PROBLEM BASED LEARNING: THE NEED FOR HEALTHCARE MANAGEMENT EDUCATION

HWANGJI S. LU

Department of Health Care Administration and Informatics, Ashford University, San Diego, CA, USA
Email: hwangji.lu@Ashford.edu

Abstract - To meet the paradigm shift of healthcare management practice, there is a need to adopt a new curriculum that is learner-centered, promotes self-directed learning,and enhances activelearning strategies. The problem-based learning approach is characterized as a student-centered approach in which small groups are guided by a facilitator to solve a professionally relevant issue or problem. It assists learners in acquiring, managing, and integrating knowledge, as well as solving problems independently. It also helps learners connect the new content with their prior knowledge and are engaged in the cooperative learning activities efficiently. The important roles of a facilitator are to empower learners to acquire new knowledge, cultivate problem-solving, critical thinking, and self-directed learning skills, as well as improve group interdependence. There are factors for example student characteristics, quality of problem design, formative feedback, and technology-enhanced learning environment affecting students' learning approaches and outcomes. Several empirical research studies are examined and presented to highlight the contributions of the problem-based learningfrom various aspects. Despite the mixed results shown in the past research, the emerging need for transforming healthcare management education isindisputable.

Index Terms - Problem-based learning,critical thinking, healthcare management, self-directed learning.

I. INTRODUCTION

In today's environment, healthcare organizations encounter intense challenges from an aging population, a shortage of key healthcare professionals, a change in national public policy, a need of providing evidence-based quality care with lower costs, and a rapid development in medical technology that advances treatment modalities and care delivery models [1]. This complex environment requires healthcare leaders to be able to effectively analyze problems and make the best decisions for each situation while facing economic, legal, political, social, and technological constraints. Healthcare leaders are responsible for evaluating, planning, and organizing the needed resources to maximize operational efficiency and effectiveness, attract patients and physicians, and other healthcare professionals, as well as build a trusted reputation in the community [1], [2]. Faced with a constantly changing healthcare world, healthcare leaders of the 21st century must have effective critical thinking and problem-solving skills to improve the health care delivery system, achieve positive patient outcomes, and accomplish organizational goals [2].

The Commission on Accreditation of Healthcare Management Education (CAHME) has accredited graduate healthcare management programs in the United States and Canada for 50 years. Graduates from CAHME-accredited programs usually assume leadership positions in a variety of healthcare related organizations [2]. In response to the evolution of healthcare, CAHME has modified and developed its accreditation criteria to ensure that by the time of graduation, learners will be proficient in the key competencies required to lead in the ever-changing healthcare environment of the 21st century [3].Equally, there is a need for higher education institutions that offer the graduate programs in healthcare management to align with CAHME's mission and vision, so that the programs will meet the ongoing needs of employers, practitioners, and other healthcare stakeholders. It is imperative for the institutions to revisit their curricula and incorporate an effective instructional design that can hone students' critical thinking and problem-solving skills. Thus, this paper is organized as follows. First, the introduction highlights the importance of problem-based learning in healthcare management education. Second, this paper will reviewavailable literature pertaining to the notion of problem-based learning. Third, this paper will describeproblem-based learningfrom the perspectives of cognitive psychologists and social constructivists. Fourth, factors impacting the effectiveness ofproblem-based learning will be discussed. Fifth, a survey of past research studies concerning the topic of problem-based learning will be presented. The sixth and final section will includethe author's final thoughts about the significance of problem-based learningin healthcare management education.

II. WHAT IS PROBLEM-BASED LEARNING?

Problem-based learning (PBL) is a student-centered, pedagogical approach that uses problems as a basis for students to obtain knowledge and improve their problem-solving skills via collaborative learning in small groups [4], [5], [6] under the guidance of a facilitator [7]. Students practice the real-world situations, so that they will readily take on their roles and responsibilities in the workplace when they enter their professions [7].

In 1968, problem-based learning was first incorporated into the pre-clinical phase of the medical curriculum at

McMaster University of Canada [6]--[8]. PBL enables a smoother transition of medical students into clinical residency at hospitals and future professional practices. Since its inception, PBL has also been implemented in diverse disciplines such as business administration, engineering, law, leadership, management, nursing, social work, and teacher education [6].

