ORIGINAL ARTICLE

Relationship of Prior Knowledge and Scenario Quality With the Effectiveness of Problem-based Learning Discussion among Medical Students of Universitas Malikussaleh, Aceh, Indonesia

Mulyati Sri Rahayu[1], Sri Wahyuni[2], Yuziani[3]

[1] Department of Anatomical Pathology, Faculty of Medicine, Universitas Malikussaleh, Aceh 24351, Indonesia
[2] Department of Biochemistry, Faculty of Medicine, Universitas Malikussaleh, Aceh 24351, Indonesia
[3] Department of Pharmacology, Faculty of Medicine, Universitas Malikussaleh, Aceh 24351, Indonesia

ABSTRACT

Introduction: Problem-Based Learning (PBL) is a student-centred learning approach that employs clinical case scenarios to trigger learning and is conducted in small group discussions. The familiarity and prior knowledge of the students with the problem affect and stimulate student discussion in the tutorial group. Effective discussion ensures successful PBL learning. This study aimed to determine the relationship between prior knowledge and the scenario quality with the effectiveness of the PBL discussions. **Methods:** This cross-sectional study was conducted in 2021 and involved 89 undergraduate medical students in the learning of the Immunology and Neoplasm module at the Faculty of Medicine of Universitas Malikussaleh. The Quality of PBL Problem Questionnaire and the Tutorial Group Effectiveness Instrument (TGEI) Questionnaire were used for data collection. The GPAs of the students were obtained as prior knowledge data. The data were analysed using the Chi-square test with a significant level of 0.05. **Results:** Most of the students had good prior knowledge (51.2% vs 47.8%). The results did not show a significant correlation between prior knowledge and the scenarios with the discussion effectiveness in the PBL group (p = 0.154 and 0.871, respectively). **Conclusion:** This study suggests that prior knowledge did not affect the effectiveness of discussions within the tutorial groups. Our study discovered a non-significant relationship between the scenario quality and the effectiveness of PBL discussions; however, our data revealed that good scenarios mostly led to effective tutorial group discussions.

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Keywords: Problem-Based Learning, PBL, Prior knowledge, Scenario quality, Effectiveness of PBL discussion

Corresponding Author:
Mulyati Sri Rahayu, MSc
Email: mulyati.srirahayu@unimal.ac.id
Tel: +62-81360300100

INTRODUCTION

Problem-Based Learning (PBL) is a teaching and learning method that focuses on the students and encourages them to be self-directed in their learning. The problems in PBL are derived from clinical cases and serve as learning triggers for group discussions. Learning objectives related to case problems are developed through a brainstorming discussion process with minimal guidance from a tutor. The PBL helps students to determine new learning needs through small discussion groups (1, 2). The quality and functionality of small group work are crucial to ensure the success of PBL (3). In small groups, students can ask questions, explain, resolve disagreements, and deepen their understanding (4). Students learn through interactions, such as explaining topics to

other students, asking and answering questions, and participating in the discussion. Students collaborate to generate collaborative explanations. They can use prior knowledge and reasoning together, construct theories, and experience cognitive conflicts during the PBL process (5). Effective discussion ensures successful PBL learning.

There are three main aspects to be considered in a PBL discussion: a problem scenario, prior knowledge, and the tutor (6). Problems are a collection of case descriptions designed to start a discussion and solve the problem. The problems in the scenario are designed to motivate students to use their previous knowledge, stimulate interest, engage them in a group discussion, and create a positive learning environment (7–9). Good scenario quality helps students understand a case that will affect the effectiveness of the discussion (10). A high-quality problem is likely to have a significant positive impact on the learning process. It is as important as the tutor's performance and prior knowledge of the students (11).

The Faculty of Medicine of Universitas Malikussaleh has seven semesters of a competency-based curriculum for an undergraduate program that uses PBL 'Seven Jumps' as an instructional design (1, 12). Two weekly tutorial discussions guide the PBL 'Seven Jumps' system. For students, there are two 2-hour sessions every week. Each small group has 8 to 10 students and is led by a tutor. The students meet and perform problem analysis brainstorming in the first session where they read the scenario, ask for clarification of terms and difficult concepts, form an opinion, and work together to define and analyse what they assume is the problem based on their prior knowledge without any intervention from the tutor. In addition, they attempt to create a systematic inventory of the explanations deduced from previous processes to establish and specify their learning objectives by consensus among students and facilitators (Steps 1-5). This is followed by an individual study to read the literature, gather additional information outside the group, and prepare responses to the defined learning objectives (Step 6). The students meet in the second session to report and discuss their answers, compare results, and discuss arguments. Then, they solve problems by synthesizing and testing the newly-gained knowledge while the facilitator is assessing whether the learning objectives have been achieved (Step 7).

