Embedding a culture of active learning in cardiorespiratory physiotherapy education- Hybrid Team Based learning(H-TBL)

SD Perumal

Cardiff University, Wales, United Kingdom.

Abstract

In recent years, team-based learning (TBL) is gaining popularity as a student-centered active collaborative learning strategy in healthcare education. This paper reports the design, implementation, and impact of a "hybrid team-based learning" (H-TBL) for one respiratory lecture in year two undergraduate physiotherapy program in 2019. A retrospective study was conducted, including 136 second-year undergraduate physiotherapy students using H-TBL design for one respiratory lecture topic. Student engagement was evaluated based on the percentage of completion for pre-class work, attendance to classroom session, and submission of formative creative assignment. Student' performance on formative creative task was evaluated based on thinking and learning rubric. Student perceptions were assessed based on the student's feedback using "Mentimeter." 109/ 136 (80%) students attended the COPD 2 session. 90/109 (82%) students engaged in COPD 1 (web- based) and tRAT in COPD 2 session. 54/109 (50%) students provided feedback and 67/90 (74%) students submitted formal formative creative assignment on completion of COPD 2 session. This study confirms that H-TBL enhances student's active engagement, creativity, and equilibration of their subject knowledge. Future randomized studies are mandated to explore the validity and specificity of H-TBL in diverse physiotherapy curriculum to evaluate the long-term student engagement and academic performance.

Keywords: Active Teaching, Team-Based Learning, Physiotherapy Education, Collaborative Learning, Cognitivism, Social Constructivism.

Author confirms this work has been conducted in Cardiff University.

ORCID ID- <https://orcid.org/0000-0002-1198-3626>

Institution Email: perumalsd@cardiff.ac.uk

1.Introduction

In the 21st century, there are renewed demands on exit competencies for cardio-respiratory knowledge and skills of physiotherapy graduates to tackle unprecedented challenges of the growing healthcare industry. Employers demand a self-sufficient graduate with interrelated skillset such as creativity, accountability, inventiveness, resilience, negotiation, and interpersonal communication beyond subject knowledge. In this millennial generation, students are highly ambitious and perceive traditional lecture limits their creativity and autonomy. Students expect educators to facilitate learning and provide immediate feedback (Atwa et al. 2019). In reality, universities face substantial financial challenges to secure grants and demand educators to teach large classes with effective teaching practices to attain the highest students' satisfaction and retention. Given the context of compounding demands and challenges, it is crucial to reform the education process "that integrates generic skills and shapes students for professional responsibilities that transcend traditional boundaries of discipline-specific roles." The educator's pedagogy should focus on a "Student-Centered Approach."

Student center approach refers to an idea "active teaching-learning strategy" that promote student's higher-order skills engagement, retention, belongingness, and performance (Freeman et al. 2014). Many diverse models of active teaching-learning strategy persist among which problem - solving, project-based learning and task-based learning are in everyday practice (Dolmans et al. 2015). In the last few years, team-based learning (TBL) has become a useful active instructional tool in many countries and disciplines, including healthcare, marketing, business, humanities, social sciences, and engineering. TBL's existence traces its roots to Professor Larry Michaelson in 1970, a concept that seeks active collaborative learning in business courses (Johnson 2009). TBL is a flipped – dynamic classroom teaching and learning strategy with a locus of the learner to foster individual and group accountability, self -directed learning of course material, and application of this new knowledge in a collaborative classroom team teaching that promotes the acquisition of higher-order thinking skills (Michaelson & Sweet 2008).

