

Students' Performance in Problem Based Learning and Their Attitude toward using Concept Mapping

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Abstract: Background: Problem Based Learning (PBL) is an innovative educational approach that adopted in several nursing schools around the world. It prepares nurses to solve problems and make effective clinical decisions in a systematic manner. Concept mapping is one of the contemporary educational strategies that enhance the PBL when incorporated into it. Aim of the study: To assess the relationship between students' performance in PBL and their attitude toward using concept mapping at the Faculty of Nursing. Research design: A correlational descriptive design was used in this study. Setting: The study was conducted at the Faculty of Nursing in Suez Canal University. Subjects: Ninety-two first-year students were included in the study. Tools of data collection: Data were collected using two tools; students' performance in PBL tutorial sessions and students' attitude of using concept mapping in PBL. Results: The total score of students' performance in PBL sessions was high, and their total score in attitude toward using concept mapping in PBL sessions was moderate. Conclusion: Nursing students have a good level of performance in PBL sessions and a moderately favorable attitude toward using concept mapping in PBL sessions. Totally, there is a significant moderate positive correlation between the students' performance in PBL sessions and their attitude toward using concept mapping. Recommendations: Providing nursing students with a training program on using concept mapping in PBL sessions could contribute to more improvement in PBL students' performance.

Keywords: Concept Mapping, Brainstorming, Debriefing, Students' Performance, Problem Based Learning.

I. INTRODUCTION

Problem Based Learning (PBL) is an innovative educational approach that adopted in several nursing schools around the world. It improves nursing students' abilities in acquiring basic clinical knowledge and progress in personal learning skills. Hence, it improves dynamism and motivation to learn (Azer, 2011; Mansoori, Abedini-baltork, Lashkari, & Bagheri, 2017; Noordegraaf-Eelens, Kloeg, & Noordzij, 2019). It prepares nurses to solve problems and make decisions in a systematic manner, which ultimately benefits patients and ensures high-quality holistic care (Cartwright, Bruce, & McInerney, 2017). So, other approaches to maximize the benefits of PBL are encouraged. Concept mapping is one of the contemporary educational strategies that enhance the PBL when incorporated into it as concept mapping improves knowledge construction, retention, and application (Bastable, 2021; Bridges, Corbet, & Chan, 2015; Tseng et al., 2011).

PBL is an educational approach in which complex problems act as a framework challenging the students to learn and work in groups to take care of one or more confusing issues related to real-life clinical situations. Students in PBL

develop skills in the gathering, blending, and assessment of resources to characterize issues first and afterward working on the problems to reach an arrangement of the issue or conclusion of it in addition to a clear understanding of the concepts (Ajmal, Jumani, & Malik, 2016).

The PBL process is implemented through several steps across its sessions (brainstorming and debriefing) in addition to the self-study period between them. In the brainstorming session, the teacher acts as a facilitator who introduces a problem scenario to learners without providing them with any previous teaching input or study. Students work in small groups composed of five to ten students to solve the problem by suggesting several possible hypotheses and in doing so they realize that their knowledge base is insufficient to solve the problem or explain how it can be solved. This leads them to identify areas for further learning and collect materials to build the necessary knowledge and evidence base during the self-study period to solve the problem. Lastly in the debriefing session, students work through the problem in a systematic way to meet the learning outcomes associated with the problem (Ousey, 2007).

Students in PBL acquire and develop several skills such as group interaction, active participation, independent study, and reasoning (Valle et al., 1999). Group interaction enhances the critical thinking process of students and encourages them to explore deep learning (Mergendoller, Maxwell, & Bellisimo, 2006). Also, PBL encourages the active participation skills of all students rather than being passive consumers of knowledge (Moallem, Hung, & Dabbagh, 2019). Although students work in groups, they became more independent because they receive little instruction from their teachers. Therefore, their independent study skills could be improved in their self-study (Gupta, 2021). Moreover, reasoning is the process of using existing knowledge about the patient in drawing a conclusion about the case. It helps students in the processes of decision-making, problem-solving, and understanding content knowledge (Misra, 2021).

The application of concept mapping is effective in PBL as it helps bridge the gap between basic sciences and clinical practice (Veronese, Richards, Pernar, Sullivan, & Schwartzstein, 2013). It stimulates active deep learning, improves critical-thinking skills, and encourages self-directed learning skills among students (Tseng et al., 2011).

