bray, & Levine, 2008), show that when the four team-based learning essentials are implemented in a course, collaboration and learner engagement improves learning, while increasing learners' collaborative teamwork and problem-solving skills, while creating improved learning result. So the four team-based learning through problem-based learning essentials are (1) groups must be properly formed and managed; (2) team assignments must promote both learning and team development; (3) learners must receive frequent and timely feedback; and (4) learners must be accountable for the quality of their individual and group work. The team-based learning process through problem-based learning is illustrated in the figure 4.
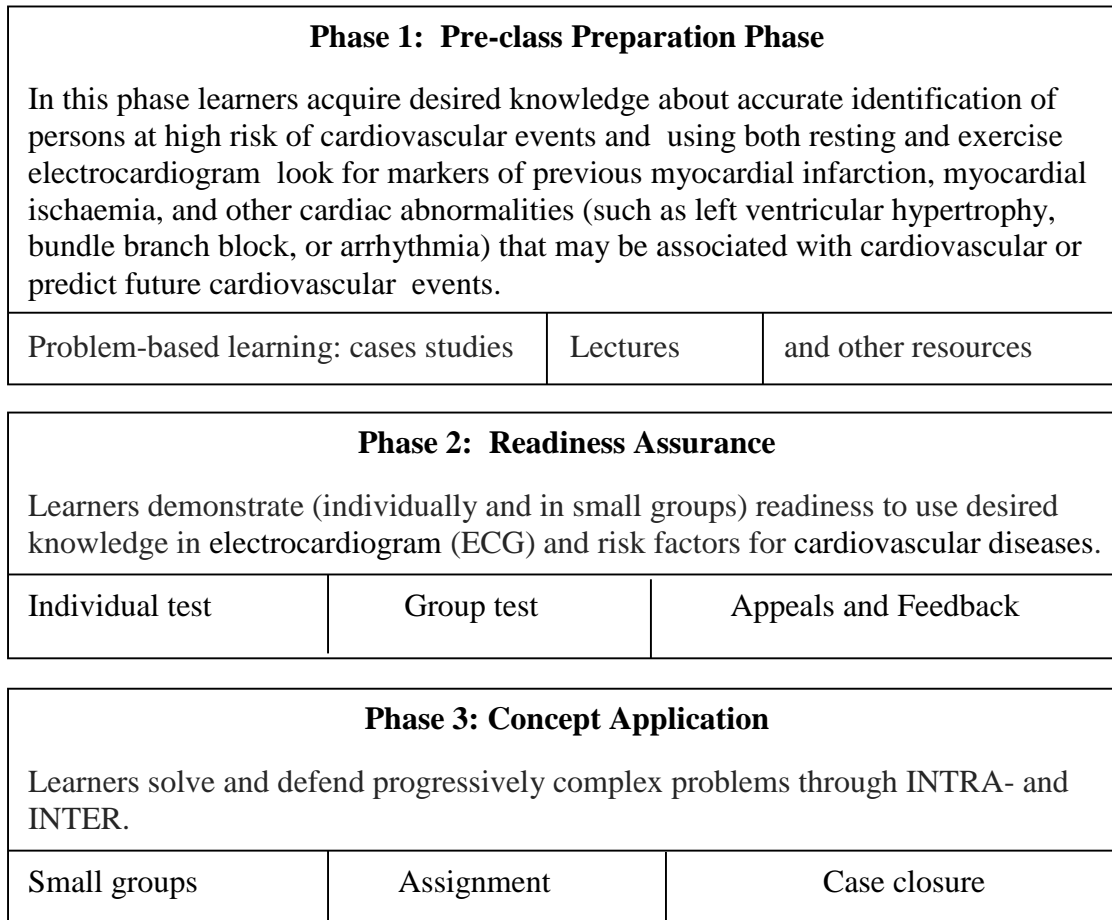
Phase 1: Pre-class Preparation Phase		
In this phase learners acquire desired knowledge about accurate identification of persons at high risk of cardiovascular events and using both resting and exercise electrocardiogram look for markers of previous myocardial infarction, myocardial ischaemia, and other cardiac abnormalities (such as left ventricular hypertrophy, bundle branch block, or arrhythmia) that may be associated with cardiovascular or predict future cardiovascular events.		
Problem-based learning: cases studies	Lectures	and other resources