From a pedagogic perspective, TBL aligns to cognitivism, social constructivism, and behaviorism (Figure 1). Cognitive learning theory argues "learning is an active process wherein a learner process constructs new knowledge or information by linking prior experiences or beliefs." Social constructivism and behaviorism argue, "learning is an active process socially constructed through shared perspectives and experiences in community of practice" (Hrynychak & Batty 2012). In TBL, students are active participants with the autonomy to engage and apply higher-order thinking skills (knowledge and cognitive process dimensions), as illustrated in Bloom's taxonomy (Anderson & Krathwohl 2001) in teams that stimulates the transformation of a novice learner to an expert in their discipline. TBL promotes self-efficacy in students learning process and stimulates enthusiasm in team working skills. TBL design supports by Kolb's learning style, a cyclic process of real experience- reflection- active experimentation- abstract formation creating an environment for engagement for revival and retrieval of information (Saul ML 2017). The four primary transformative strategies and perks of TBL compared to traditional lectures are: 1) Using concepts Vs. Knowing thoughts in problem-solving, 2) Instructor's role is a facilitator Vs. Expert, 3) Students roles are active accountability and reflective Vs. Passive, 4) Cost-effective on resources- one facilitator can execute a large class of 200 (Michaelson & Sweet 2008).

The three critical elements for prescription and successful TBL implementation to any course regardless of class size include: a. Student Accountability – Students held accountable for knowledge acquisition, creating a community of inquiry, b. Student Interactivity - Students inter and intra team discussion with

prompt feedback promotes a community of practice within a discipline, c. Task Design - The framework for task design adheres to the "4S" principle: A diligent task design around a "Significant" problem with a focus on the "Same" question, with "Specific" choice, and students are reporting "Simultaneously" their answers/ views to the whole classroom for immediate feedback (Michaelson & Sweet 2008). Basic TBL comprises of 3 phases: a) Phase 1(Outside classroom): Pre-class preparation, b) Phase 2(In-classroom): individual and team Readiness Assurance Test (iRAT and tRAT), c) Phase 3 (In- classroom): Application exercises.

A plethora of evidence affirms TBL improves students' academic outcomes compared to traditional teaching in domains of problem-solving, knowledge retention, self-efficacy, higher reasoning, negotiation, higher engagement, and examination scores (Sisk 2011, Fatmi et al. 2013, Reimschisel et al. 2017). Many courses have implemented a modified version of TBL with adherence to protocol of readiness assurance test (RAT) and application exercises to promote student interactivity and community of practice (Burgess et al. 2014, Haidet et al. 2014, Wenger 2010). Despite its proven benefits, TBL has a strong foothold in healthcare education in the United States compared to the United Kingdom (Khogali et al. 2013). There is little evidence of TBL use in physiotherapy education (Amorim et al. 2019, Lein et al. 2017, Livingston et al. 2014). This paper sought to describe and report the experience on the implementation of hybrid TBL(H-TBL) in one lecture of cardio-respiratory in an undergraduate physiotherapy program. This retrospective study aimed to answer two main questions: 1. Does H-TBL attract active student engagement to the content? 2. How do students perceive H-TBL?

2.Methods:

The presented data are from the academic year 2019 wherein H-TBL intervention implemented in one of hybrid TBL for one lecture topic – "Problem Definition of Chronic Obstructive Respiratory Disease (COPD)" in our Cardio-Respiratory block (November-December), a part of a 30-credit module in Year 2 (level 5) of an undergraduate physiotherapy program in Cardiff university.

2.1. TBL intervention

The COPD lecture was scheduled as a keynote lecture on the 4th day of week one of a 3-week Cardio-Respiratory block (November- December). TBL content and activities for COPD lecture was designed in two parts- COPD 1 session (pre-class preparation) and COPD 2 session (in & out of the classroom) in alignment with the learning outcomes of the module (Figure 2).