The problem used in PBL, as suggested by Tang, Van der Molen, and Schmidt [8], should be complex and exemplary for a field of study or a professional context to ensure that the students' learning activities and the acquired knowledge and skills are relevant to their imminent profession. Students are engaged when the problems present realistic phenomena. Huang, Mehl, andHolen [9] argued that PBL problems should mirror real-life scenario, activate appropriate prior knowledge, direct students to the intended learning objectives, promote collaboration among group members, and stimulate self-direct and life-long learning.The problem should be structured to include the information, the compass, and a clear destination for the students, which exploits the lower-level thinking skills of knowledge, comprehension, and application [8], [10]. Upon a problem scenario being presented, the PBL generally entails three stages: initial discussion stage, self-study stage, and reporting stage.

A. Initial Discussion Stage

The inquiry of a problem is in the first stage of the PBL [8], [11]. In the initial discussion stage, students analyze the problem by identifying the relevant facts from the scenario. This fact-identification step helps them cognize the problem. As students understand the problem better, they will generate hypotheses about possible solutions and research solutions to the problem [12]. In this stage, apart fromactivating their prior knowledge while discussing the problem with their group members collaboratively, studentsuse their prior knowledge and common sense to propose possible explanations or solutions [6], [7]. When the students' prior knowledge is initiated, they start building a theory about a problem and realize a variety of aspects in relation to their professional career [8]. Since their prior knowledge of the problem is limited, they uncover the deficiency of their knowledge that is needed to fully fathom the problem and satisfactorily explain or solve it. Accordingly, students formulate questions, also called as learning issues, which guide further self-study activities [6], [7].

B. Self-Study Stage

In the second stage where self-study is conducted individually, students spend time searching and studying literature related to the learning issues generated from the initial discussion stage [6]. They integrate information from multiple learning resources with the goal of finding answers or solutions to the learning issues. Students evaluate their hypotheses based upon what they have learned, develop their explanations,anddetermine the best course of action to address the phenomenon [8].

C. Reporting Stage

Afterward, students meet together to share their findings with each other. Finally, they reach the integrated answers to the learning issues and present their solutions to the class, which is referred to a reporting stage. This stage usually happens two or three days after the initial discussion of the problem [6]. Upon the completion of each problem, students reflect on the knowledge gained. Collaborative learning typically occurs in the initial discussion stage and the reporting stage.

In the PBL, students are motivated to trigger their intuition, logic, and cognition [7]. Consequently, students acquire, evaluate, and apply knowledge in a mixture of problem situations, expanding their insights into a broader problem context. Self-directed learning prepares students to engage in learning activities defined by themselves, which eventually, develops students to become lifelong learners. Overall, students develop effective lifelong learning skills and problem-solving skills, including the ability to utilize metacognitive and reasoning strategies [11], [12]. They also learn how to effectively collaborate and work as part of a team. Thus, the learning stemming from solving the problem is often more meaningful than the solution itself [8], [10].

D. The Role of facilitator in PBL

The PBL usually is guided by a facilitator whose roles are to simulate discussion and monitor progress, ensuring that appropriate information is discussed, and each student contributes to the team's work [4], [8], [11], [13]. The facilitator steers the progress of higher order critical thinking skills by providing guidance andinspiring students to justify their thinking [4]. PBLoften involves anassortment of complex problem-solving activities and extensive hands-on practices. Such complexity can overwhelm learners, which makes them unable to engage in deeper learning experiences and achieve desired learning outcomes [13].Since students possess various levels of knowledge, experience, learning styles, and learning abilities, the provision of scaffolding or support from the facilitator has been widely recognized as a vital part of learning in PBL [4]. The scaffold should provide just enough information so that the student may make further progress on his or her own.