Phase 2: Readiness Assurance		
Learners demonstrate (individually and in small groups) readiness to use desired knowledge in electrocardiogram (ECG) and risk factors for cardiovascular diseases.		
Individual test	Group test	Appeals and Feedback

Phase 3: Concept Application		
Learners solve and defend progressively complex problems through INTRA- and INTER.		
Small groups	Assignment	Case closure

Figure 4: *The Three Phases of Team-Based Learning*
(Adapted from Michaelsen et. al., 2004).

The three phases of team-based learning through problem-based learning are illustrated in the figure 4. They promote more fast gain of operating prior and new knowledge and also shared comprehending of ideas, concepts, practice and fundamental principles interdisciplinary learning in risk factors for CVD. In addition, they give more time for learners to entry the teacher's true expertise in declarative, procedural and operating prior and new knowledge and assist them to learn from, and respect, their assessments. The team abilities skills such as communication, share information, decision-making, negotiation, assessment, feedback and respect for others are fundamental to TBL classes. The team-based learning through PBL comprises three phases. The first phase is named pre-class preparation, learners are revealed to designed learning outcomes of electrocardiogram and risk factors for CVD. The command of the formulated learning outcomes of the two topics comes from a diversity of mixed and sources, such as team group and individual study, conventional lectures or workshops, concept mapping, Data-Information-Knowledge-

Wisdom pyramid system, pre-recorded slideshows, multimedia presentations and readings. The second phase is named readiness assurance that is done during the class, learners separately make a multiple-choice test to show clearly by giving their readiness to use the prior and new knowledge with perspectives disciplines in risk factors for CVD acquired in phase 1. Individual scores are recorded but not known. Afterwards, the teams of five learners take the similar multiple-choice test together. Agreement answers are communicated at the same time, then scored and recorded quickly. Coincident reporting encourages an energetic total class discussion with team groups confirming their answers, as a result of that enhancing critical thinking and problem-solving skills. The teacher makes concepts, idea, opinions clearer and associates them with different disciplines learning in risk factors for CVD. The third phase is named concept application, the teams work together during the class to solve more complex problems in electrocardiogram and risk factors for CVD with real case studies that depend on the request of the prior and new knowledge assessed in the phase 2.The target of this phase is to enlarge and further accelerate prior learning process and then create new learning process with more complex problems in the future.

3.4. Interdisciplinary Learning Activity using Team-based Learning through PBL

The two topics from cardiovascular diseases, clinical real patient connection and with like problem level were selected after discussing with other colleagues in the department of cardiovascular diseases. The team-based learning through PBL sessions were scheduled for 4-week in a time frame. Discussing about the concepts of team-based learning, problem-based learning, interdisciplinary learning and the learning goals were introduced two weeks in advance to the learners of electrocardiogram and risk factors for CVD. During the first session was directed with a multiple-choice test on the charged with the first topic risk factors for CVD comprising 20 questions (with difficulty level) then to be replied individually. The scores were given. After that the same multiple-choice test was given to all five groups and as a group learning activity they solved these questions with agreement and came out with the replies. These two multiple-choice tests verified that the learners were prepared with high quality of learning and be able to help them to apply their prior and create new knowledge to solve more complex problems in the future. Throughout the second session, a real case patient on risk factors for CVD was given to each group. At the end of this case, ten questions were asked whose responds necessitated discussion amid the group members. The facilitator was ready with a power point presentation about each topic to make necessary clarifications to the learners about any doubts that emerges during the discussion. In particular the second session, a real case patient on risk factors for CVD was given to each

group. At the end of this case, ten questions were asked whose responds necessitated discussion amid the group members. The facilitators were ready with power point presentations about each topic to make essential clarifications to the learners about any confusion that comes out through the discussion. Similarly for the second topic ECG of the same depth, weightage and difficulty level were chosen then the sessions were coordinated in the same way.