2.1.1. Phase -1- pre-class preparation

For phase 1, the author adopted a hybrid design for COPD 1 session. It comprises web-based course content and case study challenge with application exercise as a means to develop and contextualize foundational knowledge on the clinical presentation and interdisciplinary clinical practice in COPD (Figure 3). The online course content comprised of 34 slides that includes orientation of the course content mapping session's learning objectives, links to online reading material and videos (length 5-7 mins), online application exercise and technological requirements, team-based learning expectations for the COPD-session 1 and 2. The author, with support from learning technologists, designed the online course content

and case challenge using "Xerte". Four days before scheduled COPD 2 session, pre-course web-based content of COPD 1 session was uploaded in the university's learning management system (LMS) for student access, with a recommended duration of 40 – 60 minutes for completion. The completion of pre-course content is a pre-requisite for students' attendance for the COPD 2 session.

The phase 2 and 3 were designed as part of the COPD 2 session and it involved the individual, the teams, and the entire class. The activity sequence of phases 2 - 4 are illustrated in Figure (4).

2.1.2. Phase 2- Team Readiness Assurance Testing (tRAT)

The second phase began with an introduction of sessions learning objectives (Figure 5), plus an outline of the in-classroom TBL session (Figure 6) and rules of engagement (Figure 7) emphasizing professionalism and teamwork. Subsequently, a closed book, team readiness assurance test (tRAT) was administered via Kahoot, a learning game platform as ten multiple-choice questions (MCQ) with four best options, and no grades were assigned. The MCQ designed in tRAT confirmed students understanding of basic concepts and knowledge over the pre-class online content. The students were sharing devices in teams of minimum 3 to maximum 4 for tRAT. The educator revealed the answers with required feedback for each question on receipt of a response from the students. A minilecture presentation was provided by the educator (instructor) following tRAT for 10-15 mins as highlights of major vital points or to clarify any points of confusion risen from the readiness assurance test with an opportunity of verbal appeal in the classroom. Verbal appeals on any "burning questions" were acknowledged, and the educator clarified any concepts that students did not understand relating to the test and the pre-class task (reading material).

2.1.3. Phase 3- Application exercises

1.Teamwork in the classroom: Following tRAT, seven teams (A-G) were formed for peer discussion and peer presentation. Each team further was broken into 3- 4 groups, each comprised of 5–7 students allocated randomly by educator for team discussion, consensus building, and development of final thoughts on the assigned themes. Each team worked with a similar task on one of the four topics (Figure 8) for peer discussion. Within and between team discussion promoted, which involves critical thinking, problem-solving, reflection, negotiation, and decision-making, followed by peer presentation and feedback to the whole classroom for peer debate with required support from the educator.

2.Peer discussion in Teams: All teams worked on the same significant clinical problem "Exacerbation of COPD" under four themes from a renowned journal article at the "same time" to make "specific choices" concerning evidence-based investigation, management, diagnosis, future directions and recommendations. Educator instructed students that their discussion should be reflective of a case study from web-based COPD 1 session linking to allocated themes. And educator randomly assigned task to one or two students per group to be accountable for collecting a written response to ensure they are committed to their answer. During the discussion, the educator reminded students continuously that they should be prepared to defend their team's decisions and explain their decision-making processes to the classroom. Inter and Intra team's discussion promoted for critical inquiry and sharing views. During peer discussion, the educator identified

one or two members from each team for peer presentation to explain the rationale behind their teams' decisions to entire class.

3. Reporting: Teams reporting was simultaneous through the allocation of themes, and opportunities for verbal appeal promoted. One or two students from each team presented a reflective account of their discussion, to varying degrees of depth and rationale of their team's decision. The educator facilitated the intra team debate. After each reporting, the educator clarified and added critical supporting points. A mini test was exercised through "Mentimeter" to confirm and promote understanding of the session's context and contents. Before the close of the session, students' feedback on the COPD 2 session was captured through "Mentimeter."

2.1.4. Phase 4- Formative creative assignment

This phase involves out of class activity post completion of COPD 2 session in classroom activity. Students were challenged with a creative assignment (phase 4) on a common theme, "Exacerbation," to promote reflection on their application exercise (phase 3) and community of practice. Students autonomy was developed with a choice of either a blog of the maximum word length of fifty or a PowerPoint with a maximum of five slides or one-page infographics. Students were set on a target of 10 days to complete and submit the task on the university learning management system (Turnitin). Educator instructed students that the creative assignment is not summative assignment or neither add credits towards the module. The students work was assessed by educator using "Rubrics on students reflection" (Figure 9) as a guide.