Concept mapping is a visual representation of the knowledge structure of the person who constructs the map (Farooque, 2020). It is a structured process of identifying and drawing the connections between ideas or concepts (Railean, Elçi, & Elçi, 2017). The product of the concept mapping process is called a concept map which is a visual representation of how information is organized in memory and the potential for meaningful learning (Drummond, 2018; Railean et al., 2017).

Concept mapping is a feasible technique for the improvement of PBL (Joshi & Vyas, 2018; Veronese et al., 2013). Its implementation across PBL could help students to develop organized, integrated knowledge structures built on specific clinical problems (Kassab et al., 2016). Students can easily classify their old and new knowledge, emphasizing key concepts or main ideas, and integrate their new knowledge with what they have learned previously to make a deeper understanding of the problem. This could assist learners in reaching higher levels of cognitive learning rather than memorizing a series of new concepts (Nasser, 2018).

A good attitude towards any skill is essential for its good practice (Greasley, 1999). Consequently, students' good attitude towards using concept mapping in PBL sessions is essential for the good practice of concept mapping skills in PBL which in turn could be reflected in improving students' performance in PBL sessions. However, there are no identified studies evaluating the relationship between students' performance in PBL sessions and their attitude toward using concept mapping. Hence, studying this relationship could be beneficial to the PBL strategy at the Faculty of Nursing in Suez Canal University.

Aim of the study:

The study aims to assess the relationship between students' performance in PBL and their attitude toward using concept mapping at the Faculty of Nursing.

Research question:

Does students' attitude toward using concept mapping in PBL sessions have a positive correlation with students' performance?

II. SUBJECTS AND METHODS

Research Design

A correlational descriptive design was used in this study.

Setting

Faculty of Nursing in Suez Canal University.

Participants

All first-year nursing students (92) were included in the study after pilot study exclusion.

Instruments

Data were collected using two tools.

Tool 1: Students' Performance in PBL Tutorial Sessions

It was geared to identify nursing students' performance in brainstorming and debriefing sessions. It is a self-instructed questionnaire composed of 24 statements covering four skills: independent study (9 items), group interaction (5 items), reasoning (6 items), and active participation (4 items). It was rated using a six-point scale ranging from never = 1 to always = 6 (Valle et al., 1999). The scoring system for this tool was developed as; a total score of < 86.4 indicates a poor level of students' performance in PBL, 86.4 - < 100.8 indicates an accepted level, 100.8 - < 115.2 indicates a good level, 115.2 - < 129.6 indicates a very good level and 129.6 - 144 indicates an excellent level.

Tool 2: Students' attitude of using concept mapping in PBL

It was geared to determine nursing students' attitude toward using concept mapping in brainstorming and debriefing sessions. It is a self-instructed scale composed of six statements that were rated on five points Likert scale ranging from strongly disagree = 1 to strongly agree = 5. The total score ranged from 1 to 5 (Zwaal & Otting, 2012). The scoring system was developed by Nirmala and Shakuntala (2012), a total score of < 2.5 indicates an unfavorable attitude, 2.5 - < 3.75 indicates a moderately favorable attitude and 3.75 - 5 indicates a most favorable attitude.

Tools' Validity and Reliability

The validity of Tool 1 was checked by Valle et al. (1999), and both tools were translated into the Arabic language followed by a back-translation process to be suitable for the study sample. The total reliability coefficients (Cronbach's Alpha) of tool 1 and tool 2 in the current study were 0.91, and 0.70, respectively.

Data collection

Data were collected from ninety-two students at the beginning of the second semester of the academic year 2017/2018 with the second PBL case after excluding the fifteen students who participated in the pilot study to evaluate the tools' feasibility. The students needed from 15 to 25 minutes to fulfill the questionnaires.

Ethical Considerations

The procedure and purpose of the study were fully explained to the students followed by signing the informed consent. Students included in the study had the right to refuse to participate in the study or withdraw from it at any time, and the confidentiality of their responses was guaranteed by the anonymity of the questionnaires. The Research Ethics Committee at the Faculty of Nursing at Suez Canal University approved the study proposal.

Data Analysis

The Statistical Package for Social Sciences (SPSS) version 20.0 was used for data analysis. Mean and Standard Deviation (SD) were used for descriptive analysis whereas the Pearson Correlation test (r) was used for inferential analysis. P-value < 0.05 was set for the statistical significance.