3.5. Review and Test Setting

Learners from both group1 (n =30) and group 2 (n =30) were asked to diagnose risk factors for CVDs in an hour (see table1 below).

Table 1: *Learners' Responses about using TBL through PBL to construct IDL*

No	Statements	SD	D	N	A	SA
1	IDL using TBL through PBL was a lifelong learning tool to facilitate individual self-learning, Individual tests (IRAT) and G-RAT were useful learning activity in ECG and risk factors for CVD.	0	0	5	25	83%
2	IDL using TBL through PBL assisted to integrate basic and create new knowledge related to ECG and risk factors for CVD.	0	0	6	24	80%
3	IDL using TBL through PBL helped to link risk factors for CVD theoretical information to identifying different types of CVD with their risk factors.	0	0	4.5	25.5	85%
4	IDL using TBL through PBL aided to solve problem in risk factors for CVD using emerging or novel risk markers for cardiovascular disease.	0	0	3	27	90%
5	Would you continue to use IDL to solve problem in risk factors for CVD using emerging or novel risk markers for cardiovascular disease.	0	0	4.5	25.5	85%
6	Discussions of the IDL using TBL through PBL learning issues were useful learning activities ,improve my understanding of concepts, prepare for course content, in developing my information synthesizing skills, extend my knowledge of oral contraceptive cardiology (OC).	0	0	5	25	83%

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). TBL: team-based learning, PBL: problem-based learning, IDL: interdisciplinary learning , ECG : electrocardiogram , oral contraceptive cardiology (OC).

The questionnaire was composed of 6-item which were formed by the teachers and with other colleagues in the department of CVD. All of the items were close ended questions to show learners' impressions about strategies for structuring interdisciplinary learning environment using team-based learning through PBL as learning and pedagogical tool in risk factors for cardiovascular diseases.

3.6. Results

All the learners agreed that interdisciplinary learning using team-based learning through PBL created interest in the topics of risk factors for CVD. Of the learners, (83%) agreed that team-based learning through PBL supported a lifelong learning to encourage individual self-study then independent learning and about individual readiness assurance test (I-RAT), (67%) learners were agreed that it was useful learning activity , (80%) learners were of opinion that team-based learning through PBL reinforced them to integrate basic and new knowledge related to electrocardiogram

ECG and risk factors for CVD, (85%) of the learners agreed that team-based learning helped to link risk factors for CVD theoretical , practical , clinical and laboratory information to identifying different types of CVD events with their biomarkers risk factors for CVD. Then (90%) of the learners agreed that interdisciplinary learning using team-based learning through PBL assisted to solve more complex problems in risk factors for CVD using emerging or novel risk markers for cardiovascular diseases.

Overall learners were of opinion that the group discussion ameliorated their ability skills to comprehend of ideas ,concepts, subjects, topics, prepare for course content and link with different perspectives disciplines related to ECG and risk factors for CVD , in generating their data ,information and knowledge synthesizing skills, increase their knowledge of the risk factors for cardiovascular diseases with oral contraceptives (OC_s), cardiovascular diseases and solving problems using IDL through TBL and PBL was an effective manner to learn risk factors for cardiovascular diseases.

3.7. Discussion

Medical education has changed dramatically over the past few decades, with growing priority on interdisciplinary learning, problem solving, information gathering, group activities and collaborative leaning (AAMC, 2015). Also according to Duran-Dominguez, Gomez-Pulido, & Pajuelo-Holguera (2018) reported that, teachers can travel on other active learning tools to actively engage the learners with different learning styles by integrating many different learning tools into one topic then to go through more topics. For this reason we now realize that one of the important non-academic elements of medical education is to redirect leaning strategies to include group activities and cooperation (Branch, 2001; Tucker et al., 2003; Michaelsen & Sweet, 2008 & Vasan et al., 2008). Problem solving activities such as team-based learning have now become familiar in the Algerian University of medicine curriculum. As with other studies (Branch ,2001; Tucker et al., 2003 & Parmelee et al., 2009), the most of our survey participants appreciated the general learning value of the team-based learning approach through PBL to promote and develop interdisciplinary learning related to risk factors for CVD. In the middle of team-based learning through PBL, learners travel through the clinical, practical and laboratory settings, then learn about the tasks, next comprehend the concepts and systems important those tasks, and last apply their prior and new knowledge and skills in different contexts of screening tests such as ECG and risk assessment tools for CVD, and obtain global skills and abilities. So we used team-based learning through PBL as an enlarging strategy of learning strategies to generate critical thinking skills and