Various authors evaluated the association of prior knowledge and scenario quality with the effectiveness of student discussion in a PBL tutorial group (13–17). The effectiveness of small groups during the PBL process has not previously been studied in our institution. Therefore, the present study was carried out to analyse the relationship between students' prior knowledge and the scenario quality with the effectiveness of student discussions in the PBL tutorial groups of the Faculty of Medicine of the Universitas Malikussaleh, Aceh, Indonesia.

MATERIALS AND METHODS

Study design
A cross-sectional study was conducted on medical students from the Faculty of Medicine of Universitas Malikussaleh, Aceh, Indonesia, from April to May 2021. The sample of this study was students who participated in the PBL 'Seven Jumps' discussions during the academic year 2020/2021. A total of 89 respondents were selected for the study using a purposive sampling technique. The inclusion criteria were second-year medical students exposed to problem-based learning in the first year of medical school, participated in the PBL sessions in the Immunology and Neoplasm modules, and completed all their first-year modules. These modules included an introduction to medicine and medical education, the neuromusculoskeletal system, the digestive, hormone, metabolism, cardiovascular, respiratory, urogenital and human life cycle. It also included the basic anatomy,

physiology, and biochemistry of the system. The students received an explanation of the purpose of the study and were invited to participate in it. The students' responses were obtained using questionnaires. Written informed consent was also obtained from all participants. Uncompleted questionnaires were excluded. This study was approved ethically by the Ethics Committee for Health Research, Faculty of Medicine, University of Muhammadiyah Sumatera Utara (No. 601/KEPK/FKUMSU/2021).

Instruments and Data Collection
The data were collected using two questionnaires. The quality assessment of the scenario was measured using 'The Quality of PBL Problems questionnaire' from a previous study (18). The questionnaire comprised six factors that described an effective PBL problem: Factor 1: stimulates thinking, enhances analysis and reasoning (3 items); Factor 2: stimulates self-directed learning (3 items); Factor 3: leads to studying the intended contents (3 items); Factor 4: enhances interest in subject matter (3 items); Factor 5: relevance to the future profession with realistic context (3 items); and Factor 6: matches the level of prior knowledge (3 items). The score for each factor was the average of the three items' scores. The standard of interpreting the average score of all factors and the overall rating item was (scale of 1-5): 3 or less is insufficient; > 3 to 3.5 means improvement is needed; >3.5 to 4 is sufficient, and > 4 is good.

The effectiveness of small groups in tutorial discussions was measured using 'The Tutorial Group Effectiveness Instrument (TGEI)' developed by Singaram et al. as it is valid and reliable (3). The elements within the instrument were clustered around motivational, demotivational, and cognitive factors (19). The TGEI consisted of 19 statements: 1) cognitive (7 items); 2) motivational (7 items), and 3) demotivational (6 items). The students were asked to rate each item on the instrument on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Due to the negative language, the demotivational ratings were inverted in the analysis. Then, the students were asked to rate the overall productivity of the tutorial group: insufficient (1), reasonable (2), sufficient (3), good (4), and excellent (5). Mewo et al. established the validity and reliability of the Indonesian version of the TGEI with an alpha coefficient of 0.82 for the cognitive and motivational components, 0.64 for the demotivational components, and 0.79 for the entire statement (20).

The cumulative GPA (grade point average) of the first year became an indicator of the students' prior knowledge before they were introduced to the Immunology and Neoplasm module. In other words, the students with a GPA ≥ 3.00 were considered to have good prior knowledge, while those with GPA < 3.00 were assumed to have poor prior knowledge (12).

Statistical analysis

The data processing was carried out using Microsoft Excel 2019 and the SPSS spreadsheet. Descriptive statistics were presented with means and percentages. The Chi-square test was used to find the effects of prior knowledge and scenario quality on the effectiveness of group discussions. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 89 undergraduate medical students were involved in this study, consisting of 25.8% male students and 74.2% female students. The students' prior knowledge was measured using the cumulative GPA (grade point average) of the first year before they learned the Immunology and Neoplasm module. The results showed that most of the students had good prior knowledge (51.2% vs 47.8%). The quality assessment of the scenarios was measured using 'The Quality of PBL Problem questionnaire' from a previous study. Table I showed the scenario criteria, and most of the students (56.2%) reported that the quality of the scenarios used in the Immunology and Neoplasm module was good. The Tutorial Group Effectiveness Instrument (TGEI) developed by Singaram et al., was used to evaluate the effectiveness of small groups in tutorial discussions. The effectiveness of the tutorial groups in PBL was affected by three main perspectives: cognition, motivation, and demotivation, as presented in Table II. In general, the students considered the discussions of the PBL group effective (58.4% vs 41.6%).