Being learner-centered, the facilitator focuses on developing students as self-directed, independent learners [11] andchannels the collaborative learning process [8]. Subsequently, students are better capable of constructing new knowledge. Furthermore, a dedicated facilitator can reinforce student reflection [12] thatwillalso increase the probability of transfer [4]. In the course of reflection, students make the inferences, identify chasms intheir thinking, and transfer their acquired strategies, skills, and knowledge

to the new situation [4], [12]. By and large, the facilitatorshould be a subject matter expert, possess empathic attitude towards students' learning,and have the ability to communicate his/her knowledge in the way that students can comprehend [11], [13]. Because of his/her subject knowledge expertise, the facilitator is adept at posing questions at critical moments, which generatespositive student learning [7], [13].Subject-matter expertise is crucial when student's prior knowledge of a subject is insufficient and when a curriculum is poorly designed and structured [11].

It is also believed that the facilitator should have the skill in group facilitation and beproficientin probing and encouraging critical reflection as well as suggesting and challenging students in the helpful way [14], [15]. In both Maudsley's [14] and Haith-Cooper's [15] studies, a main identified issue in facilitation was a lack of understanding when and how to intervene in student learning. The traditionally trained facilitators had difficulties allowing the students to take charge of their own learning and function as self-directed learners. When facilitators saw a need to intervene, they were likely to slip back into the traditional teaching role, provide unsolicited information, and direct student's learning [14], [15]. Hence, facilitators should strive to be experts in both subject matter and facilitation [13]—being able to help students develop an understanding of knowledge and judge when, why, and how to intervene in student's learning [11]. However, the ability to facilitate PBL is not innate to many instructors who have taught in the traditional classroom setting. As a consistent theme in the literature, proper professional development is warranted to bring about the most significant impact of the facilitator on student's academic achievement, student's collaborative role in groups, and their satisfaction with PBL [11].

To sum up, an effective facilitator is thought to be a facilitator of learning. The effective facilitator not only is knowledgeable about the subjects of discussions, but alsounderstands when to intervene and help students without taking over their thinking and learning [11], [14], [15]. The effective facilitator permits students to take time to explore the problem, acquire knowledge, and develop needed skills.The effective facilitator is reflective of his/her own practice and enables students to reflect on what they have learned as well. As Williams and Patridge asserted, those facilitators who demonstrate all of these qualities will generate a meaningful impact on students' individual and group performances in the PBL learning process and outcomes [11].

III. PBL VIEWED FROM COGNITIVE PSYCHOLOGISTS AND SOCIAL CONSTRUCTIVISTS

Problem-Based Learning (PBL) underpins the cognitive psychologist and social constructivist assumptions of education [7].From the perspective of cognitive psychologists, when learners connect new information to their existing knowledge, the information gets consolidated into the long-term memory and can be retrieved later [16]. Learners construct new knowledge better when it is built upon what they already know [7], [16]. The PBL process can also potentially foster a high level of cognitive engagement [7], as learners grapple with understanding or resolving the problem [6]. Cognitive engagement, a deep-level learning strategy, is described as the quality of the individual's thinking with respect to cognitive strategies, such as elaboration, metacognitive strategy, and self-regulated learning used to place learning in the meaningful context of a problem [6].

Elaboration enhances both deep learning and knowledge retention [5] through utilizing current knowledge to generate new ideas [13], which also makes new information better structured and organized inthe long-term memory [6]. The development of metacognitive awareness is thought to be the key to successful learning [17]. Metacognition is composed of two components: metacognitive knowledge and metacognitive regulation. Metacognitive knowledge, explained as knowing about knowing, is defined as an awareness of one's strengths and weaknesses, in addition to knowing about when, how, and why to use particular strategies for learning or problem-solving [17]. Metacognitive regulation refers to the processes that coordinate cognition and solve problems, including planning, monitoring, comprehension, and evaluation [17]. Learning activities that integrate reflection and/or thinking about what to do and why will improve metacognitive awareness and regulation.Deep learning isa high level of engagement in learning, which takes place when a learner is intrinsically motivated and attempts to understand the content what he/she studies with the processes of structuring ideas, realizing underlying principles, evaluating relevant evidence, and critically appraising knowledge [5].