problem solving abilities. Finally, according to McInerney & Fink (2003) announced that small group activities extended overall learners willingness and satisfaction for the course. This finding is confirmed by the learners in our study at the University of medicine Algiers and proved by a quantitative study by (Drareni, 2018, p.465; Duran-Dominguez, Gomez-Pulido, Pajuelo-Holguer, 2018 & Siti Dutufiyah, 2019).

3.8. Limitations and Scope

There are barriers to interdisciplinary teaching and research (Franks et al., 2007). The move from discipline based knowledge to more integrated approaches is beyond the leisure zones of most academics. Communication skills is critical so there is shared understanding and relationships evolved between the diverse disciplines based academics. Further educational research should explore the factors related to learning styles (Sontillano, 2018). and self-directed learning of the fourth year medical learners who were more satisfied with a traditional lecture format they had experienced as passive learners, compared with the learning styles and self-directed learning of the fourth year medical learners who were more satisfied with an integrated team-based learning with PBL approach to foster their interdisciplinary learning related to ECG and risk factors for CVD. Such findings may ameliorate the university to understand the infrastructure factors of teaching and learning instruction that influence learners with different learning styles and mixed different methods of active learning. It also improves teachers to create the appropriate instructional design and to experiment with cooperative classrooms for both teachers and learners.

4. Conclusion

In conclusion, the team-based learning through problem-based learning pattern has been totally established with two topics from cardiovascular diseases module and clinical real patient relevance and with the same difficulty level were selected such as electrocardiogram and risk factors for cardiovascular in cardiovascular diseases module. In addition, the team-based learning through problem-based learning creates an enjoyable teaching/learning session that enhances learners' active learning, self-directed learning, lifelong learning, collaborative team, critical thinking and abilities skills to explore and integrate one or more perspectives from different disciplines, sub-disciplines and areas of expertise related to risk factors for cardiovascular diseases. According to Hrynchak & Spafford (2015) and Livingston, Lundy& Harrington (2014) announced that, the most of learners showed their positive comprehending about the effectiveness,

usefulness and the structuring of interdisciplinary learning using team-based learning through problem-based learning as a teaching and learning modality.

Finally, this preliminary study provides a platform for a class intervention in the future research and future investigations would be required to explore the analysis of learners' responses data. Future research will include a larger sample size. A quantitative and qualitative analysis would be beneficial to determine the learners' interdisciplinary learning in problem-based context using mixed approaches such as TBL through concept maps to develop Connective skills and meaningful skills in ECG and RF for CVD and also the challenges faced by the methods presented need to be identified and addressed.

References

Association of American Medical Colleges (AAMC, 2015). Task Force on the Clinical Skills Education of Medical Students: Recommendations for clinical skills curricula for undergraduate medical education. *Association of American Medical Colleges*. Retrieved from the Association of American Medical Colleges is online website: https://members.aamc.org/eweb/upload/Recommendations%20for%20Clinical%20Skills%20 Curricula%202005.pdf

Augsburg, T. & Henry, S. (2009). The politics of interdisciplinary studies: Essays on transformations in American undergraduate programs. Jefferson, NC: McFarland & Co.

Barrow, H. & Keelson, A.C. (1995). Problem-based Learning in Secondary Education and the Problem Based Learning Institute (Monograph1). *Springfield, IL*: Problem Based Learning Institute.