3.0. Results:

The overall outcome of H-TBL (Figure 10 and 11) was measured based on three main domains, as discussed below:

3.1. Student's engagement and retention

In total, 109/ 136 (80%) students attended the COPD 2 session. 90/109 (82%) students confirmed (verbal) engaged in COPD 1 online session and 75/ 90 (83%) engaged in tRAT (phase 2) of COPD 2 session. 67/90 (74%) students submitted formal creative task that includes: Blog (n= 4), PowerPoint (n= 58) and infographic (n=5).

3.2. Student's performance in Phase 2 (tRAT) and Phase 4 (formative creative task).

The percentage of student's right responses to MCQs in tRAT of phase 2 is shown in Table 1. In phase 4, the creative assignment was assessed based on a rubric for student's reflection (Fig 9). Based on the rubric, 5/ 67 (7%) students were graded excellent, 56 / 67(83%) students graded good and 6/67 (9%) students graded near expectation.

3.3. Student's feedback

Student's feedback was captured by the interactive platform "Mentimeter," and 54/ 75 (72%) students provided feedback on the session. The majority of the students recorded the COPD session 2 was "Vibey, Interactive, Energetic, Engaging, Informative, Creative, Good, Friendly, Fun, Unique and Love Group Work." In contrast, a small group of students recorded "Wanted to have a lecture, Better as a tutorial, No structure and Confusing."

4.0. Discussion:

The hybrid team-based learning (H-TBL) strategy reported in this study is an innovative model incorporating a web-based case challenge using a problem-solving model and incentivizing phase 4 to test students' creativity, knowledge equilibration, and engagement. This H-TBL session is first of its kind implemented in one lecture session of our 3-year undergraduate physiotherapy program. Particular attention given here to value H-TBL, as the author identifies benefits, challenges, and limitations.

4.1. Benefits

Our collaborative commitment to H-TBL early in the design process between educator, learning technologist, academic leadership, and facilities management was aligned to the vision of creating a student-centered learning experience. Our H-TBL session met the intended learning outcomes of the core module including active, self-directed learning, student accountability, self-efficacy in knowledge content and application were rationalized by data presented on student's engagement and performance.

Introduction of web-based course content with formative feedback in COPD 1 session, before the classroom session (COPD 2 session), attracted student autonomy, accountability, and engagement in the success of the learning objectives. Team readiness test (tRAT) ensured student understanding from the pre-class reading and involvement in the case study challenge, which facilitated a meaningful use of class time for assessing and applying knowledge "to process information at highest cognitive complexity" (Parmelee & Hudes 2012).

An explicit instruction on rules of engagement for peer discussion and presentation had placed a social constraint on students interpersonal and team engagement skills of being respectful, active listeners, inclusive, and accountable in groups. An impressive performance data was observed both in tRAT and formative creative task activities.

Besides, presenting a real-world practice challenge and inviting a different perspective though daunting for students, it was apparent, the application phase of TBL had aroused sufficient exchange of dialogue and critical thinking during the team's discussion and presentation, promoting a community of practice with critical thinking, professionalism, communication, and collaborative teamwork. Importantly, the completion of a creative assignment challenge revealed students' talents of creativity, proclivity, innovation, self-efficacy, and ownership for knowledge acquisition, and though it was instructed this assignment does not count towards summative assessment of the module. In addition, the author believes the introduction of incentive in phase 4 for creative assignment had opened the channels of enthusiasm and a collegiate competition among students.