III. RESULTS

Table (1): Students’ performance in PBL sessions (N=92).

Skills of students’ performance in PBL sessions	Min-Max	Mean ± SD
Independent study	9-54	40.34 ± 6.38
Group interaction	5-30	25.62 ± 3.64
Reasoning	6-36	27.28 ± 4.24
Active participation	4-24	19.12 ± 3.20
Total students’ performance in PBL sessions	24-144	112.36 ± 14.80

Table 1 shows the students’ performance in PBL sessions. It was found that the total mean score of students’ performance in PBL sessions was high. Also, all skills of students’ performance in PBL sessions scored high mean scores.

Table (2): Students’ attitude toward using concept mapping in PBL sessions (N=92).

Elements of students’ attitude toward using concept mapping in PBL sessions	Min-Max	Mean ± SD
1-Concept mapping supported the construction of learning goals	1-5	3.39 ± 0.66
2-Concept mapping stimulated the activation of prior knowledge	1-5	3.33 ± 0.80
3-Concept mapping helped in creating a better understanding of the problem	1-5	3.38 ± 0.64
4-Concept mapping enhanced the process of PBL	1-5	3.40 ± 0.79
5-Concept mapping enhanced my interest in the subject matter	1-5	2.92 ± 0.87
6-Concept mapping will help me to memorize relevant information for the test	1-5	3.25 ± 0.78
Total students’ attitude toward using concept mapping in PBL sessions	1-5	3.28 ± 0.48

Table 2 shows the students’ attitude toward using concept mapping in PBL sessions. It was found that the total mean score of students’ attitude toward using concept mapping in PBL sessions was moderate. Besides, the students’ attitude regarding the role of concept mapping in enhancing the process of PBL scored the highest mean score whereas their attitude regarding the role of concept mapping in enhancing interest in the subject matter scored the lowest mean score. In addition, the students’ attitude regarding the role of concept mapping in supporting the construction of learning goals and creating a better understanding of the problem scored high mean scores.

Table (3): Correlation between the students’ performance in PBL sessions and their attitude toward using concept mapping (N=92).

Students’ performance in PBL sessions	Students’ attitude toward using concept mapping in PBL sessions	
	Pearson Correlation (r)	P-Value
	0.310	0.003*

Table 3 shows the correlation between the students’ performance in PBL sessions and their attitude toward using concept mapping. It was found that there was a significant positive correlation between the students’ performance in PBL sessions and their attitude toward using concept mapping.

IV. DISCUSSION

Regarding students’ performance in PBL sessions, the total mean score of students’ performance in PBL sessions was high. This result is higher than the results of **Cordero, Rashid, El Hasnaoui, Ganesh, and Khired (2018)**. Whereas, the current study’s total score is lower than the total mean scores reported by **Cerrillo (2016)**. The total mean score of students’ performance in PBL sessions in the current study ranged from accepted level to very good level and centralized in the good level. This indicates that first-year nursing students need more training in PBL.

Concerning the skills of students’ performance in PBL sessions, the independent study scored a high mean score. This result is higher than the result reported by **Cordero et al. (2018)**. In this regard, **Sambas, Shahrill, and Sajali (2018)** indicated that students engage in independent study to research the information needed to find a solution for the problem through different resources such as journal articles, the library, and the Internet.

In the current study, the skills of group interaction scored a high mean score. This result is higher than the result reported by **Cordero et al. (2018)**. In this regard, **Schmidt, Rotgans, and Yew (2011)** indicated that group interaction is central to the different phases of the PBL tutorials. Also, **Dolmans, Wolfhagen, and Van der Vleuten (1998)** concluded that the quality of group interaction is essential for making a successful PBL tutorial group.

Reasoning skills scored a high mean score in this study. This result is higher than the result reported by **Cordero et al. (2018)**. This result is supported by **Walker, Leary, and Hmelo-Silver (2015)** who mentioned that the reasoning ability is reinforced in PBL. Also, **Boud and Feletti (2013)** indicated that the students working with the PBL problems improve their reasoning ability and knowledge application. In addition, students' prior knowledge and their reasoning ability were significant predictors of their performance in PBL **Moallem, Hung, and Dabbagh (2019)**.