The relationship between prior knowledge and the scenario with the effectiveness of the PBL discussions is shown in Table III. The results did not show a significant correlation between prior knowledge and the scenario quality with the effectivity of the discussion in the PBL group (p = 0.871 and 0.154, respectively). However, our data revealed that good scenarios have an impact on the effectiveness of tutorial group discussions, as presented in Table III (37.1%).

Table I: Criteria of the PBL scenario of immunology and neoplasm module

Criteria	n (%)		Mean
	Good	Not Good	
Stimulates thinking, enhances analysis, and reasoning	48 (53.9 %)	41 (46.1 %)	11.6
Stimulates self-directed learning	57 (64 %)	32 (36 %)	11.8
This leads to studying the intended contents	58 (65.2 %)	31 (34.8 %)	11.9
Enhances interest in subject matter	52 (58.4 %)	37 (41.6 %)	11.5
Relevance to the future profession with a realistic context	57 (64 %)	32 (36 %)	11.8
Matches the level of prior knowledge	44 (49.4 %)	45 (50.6 %)	11.2

Table II: The effectiveness of the tutorial group discussion from the three aspects

Aspects	Percentage (%)
Cognition	
Effective	50.6 %
Ineffective	49.4 %
Motivation	
Effective	59.6%
Ineffective	40.4 %
Demotivation	
Effective	55.1 %
Ineffective	44.9 %

Table III: Analysis relationship between the quality of the scenario and prior knowledge with the effectiveness of PBL discussion

Variable	Category	Effectiveness of PBL group discussion		p-value
		Effective n (%)	Ineffective n (%)	
Prior knowledge	Good	26 (29.2)	20 (22.5)	0.871
	Poor	26 (29.2)	17 (19.1)	
Quality of the scenario	Good	33 (37.1)	17 (19.1)	0.154
	Poor	19 (21.3)	20 (22.5)	

DISCUSSION

Our study investigated the relationship between prior knowledge and the scenario quality with the effectiveness of the PBL group discussions. The effectiveness of the tutorial group in PBL was affected by two main perspectives: cognition and motivation. These aspects were operationalised in the 'Tutorial Group Effectiveness Instrument (TGEI)' used to assess tutorial discussions based on their scores (21). The TGEI can be used by academics to learn about group effectiveness in various PBL settings (22).

Our results showed that most of the students (58.4%) perceived that the discussion in the PBL tutorial group was effective. In particular, the students rated motivational, demotivational, and cognitive aspects as good (59.6%, 55.1%, and 50.6%, respectively). Cognitive and motivational factors improve the acquisition and retention of students' knowledge (19, 23). The motivational domain shows how much students motivate, care for, and support each other in their learning. This domain emphasises the importance of cohesion or team spirit (3, 19). The demotivational domain highlights how passive students can influence group dynamics significantly which, as a result, has a negative impact on students' learning in the groups. Peer interactions and explanations are central to the cognitive domain (elaboration and interaction) (3). These cognitive processes are believed to impact students' learning positively (19).

Prior knowledge and effectiveness of group discussion
The PBL 'Seven Jumps' conferred a great deal of

brainstorming and utilised prior knowledge to tackle the problems. The students addressed the problems using their prior knowledge at the beginning of the learning process. The issues that required further investigation in the group discussion served as guidance for students' self-directed learning activities. After a period of self-study, they regrouped to discuss, shared information, synthesized answers to their questions, and integrated their new knowledge into the context of the problems (11, 7).

In this study, there was no significant correlation found between prior knowledge and the effectiveness of the PBL discussions. This result was supported by Imelda et al., who reported that prior knowledge did not have a significant effect on the effectiveness of a group discussion (13). Soppe et al., (7) reported that students considered the familiar problems to be of higher quality than the non-familiar problems. However, there was no difference in the effectiveness of the discussions among the students. As an aspect of PBL, problem familiarity or prior knowledge is defined as how the students' previous experience contributes to solving a problem. Students who are more familiar with the problem/scenario may have more relevant information to initiate a discussion (7).

Several studies concluded that prior knowledge plays a minimal role in predicting group effectiveness in PBL. Excellent tutor performance compensates for students' lack of prior knowledge in the discussion (13, 14, 24). In general, when students have relevant prior knowledge before the discussion, they are able to recall the information and make connections to the new topic. The elaboration also becomes more effective when the students have greater prior knowledge of a subject. However, students with irrelevant prior knowledge may have provided false information to their group members when they attempt to give responses to the teacher's questions, which will consequently impede their intake of knowledge from the module being studied (17).