For those aforementioned reasons, the author believes H-TBL had promoted a culture of self-regulated learners and community of inquiry as illustrated by Garrison et al. (2000). Overall, majority of students' feedback data confirms student's acceptance of this new instructional strategy- "H-TBL," with consideration of some challenges for implementation and it is consistent with other studies in both under and postgraduate healthcare education (Camille & Holly 2017, Koles et al. 2010, Mennenga 2013, Perksy 2012, Reimschisel et al. 2017, Swanson et al. 2019). Upon reflection on the student's engagement, performance and feedback data, there is potential for transferability of H-TBL across other cardio-respiratory, musculoskeletal, and neurology modules in our physiotherapy program. These data are rich sources of information that could inform a consistent quality improvement in curriculum development and program evaluation.

4.2. Challenges:

First, there was a widespread resistance among the lectures in teaching teams to acknowledge H-TBL. We perceive this might be though universities are willing to adopt effective teaching-learning methods, often teaching practices in healthcare courses lacks training in practice performance or task design due to resistance from some students or educators or cultural perceptions (Yildirim 2006, Topbas 2013). Some of the perceived barriers by lecturers for active teaching over traditional lectures are such as insufficient time, limited resources, a lack of departmental support, concerns about content coverage, concerns about evaluations of their education, and student's resistance to engage with their peers (Logan et al. 2019).

Second, there is a perceived barrier of student's attitudes and behaviors for classroom engagement. Extending the previous findings, though majority of our students appreciated and embraced the student-centered learning opportunities, while some were challenged by increased accountability, working in teams, being creative, and time management skills (Livingston et al. 2014, Ghorbani et al. 2014).

Third, creating an "environment for engagement" in classroom discussion. From a teaching perspective, it was notable to watch some students' unwillingness to challenge colleagues, lack confidence to voice their ideas or opinions to the class and educator, and increase anxiety during presentation though the application exercise in classroom (phase 3) was not part of the module summative assessment.

Fourth, though students perceived that the availability of pre-class web-based lecture content added value to their learning experience, there was a significant variation in perceptions, usage patterns, and attendance records.

A suggestive reason for second, third and fourth challenges can be attributed to some students poor coping skills to their paradoxical transition to tertiary education setting and been reared in a culture of traditional passive lecture (Atwa et al. 2019).

Fifth, team formation was random due to barriers of logistics support and time management which could have an implicit bias on students' engagement. However, the author believes this had given the team a potential mix for diverse intelligence quotient and learning behaviors, promoting depth of accountability to self and peers in collaborative learning.

4.3. Limitations

This study has several limitations. First, this study design is retrospective and lacks a control group. Second, this study results cannot be generalized as it only reports the effects of TBL for one lecture in the cardio-respiratory module of a 3-year undergraduate physiotherapy program. Third, this study only reports on overall student engagement and does not explore students' cognitive engagement in different TBL phases or differences between elite and low performers. Fourth, the rate of student's class attendance cannot be commented as there was no previous data for the same session. Fifth, there was no validated instrument to capture students' perceptions to culminate qualitative data. Sixth, this study does not explore long term impacts on students learning and academic performance.

5.0. Conclusion:

Despite the challenges and limitations mentioned above, this study confirms that H-TBL can foster self-regulated active learners beyond knowledge and skills acquisition. In addition, this study confirms that the use of H-TBL would enhance students' creativity and equilibrate their subject knowledge. Adopting TBL, with appropriate instructional content, design and incentive strategies, can increase student engagement both inside and outside the classroom. Overwhelming response of student's creative work evidence their heightened commitment of higher-order skills, self-efficacy in the subject content and has the potential to produce millennial self-sufficient cardio-respiratory physiotherapists in the growing healthcare industry. This study is first of its kind to introduce H-TBL in our undergraduate physiotherapy and may serve as a springboard to encourage other educators to deploy future diverse TBL teaching strategies in many courses beyond the school of healthcare sciences. Prospective randomized studies are warranted to confirm the validity and specificity of H-TBL impacts on academic performance, self-efficacy, content mastery, attitudes of students and educators.