Bhatia R.S., Bouck Z., Ivers N.M. et al. (2017). Electrocardiograms in low-risk patients undergoing an annual health examination. *JAMA Intern Med*, 177(9),1326-1333. https://doi.org/10.1001/jamainternmed.2017.2649

Branch,W.T. (2001). Small-group teaching emphasizing reflection can positively influence medical student's values. *Acad Med,* 76, 1171-1173. https://doi.org/10.1097/00001888-200112000-00001

Drareni N. (2018, June). Using Concept Mapping Through Problem-Based Learning to Facilitate Lifelong Knowledge of Risk Factors for Cardiovascular Diseases: Case University of Algiers. *Journal of Modern Education Review* .8(6), 458–468. DOI: 10.15341/jmer(2155-7993)/06.08.2018/006

Duran-Dominguez, A., Gomez-Pulido, J. A., & Pajuelo-Holguera, F. (2018). Virtual Classrooms as Data Sources for Prediction Tools. *PUPIL: International Journal of Teaching, Education and Learning*, 2(2), 170-180. https://doi.org/10.20319/pijtel.2018.22.170180

Framingham Heart Study. (2018), Cardiovascular disease (10-year risk) calculator. Retrieved from the Framingham heart study is online website https://www.framinghamheartstudy.org/fhs-risk-functions/cardiovascular-disease-10-year-risk/

Franks, D., Dale, P., Hindmarsh, R., Fellows, C., Buckridge, M.and Cybinski, P. (2007). Interdisciplinary foundations: reflecting on interdisciplinarity and three decades of teaching and research at Griffith University, Australia, *Studies in Higher Education*, 32(2), 167-185. https://doi.org/10.1080/03075070701267228

Ge Y. & Wang T. J. (2012). Identifying novel biomarkers for cardiovascular disease risk prediction. *Journal of Internal Medicine*, 272, 430-439. https://doi.org/10.1111/j.1365-2796.2012.02589.x

Haidet, P., O¨Malley, K., & Richards, B. (2002). An initial experience with "team learning" in medical education. *Journal of the Association of American Medical Colleges, Academic Medicine*, 77(1), 40-44. https://doi.org/10.1097/00001888-200201000-00009

Haidet, P., Schneider, V., & Onady, G. (2008). Research and scholarship: Team based learning in health professions education (pp.117-130). In L. Michaelsen, D. Parmelee, K. McMahon, & R. Levine (Eds.), Team-based learning for health professions education: A guide to using small groups for improving learning. Sterling, VA: Stylus Publishing.

Harden, R.M. & Davis, M.H. (1999). The continuum of problem-based learning. *Medical Teacher,* 20, 317-322. https://doi.org/10.1080/01421599880733

Hargreaves, H. & Fullan, M. (2000). Mentoring in the new millennium. Theory into Practice, 39 (1), 50-56. https://doi.org/10.1207/s15430421tip3901_8

Hmelo-Silver, C. (2004). Problem-Based Learning: What and How Do Students Learn? *Educational Psychology Review*, 16(3), 235-266. https://doi.org/10.1023/B:EDPR.0000034022.16470.f3

Holley, K. (2009b). Understanding interdisciplinary challenges and opportunities. *Published online in Wiley InterScience*, 35(2), 1-131. https://doi.org/10.1002/aehe.3502

Hrynchak P.K. & Spafford M.M. (2015, Winter-Spring). Optometry Students' Attitudes about Team-Based Learning. *Journal opted: Optometric Education*, 40(2), 89-93.

Klein, J.T. (1990). Interdisciplinarity: History, theory and practice. Indiana: Wayne State University Press.

Klein, J.T. (2010), The taxonomy of interdisciplinarity. In: Frodeman, R., Klein, J.T., Mitcham, C. (Eds.), *Oxford Handbook of Interdisciplinarity*, Oxford: Oxford University Press. 14-33.

Koenig, J. A. (2011). Assessing 21st Century Skills: Summary of a Workshop. Washington, DC: *The National Research Council*.