From a constructivist's perspective, learning takes place in a rich environment that motivates students to take on self-directed and collaborative learning by actively engaging in the creation of knowledge [7], [8], [11]. Self-directed learning comes into play in PBL when students take the responsibility for their own learning in the self-study stage [5]. Students are learning how to become self-directed learners who determine their learning goals, identify and deal with obstacles, and undertake necessary research [11]. Self-direct learning is the mechanism through which PBL is assumed to enhance deep learning [18]. In PBL, students analyze, compare, contrast, and explain information. Students are actively involved in their learning process to develop and explain hypotheses for the problem and search for evidence for these explanations and hypotheses, using various literature and other learning resources [5].Additionally, the ability of self-directed learning is paramount because

online courses have become an indispensable part of higher education. Unlike students in the traditional classroom setting, learners in the online environment usually take an active role in identifying their learning needs, formulating learning goals, implementing proper learning strategies, and evaluating their learning process and outcomes. As one of the fundamental characteristics of PBL [9], self-directed learning helps students build confidence, promote the realization of prior knowledge, and self-regulate their own study [7], which is also a successful factor in online learning.

Moreover, collaborative knowledge building is an essential characteristic of PBL, and it is not just about the active sharing of thoughts and ideas through discussions and exchanges among learners [12]. Rather, it is a connective process of making meaningful links along with relating and creating the new knowledge through active sharing and contextualization [4]. This connective process ties students to the context, to their peers' new and multiple perspectives, and to metacognitive awareness [12].

IV. OTHER FACTORS IMPACTING THE EFFECTIVENESS OF PBL

Factors such asstudent characteristics, quality of problem design, formative feedback, and technology-enhanced learning environment could influence how students approach their learning in PBL. These factors could also result in very different outcomes regarding students' individual learning processes as well as group processing.

A. Student Characteristics

Each learner is unique, with a different personality. A person's personality is associated with his/her behavior in a group setting [19]. The relationship between personality and learning is dependent on the task and context. Individual problem-solving execution is considered to be influenced by social contexts, for instance, competitiveness and social status [19], [21]. Individuals who have low competitive dominance often exhibit better performance in solving novel searching tasks [21]. Individual differences in social learningalso affect the ability of problem solving in a group[19]. Moreover, individual innovativeness and personality traits are found to be correlated with the use of social information positively [19], [21]. Faster explorers use more personal information and display more routine-like and autonomous behavior. In contrast, slower or shyer individuals reply on more social information and are more reactive and attentive to social cues [21].

B. Quality of Problem Design

The use of meaningful and realistic problems plays an important role in developing complex problem-solving skills [22]. Crafting a problem scenario is of great importance because, from the pedagogical perspective, problem design influences participants' learning process [12]. For the purpose of encouraging flexible thinking, problems need to be complex, ill-structured, and open-ended; problems ought to be realistic and resonate with the students' experiences in order to support intrinsic motivation [4]. A good problem should arouse students' desire to know and learn, helping students become engaged in the learning process based on their prior knowledge and understanding.

The quality of problem design has a considerably cognitive or psychological impact on student learning in the PBL environment—In either positive or negative way [9]. Cognitively, the design of the problem could have an influenceon students' acquisition of intended content knowledge, students' establishment of situational knowledge, and students' construction of the conceptual framework about the problemdomain[9]. In addition, the design of reflecting, reasoning, and researching could calibrate the learners' cognitive abilities during the problem-solving process. Along the line, the design of PBL problem affects the learning process and outcomes as well. If the PBL problem has ill-designed authenticity elements, it will lead to psychological separation of the students and demotivate students to be involved in the PBL process [9]. Overall, PBL problems would be designed to infuse an effective cognitive or psychological component that helps students establish their sense of ownership of the problem, so that they will actively engage in the problem-solving process and stimulate their commitment to solving the problem [9]. The quality of the problem posed in PBL is vital in promoting collaborative efforts and developing various skills in critical thinking, problem-solving, and self-directed learning [12].