6.0. Future directions and recommendations:

Beyond application in one lecture on the cardio-respiratory module, there are several implications for employing H- TBL into learning. First, the importance of widening student's engagement cannot be underestimated. For this, it would be valuable to consider revising the module planning and potentially introducing the learning strategies for every lecture in the student handbook that could relinquish the control and management of student ownership to active learning. Second, to control time commitments, creating a living physiotherapy curriculum with learning contracts could appeal to diverse individual learning styles and academic bents. Third, supporting and developing a culture of openness to H-TBL approach between students and educators would unveil the ambiguity of its efficacy in the light of student benefits. Fourth, a monthly update on subject-specific active pedagogical practices would enhance co-operation and confidence among educators in active teaching-learning design, implementation methods, and benchmarking practices at the local, national and international arena.

Acknowledgement

The author would like to acknowledge the support from both Ms. Rebecca Potton, learning technologist, School of Healthcare Sciences and Mr. Owen Crawford, Learning technology officer, Centre for Education

support and innovation, Cardiff University for assistance on formatting and administrative support for developing the web-based content for COPD Session 1 of H-TBL (Phase 1).

Declaration of interest

The author reports no conflict of interest. The author is solely responsible for the content and writing of the article. No funding received and article produced in author's personal time.

References:

1. Amorim JS, Poltronieri CD, Ribeiro BC, et al. 2019. Team-based learning in Physical therapy undergraduate course: experiment report. *Fisioter. mov.* [online]. 2019, vol.32, e003246. ISSN 1980-5918. <https://doi.org/10.1590/1980-5918.032.ao46>.
2. Anderson LW & Krathwohl D. 2001. A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives. New York: Longman.
3. Atwa S, Gauci-Mansour VJ, Thomson, R et al. 2019. Team-based and case-based learning: a hybrid pedagogy model enhancing students' academic performance and experiences at first-year tertiary level. *Aust. Educ. Res.* 46, 93–112. <https://doi.org/10.1007/s13384-018-0282-y>.
4. Burgess AW, McGregor DM, Mellis CM. 2014. Applying established guidelines to team-based learning programs in medical schools: a systematic review *Acad Med*, 89, p. 678.
5. Camille L & Holly W. 2017. Evaluating Self-Efficacy After a Team-Based Learning Activity, *The Journal of Physician Assistant Education: June- Volume 28 - Issue 2 - p 96-102* doi: 10.1097/JPA.000000000000119.
6. Dolmans D, Michaelsen L, Van Merriënboer J & Van der Vleuten C. 2015. Should we choose between Problem-based Learning and Team-based Learning? No, combine the best of both worlds. *Medical Teacher*, 37, 354-359.
7. Freeman S, Eddy SL, McDonough M, Smith MK, et al. 2014. Active learning increases student performance in science, engineering and mathematics. *Proc Natl Acad Sci USA* 111: 8410–8415.
8. Fatmi M, Hartling L, Hillier T, et al. 2013. The effectiveness of team-based learning on learning outcomes in health professions education: BEME Guide No. 30. *Med Teach*, 35, pp. e1608-e1624.
9. Garrison DR, Anderson T, Archer W. 2000. Critical Inquiry in a Text-Based Environment: Computer Conferencing in Higher Education. *The Internet and Higher Education* 2(2-3): 87–105.