Active participation skills scored a high mean score in the current study. This result is higher than the result reported by **Cordero et al. (2018)**. This result is supported by **Tick (2007)** who indicated that students in PBL are actively participating in the learning process as well as actively taking part to gain knowledge.

Concerning students' attitude toward using concept mapping in PBL sessions. It was found that the total students' attitude toward using concept mapping in PBL sessions scored a moderate mean score. This result is lower than the results reported by **Zwaal and Otting (2012)** for the students who trained and practiced concept mapping in PBL sessions for a period of time. The current study score regarding attitude indicates that the level of students' attitude toward using concept mapping in PBL sessions is moderately favorable (**Nirmala & Shakuntala, 2012**). Hence, the students' training and practicing of concept mapping during PBL sessions are essential for improving their attitude towards using concept maps.

Regarding the elements of students' attitude toward using concept mapping in PBL sessions, the students' attitude about the role of concept mapping in enhancing the process of PBL scored the highest mean score. This result is supported by **Zwaal and Otting (2012), and Smith (2014)** who indicated the concept mapping role in enhancing the PBL process. Whereas the students' attitude regarding the role of concept mapping in enhancing interest in the subject matter scored the lowest mean score. This result could be due to unfamiliarity with students' practice of concept mapping in PBL sessions which is expected to be improved after students training on concept mapping and repeated practice of its skills. In this regard, **Harrison and Gibbons (2013)** indicated the improvement of students' feelings towards concept mapping over time as students became more at ease with it. That could be reflected in evaluating students' performance in PBL sessions.

In addition, the students' attitude regarding the role of concept mapping in supporting the construction of learning goals scored a high mean score. This result is supported by **Kassab (2016)** who indicated the role of concept mapping in generating learning goals relevant to the case in the brainstorming sessions. Besides, **Nasser (2018)** mentioned that concept mapping is expected to enhance and facilitate the production of learning goals. This indicates the importance of scheduling concept mapping as an educational strategy with PBL.

Also, the students' attitude regarding the role of concept mapping in creating a better understanding of the problem scored a high mean score. This result is supported by **McCafferty & Beaudry (2018)** who indicated that concept maps help in more and deeper connections between concepts and hence deeper understanding of the relations between these concepts resulting in better understanding.

There was a significant positive correlation between the students' performance in PBL sessions and their attitude toward using concept mapping. This result could be explained by the elements of students' attitude that interact with each other to produce a positive relationship with the attitude regarding using concept mapping in PBL sessions. Hence it could be associated with improving students' performance in PBL sessions. These elements of attitude could have an effective and high influence on students' performance in PBL sessions through several aspects.

Firstly, concept mapping plays an important role in the activation of students' prior knowledge and the construction of learning goals, and hence it could enhance the brainstorming session. Also, concept mapping could help students target the needed learning resources that contribute to solving the problem in the debriefing session (**Walsh, 2013**). Secondly, the concept mapping role in problem understanding and enhancing the process of PBL could contribute to effective students' practice of the steps for the PBL process. Hence, this could be a guarantee for achieving the purpose of PBL as an educational approach (**Zwaal & Otting, 2012**).

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Thirdly, the student's interest in subject matters creates a motive for learning among those students. Then they will be able to achieve higher academic achievement (Neuffer, 2016). This could contribute to a fuller understanding of subject matter knowledge and applying its science in real work situations. Therefore, it contributes to achieving the overall aims of subject matters and hence, the intended learning outcomes of the bachelor's nursing program. Finally, the concept mapping role in memorizing relevant information for the test could help students to achieve high academic achievements. In this regard, Kassab and Hussain (2010) reported that there is a correlation between the concept mapping practice scores of students and their academic achievements.

V. CONCLUSION

Nursing students have a good level of performance in PBL sessions and a moderately favorable attitude toward using concept mapping in PBL sessions. Totally, there is a significant moderate positive correlation between the students' performance in PBL sessions and their attitude toward using concept mapping.

VI. RECOMMENDATIONS

Providing nursing students with a training program on using concept mapping in PBL sessions could contribute to more improvement in PBL students' performance in addition to providing them with more training on PBL.