C. Formative Assessment and Feedback

Being designed to help students succeed, feedback for formative assessments is provided to the students during a learning activity [22]. Feedback helps students grasp the subject studied and presents evident guidance on how to improve their learning [23]. Consequently, substantive feedback facilitates learning and improves student's performance.Feedback should be incorporated into the problem-solving process, which, in turn, enables students to evaluate the effectiveness of their knowledge, reasoning, and learning strategies [4].Feedback may be intended as constructive and encouraging, but the student could perceive it as discouraging or disheartening. If the meaningful, supportive, and potentially corrective feedback is not provided early in the problem-solving process, then the student may build up misconceptions that are difficult to overcome later as he/she develops a conceptualization of the problem [22].Additionally,the amount and timing of feedback should be appropriate for anindividualstudent [23].Timely and informative feedback promotes learning and is centralto learning activity to be effective [22], [23]. The feedback that

encourages continued engagement tends to be more effective in support of learning. Learners will gain more understanding and competence. In contrast, delayed feedback may not serve well to support continued engagement in a learning activity [22].Nonetheless, the challenge is that how and when feedback should be provided.

D. Technology-Enhanced Learning Environment

With the advance in communication technology, educational institutions have adopted the web-based learning management system to broaden the access to education. The virtual environment has been increasingly explored to support problem-based learning because of its accessible computer-based learningand support[24]. Solving a real-world issue encompasses sophisticated processes, including realizing the problem, searching for problem information about multiple aspects, relating abstract knowledge to problem information, and employing needed methods and strategies to solve the problem [25]. Such complex learning processes could engender a heavy cognitive load to the learners [24], [25], which is often underestimated by the instructional designers and/or the instructors who are the subject matter experts [25]. Without sufficient supports to embark the complex problem-solving process, many students do not get involved in authentic task experience and attain desired learning outcomes because they tend to engage in surface learning, and there is no deep learning towards an in-depth perception of the problem[24], [25].To those students who have limited problem-solving skills and little real-world experience, they need proper support and guidance to develop expert-like performance [24].

Undeniably, effective learning through problem-solving experience is not easy to fullfill in both the traditional classroom and virtual settings [25]. Indeed, a technology-enhanced learning environment can sustain PBL learning with agreat flexibility in the establishment of learning activities, feedback, and support to learners without time and space constraints [24], [25].It has been noted that the learners often are overwhelmed by the complex problem-solving tasks, and the utilization of scaffolding is critical to such alearning practice. The technology-enhanced, computer-based scaffolds can be used to guide individuals and/or small groups throughout their inquiry processes [22]. The technology also can enable the complex process accessible, trackable, and attainable [24].Furthermore, the reusability of learning resources in such learning generates the potential of saving in costs and many resources [25].

It is a suggested best practice to follow a pathway of graduated complexity to design the problem scenario and support the learners to acquire neededcompetences in a challenging problem domain [24]. The technology can sustain such a process by realizing where a learner is within a learning progression track and instituting increasingly challengingtasks to complete [22]. As the learner develops a conceptualization of the problem, theemerging technology has the capabilityofoffering dynamic, meaningful, and real-time feedback to improve his/her problem-solving and critical thinking skillssincethe technology is able to track and report the expansion of such skills [22].

Computer-based visual representations, for example causal maps, concept maps, and system models, have been increasingly utilized to expand human cognition, showing the benefits in fostering high-order thinking and meaningful learning as well as sustaining improvements in knowledge and task performance [25]. Such visual representations also assist learners in integratingdistinct pieces of knowledge into a coherent one for meaningful comprehension and effective application because theycansee a big picture of knowledge on a visual map[25]. The ability of emerging technology to collect data and present visualizations to help learners make progress has become more prominent in support of problem-based learning.

PAST RESEARCH STUDIES

The effectiveness of PBL has been an issue for debate. In the past few decades, numerous studies have been carried out to investigate the usefulness of PBL.Nevertheless, the findings from past research studies on this subject appear to be mixed.

To examine the effects of PBL on problem-solving ability and learning outcomes, Kim, Song, Lindquist, and Kang [26] utilized a randomized controlled trial to include 63 third-year undergraduate nursing students at a Korean university. The findings from this study revealed that compared to the students in the control group, students in the PBL group had significantly higher scores in problem-solving ability, knowledge of pulmonary nursing care, and clinical performance.PBL yields favorable outcomes on longer-term knowledge acquisition and retention. This can be attributed to a deeper processing of new information, through elaboration and group discussions,whichenables new information to be better organized in the long-term memory [26]. Kim and colleagues concluded that team-based problem-solving learning is an effective learning strategy to boost problem-solving ability, build subjectknowledge, and improve clinical performance [26].