10. Ghorbani N, Karbalay-Doust S, Noorafshan A. 2014. Is a team-based learning approach to anatomy teaching superior to didactic lecturing? Sultan Qaboos Univ Med J;14: e120-5. <https://doi.org/10.12816/0003345>.
11. Haidet P, Kubitz K, McCormack WT. 2014. Analysis of the Team-Based Learning Literature: TBL Comes of Age. J Excell Coll Teach. 25(3-4):303-333.
12. Hrynchak P & Batty H. 2012. The Educational Theory Basis of Team-based Learning. Medical Teacher, 34, 796-801.
13. Johnson C. 2009. Team-Based Learning for Health Professions Education: A Guide to Using Small Groups for Improving Learning. The Journal of Chiropractic Education, 23(1), 47–48.
14. Khogali S. 2013. Team-based learning: a practical guide: Guide Supplement 65.1--viewpoint 1. Med Teach. 35(2):163–5.
15. Koles PG, Stolfi A, Borges NJ, et al. 2010. The impact of team-based learning on medical students' academic performance. Acad Med. 85(11):1739-1745. doi: 10.1097/ACM.0b013e3181f52bed.
16. Lein DH, Lowman JD, Eidson CA, Yuen HK. 2017. Cross-validation of the Student Perceptions of Team-Based Learning Scale in the United States. J Educ Eval Health Prof. 14:15. doi:10.3352/jeehp.2017.14.15.
17. 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>.
18. Logan SMC, Kelly M, Kristina C, Greg K. 2019. Measuring actual learning versus feeling of learning in response to being actively engaged in the classroom. <https://doi.org/10.1073/pnas.1821936116>.
19. Mennenga HA. 2013. Student engagement and examination performance in a team-based learning course. J Nurs Educ. 52(8):475-479. doi:10.3928/01484834-20130718-04.
20. Michaelsen LK, Sweet M. 2008. Fundamental principles and practices of team-based learning. <https://www.med.illinois.edu/facultydev/tbl/readings/MichaelsenSweetEssentialsTBL2008.pdf>.
21. Nieder GL, Parmelee DX, et al. 2005. "Team-based learning in a medical grossanatomy and embryology course." Clinical anatomy (New York, N.Y.)18(1): 56-63.
22. Parmelee, DX & Hudes P. 2012. "Team-based learning: a relevant strategy in health professionals' education." Medical Teacher34(5): 411-413.

23. Persky AM 2012. The impact of team-based learning on a foundational pharmacokinetics course. *Am J Pharm Educ.*76:31. <https://doi.org/10.5688/ajpe76231>.
24. Reimschisel T, Herring AL, Huang J, et al. 2017. A systematic review of the published literature on team-based learning in health professions education *Med Teach*, 39, pp. 1227-1237.
25. Saul Mclead. 2017. Kolb's Learning Styles and Experiential Learning Cycle. <https://www.simplypsychology.org/learning-kolb.html>.
26. Swanson E, McCulley LV, Osman D J, et al. 2019. The effect of team-based learning on content knowledge: A meta-analysis. *Active Learning in Higher Education*, 20(1), 39–50. <https://doi.org/10.1177/1469787417731201>.
27. Sisk RJ. 2011. Team-based learning: systematic research review. *J Nurs Educ.*50:665–669. <https://doi.org/10.3928/01484834-20111017-01>.
28. Topbas E. 2013. A Comparison of Teacher Training Programs in Turkey and Finland. *International Journal of Academic Research Part B*, 5, 111–120.
29. Yildirim I. 2006. Daily Hassles and Social Support as Predictors of Academic Achievement. *Hacettepe University Journal of Education*, 30, 25.
30. Wenger E. 2010. Communities of Practice and social learning systems: The career of a concept. In: Blackmore, C (ed.) *Social Learning Systems and Communities of Practice*. London: Springer Verlag and the Open University, 179–198.

Supplementary materials- Appendix 1 - Figures

Figure 1

Figure 2

Figure 3

CARDIFF UNIVERSITY **HC2126 Problem Definition COPD**
Coursework Structure

Section 1: This section will be launched on 25th Nov 2019.

This section comprises of: Introduction to COPD, diagnosis & management, co-morbidities and Palliative care. This section ends with a virtual case study challenge and an Editorial review to enhance your understanding of COPD.

How much time I require to complete Section 1?

This Section1 comprises 4 short videos each 5-7 mins, Case study challenge and some MCQ's. You should be able to complete this section in between 40- 60 mins depending on your pace of learning.