REFERENCES

- [1] Ajmal, M. F., Jumani, N. B., & Malik, S. (2016). Utilizing Problem Based Learning in Pre-service teacher Education: Experiences of Prospective Teachers in Pakistan. *Journal of Education and Human Development*, 5(2), 215-222.
- [2] Azer, S. A. (2011). Introducing a problem-based learning program: 12 tips for success. *Med Teach*, 33(10), 808-813. doi:10.3109/0142159X.2011.558137
- [3] Bastable, S. B. (2021). *Nurse as educator: principles of teaching and learning for nursing practice: principles of teaching and learning for nursing practice*: Jones & Bartlett Learning.
- [4] Bridges, S. M., Corbet, E. F., & Chan, L. K. (2015). Designing problem-based curricula: The role of concept mapping in scaffolding learning for the health sciences. *Knowledge Management & E-Learning: An International Journal*. doi:10.34105/j.kmel.2015.07.008
- [5] Cartwright, P., Bruce, J., & McInerney, P., (2017). Effects of problem-based learning on nurse competence: A systematic review. *Journal of Nursing Education*, 7(4), 67-75.
- [6] Cerrillo, S. R. (2016). PROBLEM-BASED LEARNING (PBL) AND CLINICAL REASONING IN NUTRITION BACHELOR STUDENTS. *European Journal of Education Studies*, 2(5).
- [7] Chan, Z. (2017). A qualitative study on using concept maps in problem-based learning. *Nurse Education in Practice*, 24, 70-76. doi:10.1016/j.nepr.2017.04.008
- [8] Cordero, M. A., Rashid, N. A., El Hasnaoui, R., Ganesh, K., & Khired, Z. (2018). Tutors and self-assessment of medical students' performance in pre-clinical problem-based learning tutorial sessions. *MedEdPublish*, 7. doi:https://doi.org/10.15694/mep.2018.0000265.1
- [9] Dolmans, D. H., Wolfhagen, I. H., & Van der Vleuten, C. P. (1998). Thinking about student thinking: motivational and cognitive processes influencing tutorial groups. *Academic Medicine*, 73(10), S22-24.
- [10] Boud, D., & Feletti, G. (Eds.). (2013). *The challenge of problem-based learning*. Psychology Press.
- [11] Drummond, C. K. (2018). Financial decision-making for engineers. In *Financial Decision-Making for Engineers*: Yale University Press.
- [12] Farooque, M. S. M. (2020). *New trends in teaching and learning*: OrangeBooks Publication.
- [13] Greasley, A. (1999). *Operations management in business*: Nelson Thornes.
- [14] Gupta, R. (2021). *Information and Communication Technology in Physical Education*: Friends Publications (India).