A study by Loyens, Jones, Mikkers, and van Gog [6]investigated whether PBL can foster conceptual change, which requires students to thoughtfully and critically weigh the contrasting information between the scientific explanation and their prior misconception. Students were randomly assigned into three groups: PBL, lecture-based, and self-study.The conceptual change was measured right after instruction given and one week after instruction given. Results exhibited that the PBL-group outperformed both the lecture-led group and the self-study group [6].Loyens and colleagues [6] concluded that PBL could increase

the probability of conceptual change.

In Takahashi andSaito's study [18], theyinvestigated what and how students learned cognitively, socially, and internally in the PBL model at a Japanese women's college over a period of 5 years. This study concluded that beyondknowledge building and skill acquisition, PBL has also contributed to broadening their perspectives and promoting their personal development [18]. Therefore, Takahashi andSaito suggested that PBL generates rich and varied emotions in learners when they deal with problems; PBL also enables learners to acquire related knowledge and skills through dialogue and ultimately drives them to attain personal transformation [18].

Dolmans, Loyens, Marcq, and Gijbels [5] conducted a systematic review of 21 studies to ascertain the effects of PBL on deep and surface learning.According to the findings, PBL augmented deep learning in 11 of the 21 studies; six studies showed no effect on deep learning;four studies showed a reduction in deep learning.In general, PBL has demonstrated its benefits in helping students develop their collaborative, critical, and reflective skills.PBL has also improved the quality of learning when elaboration, retrieval, and retention of knowledge occurs and is enhanced.As Dolmans and colleagues [5] concluded, by means of boosting active learning and the learners' intrinsic motivation, PBL enhances a deep approach to learning while PBL has no effect on a surface learning and short-term knowledge acquisition. They also alluded thata high perceived workload will be more likely to cause surface approaches tostudy and might be detrimental to deep learning [5].

CONCLUSION

Learning through executing real-world tasks is not new to health science and management studies. It becomes more important than ever before in today's rapidly changing world, where learners in healthcare management are required to deal with more sophisticated real-world problems compounded with legal, ethical, economic, financial, social, and technologicalconstraints. There is a concern about the traditional lecture approach ineffectively taught.The problem-based learning approach can enable students to improve recall and application of information in the context of healthcare management practice, sharpen critical thinking and reasoning, advanceself-directed learning skills, and foster motivation for learning. Furthermore, witheffective design and implementation of the technology-based learning environment, problem-based learning can be better realized with appropriate analysis and reporting of learning in such anenvironment.

REFERENCES

[1] A. T. Belasen, B. Eisenberg, and J. W. Huppertz, Mastering Leadership: A Vital Resource for Healthcare Organization, Sudbury, MA: Jones and Bartlett Publishers, 2015.

[2] M. F. Schulte, F. E. Coyne, D. J. West, and A. N. Garman, "Accreditation of fully online graduate programs in healthcare management: Ensuring quality education," The Journal of Health Administration Education, vol. 32, no. 4, pp. 621-632, 2015.

[3] Commission on Accreditation of Healthcare Management Education (CAHME). (2017). Why CAHME is important to university programs. Available https://cahme.org/healthcare-management-education-accreditation/university-programs/

[4] C. E. Hmelo-Silver, "Problem-Based learning: What and how do students learn?," Educational Psychology Review, vol. 16, no. 3, pp. 235-266. September 2004.

[5] D. H. Dolmans, S. M. Loyens, H. Marcq, and D. Gijbels, "Deep and surface learning in problem-based learning: A review of the literature," Advances in Health Sciences Education, vol. 21, no. 5, pp. 087–1112. December 2016. doi: 10.1007/s10459-015-9645-6

[6] S. M. Loyens, S. H. Jones, J. Mikkers, and T. van Gog, "Problem-based learning as a facilitator of conceptual change," Learning and Instruction, vol. 38, pp. 34-42. 2015.

[7] E. Bates, J. Hommes, R. Duvivier, and D. C. Taylor, "Problem-based learning (PBL): Getting the most out of your students – Their roles and responsibilities: AMEE Guide No. 84," Medical Teacher, vol. 36, no. 1, pp. 1–12. Jan 2014. doi: 10.3109/0142159X.2014.848269

[8] C. P. Tan, H.T. Van der Molen, and H. G. Schmidt, "To what extent does problem-based learning contribute to students' professional identity development?," Teaching and Teacher Education, vol. 54, pp. 54-64. 2016.