It is important to complete SECTION 1 before your lecture session on 29th Nov in order to be able to complete SECTION 2 in your lecture session.

CARDIFF UNIVERSITY **HC2126 Problem Definition COPD**
Coursework Structure

Section 2: Critical reflection: This section will be launched on 29th Nov 2019 in your lecture session.

You are provided with one Journal article related to COPD in Learning Central. You are required to read and produce a creative piece for a given question. Your creative piece could be a "Blog" not exceeding 50 words in a Word document, or a "PowerPoint Presentation" not exceeding 5 power point slides or an "infographics". You should submit your creative work no later than **9th December 2019** using the Turnitin link provided.

What to expect on 29th Nov in your lecture session - between 9.00am -10.00am, LT2.

You will experience a team based learning that includes but not limited to discussion, debate and presentation on multidisciplinary themes. Be prepared to contribute and display your creative side towards this lecture. To facilitate an effective use of our time, I would request everyone a prompt presence 5 -10 mins earlier for your 9.00 am session on 29th Nov.

Figure 4

Figure 5

Intended learning Outcomes

- **Assess and Integrate** the learning obtained from your COPD pre course work(online learning), apply these lessons to critical reflection of COPD exacerbations & management (Readiness test)
- Understand the importance of **ground rules** prior to the session to facilitate confidentiality and nurture critical self-reflection.
- Explore the **cognitive reasoning skills** used by themselves and other learners behind COPD management to enhance learning experience for all.
- Emphasize enhanced **Verbal & Non verbal communication skills** between and within multidisciplinary team.

29/11/2019
SDP
2

Figure 6

Figure 7

Figure 8

Figure 9

Rubric for Students reflection

	Above Expectations	Meets Expectations	Near Expectations	Below Expectations
	4	3	2	1
Reflective Thinking	The reflection explains the student's own thinking and learning processes, as well as directions for future learning.	The reflection explains the student's thinking about his/her own learning processes.	The reflection attempts to demonstrate thinking about learning but is vague and/or unclear about the personal learning process.	The reflection does not address the student's thinking and/or learning.
Analysis	The reflection demonstrates an in-depth analysis of the learning experience, the value of the derived learning to self or others, appreciation of the subject related to discipline.	The reflection demonstrates an analysis of the learning experience, the value of the derived learning to self or others.	The reflections attempt a shallow analysis and value of the learning to the student or others is vague and/or unclear.	The reflection does not move beyond a description of the learning experience.
Making Connections	The reflection articulates multiple connections between this learning experience and content from other courses, past learning, life experiences and/or future goals.	The reflection articulates connections between this learning experience and content from other courses, past learning experiences, and/or future goals.	The reflection attempts to articulate connections between this learning experience and content from other courses, past learning experiences, or personal goals, but the connection is vague and/or unclear.	The reflection does not articulate any connection to other learning or experiences.

<https://www.scribd.com/document/333036195/portfolio-rubric-for-reflection-print-copy>

Figure 10

Figure 11

Supplementary Materials

Appendix 2- Table1

Team Readiness awareness test (tRAT)

No	Questions	Total response	Right response	Percentage
1	What is COPD?	37 teams	19/37	51%
2	What is main cause of COPD?	37 teams	37/37	100%
3	COPD comprises of?	37 teams	34/37	91%
4	What are cardinal symptoms of COPD	37 teams	35/37	95%
5	Why is exercise tolerance limited in COPD?	37 teams	20/37	54%
6	What does COPD management comprise of?	37 teams	36/37	97%
7	Which additional investigation gives more information on oxygen needs in COPD patients? 4 choices	37 teams	25/37	68%
8	COPD patients who experience frequent exacerbations are more likely to also experience	37 teams	32/37	86%
9	Exacerbation frequency is the best measure for predicting exacerbation risk – True or false?	37 teams	18/37	47%
10	What is the key patient related outcome measures?	37 teams	30/37	81%