Scenario quality and effectiveness of the group discussion
This study did not find a significant relationship between the scenario quality and the effectiveness of the PBL discussions. However, most of our students agreed that the scenario quality was good (56.2%). They believed that the scenarios encouraged them to use literature related to the learning objectives. This result was consistent with Hamidy et al., who reported that a scenario was not correlated with the discussion process (25). Our result contradicted the findings of previous studies that a good scenario had a substantial effect on a PBL discussion (10, 26). The more compelling the scenario, the more effective the PBL discussion (27). Students are more motivated to study, collaborate and actively participate in the discussion when the problems presented are engaging and challenging (10, 15, 26). If the relevance is high for future practice, students will be interested and determined to solve the problems. In other words, the students are stimulated to learn to cooperate and be active (28).

The quality of a problem is the main aspect that distinguishes the principles of PBL and the other learning strategies. PBL is collaborative learning in which students attempt to explain a problem or scenario. When compared to the students' prior knowledge of the students and the tutor's performance the quality of the problems had a more significant impact on the functioning of the group and the time spent on an individual study (11). Dolmans et al., identified several elements that determined scenario quality in PBL. The scenario should challenge the students' prior knowledge and induce them to ask questions that develop their new knowledge (9).

CONCLUSION

This study suggests that prior knowledge did not have any correlation with the effectiveness of a discussion. Although the results found in this study statistically showed that there was a non-significant relationship between scenario quality and the effectiveness of PBL discussions, our data revealed that good scenarios mostly led to effective tutorial group discussions. The scores of the cognitive and motivational components showed an opportunity for future development in the effectiveness of the PBL tutorial groups within our institution. A scenario provided should be of high quality and able to encourage students to recall their prior knowledge. Further studies are needed to explore other factors that may affect the effectiveness of a PBL group discussion.

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REFERENCES

1. Wood DF. Problem based learning. BMJ. 2003;326(7384):328-330. doi:10.1136/bmj.326.7384.328
2. Dolmans DH, De Grave W, Wolfhagen IH, van der Vleuten CP. Problem-based learning: future challenges for educational practice and research. Med Educ. 2005;39(7):732-741. doi:10.1111/j.1365-2929.2005.02205.x
3. Singaram VS, Van Der Vleuten CP, Van Berkel H, Dolmans DH. Reliability and validity of a Tutorial Group Effectiveness Instrument. Med Teach. 2010;32(3):e133-e137. doi:10.3109/01421590903480105
4. Visschers-Pleijers AJ, Dolmans DH, Wolfhagen IH, van der Vleuten CP. Development and validation of a questionnaire to identify learning-oriented group interactions in PBL. Med Teach. 2005;27(4):375-

381. doi:10.1080/01421590500046395

5. Dolmans DH, Schmidt HG. What do we know about cognitive and motivational effects of small group tutorials in problem-based learning?. Adv Health Sci Educ Theory Pract. 2006;11(4):321-336. doi:10.1007/s10459-006-9012-8

6. Henk G. Schmidt, Diana Dolmans, Wim H. Gijselaers & Jacques E. Des Marchais. Theory-guided design of a rating scale for course evaluation in problem-based curricula, Teaching and Learning in Medicine. 1995;7(2): 82-91. doi: 10.1080/10401339509539719

7. Soppe M, Schmidt HG, Bruysten RJMP. Influence of problem familiarity on learning in a problem-based course. Instr Sci. 2005; 33(3):271-281. doi: 10.1007/s11251-004-7688-9

8. Azer SA. Becoming a student in PBL course: twelve tips for successful group discussion. Med Teach. 2004;26(1):12-15. doi:10.1080/0142159032000156533

9. Dolmans D, Snellen-balendong H, Hap Wolfhagen I, van der Vleuten CP. Seven principles of effective case design for a problem-based curriculum. Med Teach 1997;19(3):185-189. doi: 10.3109/01421599709019379

10. Sianipar I, Himanto D, Siregar I, Husin F, Sutedja E, Sukandar H. Hubungan Kinerja Tutor dan Kualitas Kasus Skenario Terhadap Keefektifan Kelompok Pada Metode Belajar Problem Based Learning. Indonesia Journal Education and Midwifery Care (IJEMC) 2016;3:1–7. doi: 10.24198/ijemc.v3i2

11. Sockalingam N, Rotgans J, Schmidt HG. Student and tutor perceptions on attributes of effective problems in problem-based learning. High Educ 2011;62:1–16. doi: 10.1007/s10734-010-9361-3