[9] W. Hung,K. Mehl, andJ. B. Holen, "The relationships between problem design and learning process in problem-based learning environments: Two cases," Asia-Pacific Education Research, vol. 22, no. 4, pp. 635–645. 2013. doi: 10.1007/s40299-013-0066-0

[10] N. Hirca, "Impact of problem-based learning to students and teachers," Asia- Pacific Forum on Science Learning and Teaching, vol. 12, no. 1, pp. 1-19. June 2011.

[11] J. C. Williams, and D. J. Paltridge,"What we think we know about the tutor in problem-based learning," Health Professions Education, vol. 3, pp. 26–31. 2017.

[12] B. Chua, O. Tan, and W. Liu, "Development and validation of the problem-based Learning process inventory (PBLPI)," New Waves Educational Research & Development, vol. 19, no. 1, pp. 20-40. May 2016.

[13] H. G. Schmidt, J. I. Rotgans, and E. H. Yew, "The process of problem-based learning: what works and why," Medical Education, vol. 45, pp. 792–806. 2011. doi:10.1111/j.1365-2923.2011.04035.x

[14] G. Maudsley, "making sense of trying not to teach: An interview study of tutors' ideas of problem-based learning," Acad Med, vol. 77, no. 2. pp. 162-172. 2002.

[15] M. Haith-Cooper, "An exploration of tutors' experiences of facilitating problem-based learning. Part 2-implications for the facilitation of problem-based learning, Nurse Education Today, vol. 23, pp. 65-75. 2003.

[16] E. H. Yew, and K. Goh, "Problem-Based learning: An overview of its process and Impact on Learning," Health Professions Education, vol. 2, pp. 75-79. 2016.

[17] A. Raes, T. Schellens, B. De Wever, and E. Vanderhoven, "Scaffolding information problem solving in web-based collaborative inquiry learning," Computers & Education, vol. 59, pp. 82–94. 2012.

[18] S. Takahashi, andE. Saito, "Unraveling the process and meaning of problem-based learning experiences," High Education, vol. 66, pp. 693–706. 2013. Doi: 10.1007/s10734-013-9629-5

[19] L. Zandberg, J. L. Quinn, M. Naguib, and K. van Oers,"Personality-dependent differences in problem-solving performance in a social context reflect foraging strategies," Behavioural Processes, vol. 134, pp. 95-102. 2017.

[20] E. F. Cole, and J. L. Quinn, "Personality and problem-solving performance explain competitive ability in the wild," Proceedings of the Royal Society B: Biological Sciences, vol. 279, pp. 1168–1175. 2011.

[21] A. J. Carter, H. H. Marshall, R. Heinsohn, and G. Cowlishaw, "Personality predicts the propensity for social learning in a wild primate," PeerJ, vol. 2, e283. 2014.https://doi.org/10.7717/peerj.283

[22] K. K. Bhagat, and J. M. Spector, "Formative assessment in complex problem-solving domains: The emerging role of assessment technologies," Educational Technology & Society, vol. 20, no.4, pp. 312–317. 2017.

[23] H. Lu, "How can effective online interactions be cultivated?," Journal of Modern Education Review, vol. 7, no. 8, pp. 557-567. August 2017. Doi: 10.15341/jmer(2155-7993)/08.07.2017/003

[24] B. Yuan, M. Wang, A. W. Kushniruk, and J. Peng, "Deep learning toward expertise development in a visualization-based learning environment," Educational Technology & Society, vol. 20, no. 4, pp. 233–246. 2017.

[25] J. Peng, M. Wang, and D. Sampson, "Visualizing the complex process for deep learning with an authentic programming project. Educational Technology & Society, vol. 20, no.4, pp. 275–287. 2017.

[26] H. Kim, Y. Song, R. Lindquist, and H. Kang, "Effects of team-based learning on problem-solving, knowledge and clinical performance of Korean nursing students," Nurse Education Today, vol. 38, 115-118. 2016.

★★★