Lam, J. (2018). The Pedagogy-Driven, Learner-Centred, Objective-Oriented and Technology-Enable (Plot) Online Learning Model. *PUPIL: International Journal of Teaching, Education and Learning,* 2(2), 66-80. DOI-https://dx.doi.org/10.20319/pijtel.2018.22.6680

Livingston, B., Lundy, M., & Harrington, S. (2014). Physical therapy students' perceptions of team-based learning in gross anatomy using the Team-Based Learning Student Assessment Instrument. *Journal of educational evaluation for health professions*, *11*, 1. https://doi.org/10.3352/jeehp.2014.11.1

McInerney, M. & Fink, L. (2003).Team-based learning enhances long-term retention and critical thinking in an undergraduate microbial physiology course. *Microbial Education*,4(1), 3-12. https://doi.org/10.1128/154288103X14285806229759

Michaelsen, L.K., Parmelee, D.X. & Sweet, M. (2008) Team-Based Learning: Small-Group Learning Next Big Step. Number 116, San Francisco: Stylus. https://doi.org/10.1002/tl.v2008:116

Newell, W. H. (1992). Academic Disciplines and Undergraduate Interdisciplinary Education: Lessons from the School of Interdisciplinary Studies at Miami University, Ohio. *European Journal of Education*, 27, 211-221. https://doi.org/10.2307/1503450

Parmelee, D. X., DeStephen, D., & Borges, N. J. (2009). Medical students' attitudes about team-based learning in a pre-clinical curriculum. *Medical education online*, *14*, 1. https://doi.org/10.3885/meo.2009.Res00280

Reiter-Palmon R., Kennel V., Allen J., Jones K. J. (2018). Using Interdisciplinary Teams and Team Reflexivity to Improve Patient Safety. 43 (3), 414-439. https://doi.org/10.1177/1059601118768163

Seidel, C. & Richards, B. (2001). Application of team learning in a medical physiology course. *Academic Medicine*, 76, 533-534. https://doi.org/10.1097/00001888-200105000-00071

Siti Dutufiyah, S.Pd. (2019). Influence of The Problem-Based Learning Assessment of Audiovisual Media Towards The Results of Students Learning in The Economic Lessons of The Xi Class of High School. *IOSR Journal of Research & Method in Education*, 9(1),17-23. DOI: 10.9790/7388-0901011723

Smith, B. L. & MacGregor, J. T. (1992). What is collaborative learning? In Goodsell, A., Maher, M., Tinto, V., Smith, B. L. & MacGregor J. T. (Eds.), *Collaborative Learning: A Sourcebook for Higher Education.* Pennsylvania State University; USA, National center on postsecondary teaching, learning, and assessment publishing.

Sontillano, R. D. (2018). Impact of Whole Brain Teaching Based Instruction on Academic Performance of Grade 8 Students in Algebra: Compendium of WBT-Based Lesson Plans. *PUPIL International Journal of Teaching, Education and Learning*, 2(2), 98-114. DOI-https://doi.org/10.20319/pijtel.2018.22.98114

Staples, H. (2005). The integration of biomimicry as a solution-oriented approach to the Environmental Science curriculum for high school students. Retrieved from http://www.eric.ed.gov/ERIC/Docs/data/ericdocs2sql/content_storage_01/0000019b/80/1b/c2/3d.pdf

Tan, O.S. (2003). Problem-based Learning Innovation: Using problems to power learning in the twenty-first century. Singapore: Pearson.

Tucker, K., Wakefield, A., Boggis, C., Lawson M., Roberts, T., & Gooch, J. (2003) Learning together: clinical skills teaching for medical and nursing students. *Med Educ,* 37, 630-637. https://doi.org/10.1046/j.1365-2923.2003.01558.x

Vacca, R. T. & Vacca, J. A. (2005). Content area reading: Literacy and learning across the curriculum (8th ed.). Boston: Pearson Education MA. Allyn and Bacon.

Vasan, NS, DeFouw, D.O. & Holland, B.K. (2008). Modified use of team-based learning for effective delivery of medical gross anatomy and embryology. *AnatSciEduc*, 1, 3-9. https://doi.org/10.1002/ase.5