12. Faculty of Medicine Universitas Malikussaleh. Academic Guidelines of Faculty of Medicine Universitas Malikussaleh / Panduan Akademik Prodi Pendidikan Dokter. 2020

13. Martina GS I. Hubungan prior knowledge terhadap keefektifan kelompok pada metode belajar problem based learning di program studi D3 Kebidanan STIK Immanuel. Health Science Growth (HSG) Journal 2016;1:1–12

14. Abdalla ME, Eladl MA. Student perception of the effect of problem familiarity on group discussion quality in a problem-based learning environment. GMS J Med Educ. 2019;36(3):Doc29. Published 2019 May 16. doi:10.3205/zma001237

15. Sandaria FG, Sulistiawati, Purnamasari BC. The Relationship of Scenario Quality With the Effectiveness of Seven Jumps Problem-Based Learning Discussion on Medical Students of Mulawarman University. Jurnal Ilmu Kesehatan 2021;9:137–141 doi: 10.30650/jik.v9i2.2257

16. Keshk LI, El-Azim SA, Qalawa SA. Quality of Problem Based Learning Scenarios at College of Nursing in Egypt and KSA: Comparative Study. American Journal of Educational Research, 2016; 4(9):701-710. doi: 10.12691/education-4-9-10

17. van Blankenstein FM, Dolmans DHJM, van der Vleuten CPM, Schmidt HG. Relevant prior knowledge moderates the effect of elaboration during small group discussion on academic achievement. Instr Sci 2013;41:729–744. doi: 10.1007/s11251-012-9252-3

18. Munshi FM, Sayed EZA el, Dolmans DH. Development and utility of a questionnaire to evaluate the quality of PBL problems. South East Asian Journal of Medical Education 2008;2(2):32–40. doi: 10.4038/seajme.v2i2.481

19. Slavin RE. Research on Cooperative Learning and Achievement: What We Know, What We Need to Know. Contemp Educ Psychol 1996;21:43–69. doi: 10.1006/ceps.1996.0004

20. Mewo YM, Manoppo FP, Wungouw HIS. Evaluasi kualitas skenario Problem-Based Learning di Fakultas Kedokteran Universitas Sam Ratulangi. Jurnal e-Biomedic 2018; 6(2):90-95. doi: 10.35790/ebm.6.2.2018.20967

21. Singaram VS, Van Der Vleuten CP, Van Berkel H, Dolmans DH. Reliability and validity of a Tutorial Group Effectiveness Instrument. Med Teach. 2010;32(3):e133-e137. doi:10.3109/01421590903480105

22. Shankar PR, Nandy A, Balasubramanium R, Chakravarty S. Small group effectiveness in a Caribbean medical school's problem-based learning sessions. J Educ Eval Health Prof. 2014;11:5. Published 2014 Mar 24. doi:10.3352/jeehp.2014.11.5

23. Norman GR, Schmidt HG. Revisiting 'Effectiveness of problem-based learning curricula: theory, practice and paper darts'. Med Educ. 2016;50(8):793-797. doi:10.1111/medu.12800

24. Istadi Y, Harsono, Prabandari YS. Faktor-faktor yang dianggap sebagai prediktor terhadap keefektifan kelompok tutorial Problem Based Learning (PBL). Jurnal Pendidikan Kedokteran Indonesia 2012;1:59–67. doi: 10.22146/jpki.25130

25. Hamidy MY, Asni E. Faktor-faktor yang Mempengaruhi Partisipasi Mahasiswa dalam Proses Tutorial pada Metode Belajar Problem-Based Learning (PBL) di Fakultas Kedokteran Universitas Riau. Jurnal Ilmu Kedokteran (Journal of Medical Science) 2017;4:30-35. doi: 10.26891/JIK.v4i1.2010.30-35

26. Susanti PFE, Lisiswanti R, Soleha TU, Saputra O, Okyafany. Hubungan Kualitas Skenario Terhadap Keefektifan Diskusi Problem-Based Learning (PBL) Blok Emergency Pada Mahasiswa Fakultas Kedokteran Universitas Lampung. Medulla 2017;7:157–163

27. Pioh VE, Mewo Y, Berhimpon S. Efektivitas kelompok diskusi tutorial problem based learning di Fakultas Kedokteran Universitas Sam Ratulangi. Jurnal e-Biomedik 2016;4(1): 1-9. doi: 10.35790/ebm.4.1.2016.12141

28. Schmidt H, Moust J. Processes that shape small-group tutorial learning: A review of research. In: the Annual Meeting of the American Educational Research Association. 1998. pp 1–21