- [15] Harrison, S., & Gibbons, C. (2013). Nursing student perceptions of concept maps: From theory to practice. *Nursing Education Perspectives*, 34(6), 395-399. doi:10.5480/10-465
- [16] Joshi, U., & Vyas, S. (2018). Assessment of perception and effectiveness of concept mapping in learning epidemiology. *Indian journal of community medicine: official publication of Indian Association of Preventive & Social Medicine*, 43(1), 37. doi:10.4103/ijcm.IJCM_375_16
- [17] Kassab, S. E. (2016). Concept mapping as a Tool for Learning and Assessment in Problem-based Learning. *Suez Canal University Medical Journal*, 19(1), 1-9.
- [18] Kassab, S. E., Fida, M., Radwan, A., Hassan, A. B., Abu-Hijleh, M., & O'Connor, B. P. (2016). Generalisability theory analyses of concept mapping assessment scores in a problem-based medical curriculum. *Med Educ*, 50(7), 730-737. doi:10.1111/medu.13054
- [19] Kassab, S. E., & Hussain, S. (2010). Concept mapping assessment in a problem-based medical curriculum. *Med Teach*, 32(1), 926 - 931. doi:10.3109/0142159X.2010.497824
- [20] Machado, J. L. M., Machado, V. M. P., Grec, W., Bollela, V. R., & Vieira, J. E. (2008). Self- and peer assessment may not be an accurate measure of PBL tutorial process. *BMC medical education*, 8(1), 55. doi:10.1186/1472-6920-8-55
- [21] Mansoori, S., Abedini-baltork, M., Lashkari, H., & Bagheri, S. (2017). Effectiveness of problem-based learning on student's academic performance: A quasi-experimental study. *Research in Medical Education*, 9(1), 8-1.
- [22] McCafferty, A. S., & Beaudry, J. S. (2018). *Teaching strategies that create assessment-literate learners*. Corwin Press.
- [23] Mergendoller, J. R., Maxwell, N. L., & Bellisimo, Y. (2006). The effectiveness of problem-based instruction: A comparative study of instructional methods and student characteristics. *Interdisciplinary journal of problem-based learning*, 1(2), 49-69.
- [24] Misra, P. K. (2021). *Learning and Teaching for Teachers* Springer Singapore.
- [25] Moallem, M., Hung, W., & Dabbagh, N. (2019). *The Wiley handbook of problem-based learning*: Wiley Online Library.
- [26] Nasser, D. (2018). *Using Concept Mapping through Problem-Based Learning to facilitate Lifelong Knowledge of Risk Factors for Cardiovascular Diseases: Case University of Algiers*. Paper presented at the PBL for the Next Generation, Blending Active learning, Technology and Social Justice, Santa clara, California, USA.
- [27] Neuffer, P. (2016). *Relationship between Subject-matter Interest and Academic Achievement: A Study of Grade 7 Students at a Bilingual School in Thailand*. Paper presented at the RSU International Research Conference.
- [28] Nirmala, T., & Shakuntala, B. S. (2012). ATTITUDE OF STUDENTS ON CONCEPT MAPPING - AN INNOVATIVE TEACHING LEARNING STRATEGY. *Nitte University Journal of Health Science*, 2(4).
- [29] Noordegraaf-Eelens, L., Kloeg, J., & Noordzij, G. (2019). PBL and sustainable education: addressing the problem of isolation. *Advances in Health Sciences Education*, 24(5), 971-979. doi:10.1007/s10459-019-09927-z
- [30] Ousey, K. J. J. o. A. N. (2007). Solution focused nursing. Rethinking practice. 59(2), 195-195.
- [31] Railean, E., Elçi, A., & Elçi, A. (2017). *Metacognition and successful learning strategies in higher education*: IGI Global.
- [32] Schmidt, H. G., Rotgans, J. I., & Yew, E. H. (2011). The process of problem-based learning: what works and why. *Medical education*, 45(8), 792-806.
- [33] Sambas, A. A. M., Shahrill, M., & Sajali, M. Z. (2018). Supporting Design and Technology Lessons with the Use of Problem-Based Learning. *European Journal of Education*, 1(3), 25-36.

- [34] Smith, R. O. (2014). *Beyond Passive Learning: Problem-Based Learning and Concept Maps to Promote Basic and Higher-Order Thinking in Basic Skills Instruction*.
- [35] Tick, A. (2007). Application of problem-based learning in classroom activities and multimedia. In *5th Slovakian Hungarian joint symposium on applied machine intelligence and informatics, Poprad, Slovakia*.
- [36] Tseng, H. C., Chou, F. H., Wang, H. H., Ko, H. K., Jian, S. Y., & Weng, W. C. (2011). The effectiveness of problem-based learning and concept mapping among Taiwanese registered nursing students. *Nurse Educ Today*, 31(8), e41-46. doi:10.1016/j.nedt.2010.11.020
- [37] Valle, R., Petra, L., Martínez-González, A., Rojas-Ramirez, J. A., Morales-Lopez, S., & Piña-Garza, B. (1999). Assessment of student performance in problem-based learning tutorial sessions. *Medical Education*, 33(11), 818-822. doi:10.1046/j.1365-2923.1999.00526.x.
- [38] Veronese, C., Richards, J. B., Pernar, L., Sullivan, A. M., & Schwartzstein, R. M. (2013). A randomized pilot study of the use of concept maps to enhance problem-based learning among first-year medical students. *Med Teach*, 35(9), 1478-1484. doi:10.3109/0142159X.2013.785628
- [39] Walker, A., Leary, H., & Hmelo-Silver, C. (Eds.). (2015). *Essential readings in problem-based learning: Exploring and extending the legacy of Howard S. Barrows*. Purdue University Press.
- [40] Walsh, K. (2013). *Oxford textbook of medical education*: Oxford University Press.
- [41] Zwaal, W., & Otting, H. (2012). The Impact of Concept Mapping on the Process of Problem-based Learning. *Interdisciplinary Journal of Problem-based Learning*, 6(1), 7. doi:10.7771/1541-5015.1314