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The Effect of Problem-Based Learning on Knowledge in Electronic Medical Records for Registered Nurses

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Background: The private hospital changed from paper to electronic medical records (EMRs), which were implemented in accordance with international and other relevant requirements. The hospital's chief of nursing and registered nurses oversee the transition from paper to EMRs.

Objective: To study the effects of problem-based learning (PBL) on the knowledge of EMR for registered nurses.

Methods: This was a quasi-experimental research design. This research assigned the population from the registered nurses of the BNH Hospital, Bangkok, Thailand. There were 128 subjects comprising 64 subjects in the experimental group, and 64 subjects in the control group. Each assigned session was 6 hours with traditional learning and PBL in EMR. The instruments used were multiple-choice questions, case scenarios, and satisfaction questionnaires.

Results: The average score of PBL of the posttest was higher in the experimental group compared to the control group, with statistically significant differences (mean [SD], 38.91 [1.84] and 27.13 [2.50] points, respectively; $P < .05$). Overall, the satisfaction level of PBL was strongly satisfied (mean [SD], 4.55 [0.50] points).

Conclusions: This study found that PBL resulted in registered nurses being more involved in learning EMR than in traditional learning and having a good satisfaction with learning.

Keywords: Problem-based learning, Electronic medical records, Registered nurses

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Introduction

The private hospital changed from paper to electronic medical records (EMRs), which were implemented in accordance with international and other relevant requirements. This change began with patients who would come to the hospital to be diagnosed and discharged to return home.[1] Following this, registered nurses, physicians, and nurses started to use the EMR system. Furthermore, in 2021, BNH Hospital became a pilot hospital in the private hospital chain that utilized the EMR system. This was done to develop and test the system's use and validity, with 9 physicians and 24 registered nurses participating. In-house EMR training leaders could obtain continuing EMR software education and training by attending user conferences and seminars held by their EMR software vendor. After teaching, a random number of medical records were evaluated from the patients' database from the EMR. It was found that documents in the medical database were incomplete according to the prescribed form, especially for the nursing part, which resulted in insufficient patients' history and the inability to follow up on the medical records, thus resulting in various standard assessments. The quality of medical records is not good enough for the Joint Commission International (JCI) standard. After 2 weeks of teaching, interviews with all students revealed that students did not understand the complete process of the system's operation from the teaching and learning management and the interdepartmental working system. This resulted in the incomplete recording of the data.

Researchers, therefore, reviewed the literature. It was found that teaching should be conducted by using problems for the learner to have an analytical process of the problem and make them have a good level of knowledge.[2] Additionally, appropriate teaching would enable learners to learn and understand, so a teaching model would need to be developed for doctors and those in other medical professions according to the various standards of the hospital. Students should also measure their knowledge by using multiple-choice questions (MCQ), a tool used to test their knowledge at the recall level, A-type, or one best answer.[3]

Therefore, EMR training should be conducted by the hospital's chief of nursing and registered nurses oversee the transition from paper to EMR. The teaching method used traditional EMR with group learning to describe the use and working process. Information was also transferred to other areas, such as nursing assessment, nursing intervention, etc, with questions and answers for each class for 3 hours. Researchers then reviewed the literature and found that using PBL to create a systematic thinking process in foreign hospitals by incorporating problems consistent with work experience enabled learners to learn.[4] Moreover, the learning emphasized the work processes and EMR; hence the effectiveness of the different learning styles was compared. Therefore, researchers utilized the question, "What is the effect of PBL on the knowledge of EMRs for registered nurses?" This was so that researchers could know the appropriate teaching and learning styles about EMR for registered nurses.

This study aimed to determine the effects of PBL on the knowledge of EMRs for registered nurses and to evaluate the satisfaction of learning with PBL of EMRs for registered nurses.

Methods

Participants

This study recruited 350 registered nurses from BNH Hospital, Bangkok, Thailand. The registered nurses had already taught EMR to 180 nurses; however, there was a population of 170 people who had not received EMR instruction. Hence, this study chose to undertake the research with the latter group to avoid misunderstandings in the teaching and learning forms and the unreliability of the research results. Therefore, the qualifications of the research participants were determined as follows: 1) had graduated with a bachelor's of nursing; 2) had worked in the BNH Hospital for over one month; 3) had never attended another similar program, and 4) this was the first time learning with PBL in EMR.

The statistics for calculating the sample size by the G*Power program determined the productive dimension of 0.50 at the statistical significance level of .05, the power of the test was 0.80, the degree of freedom (*df*) of the model was 50, and the total sample size of the study was 128 subjects with 64 subjects in the experimental group and 64 subjects in the control group. The study was limited to only registered nurses of BNH Hospital. All participants were divided into 2 study groups. Permission was requested from each group, and all participants signed consent forms for participation in the research. All participants in both groups received a pretest and posttest to measure the level of knowledge of each group. The experimental group was evaluated for the satisfaction of learning with PBL of EMR.

Ethics

This study was approved by institutions' human ethics committees to comply with university rules and hospital regulations to support data collection, from the Human Research Protection Agency, Faculty of Medicine Siriraj Hospital, Mahidol University, Thailand (COA. No. Si 865/2019 on December 27, 2019).

Researchers explained that the research would not affect the work or cause any defamation of participants.

Study Design

This quasi-experimental research design was a nonequivalent control group with a pretest-posttest design. The intervention was to create a PBL program for EMR. Quasi-experiments demonstrated the causality between the intervention and the outcome. It should be noted that quasi-experimental studies can use pre-intervention and post-intervention measurements and non-randomly selected control groups. The procedures were as follows: 1) participants were selected with the criteria that this study had determined according to the objective's qualifications; 2) all participants were asked for their permission and signed the consent form for participation in the research. The research was information that did not mention the participants, so everything was anonymous, and participation was voluntary; 3) all participants in both groups received a pretest to measure the level of knowledge of each group; 4) the control group learned with traditional learning, and the experimental group was taught in a learning style with PBL divided into sequences; 5) the experimental group was evaluated for their satisfaction with the teaching and learning of PBL; and 6) all participants in both groups received a posttest to measure the level of knowledge of each group (Figure 1).

Research Instruments

Experimental Instrument

The lesson plans of PBL for EMR: This study designed programs composed of specific objectives, content, teaching methods, and evaluation.

The case scenario of EMR: This study designed a case scenario using basic vocabulary, primary nursing care for patients consisting of the patients' profiles, chief complaints, present illness, past illness, medication, and chemical allergy history, family history, review of the system and laboratory results.

Data Collection Instrument

The purpose of the test was to evaluate the acquired knowledge of EMR. The questionnaire consisted of 40 MCQs that tested the ability of EMR of registered nurses. Each question was assigned a value of one score, and the score for this questionnaire ranged from 0 to 40.

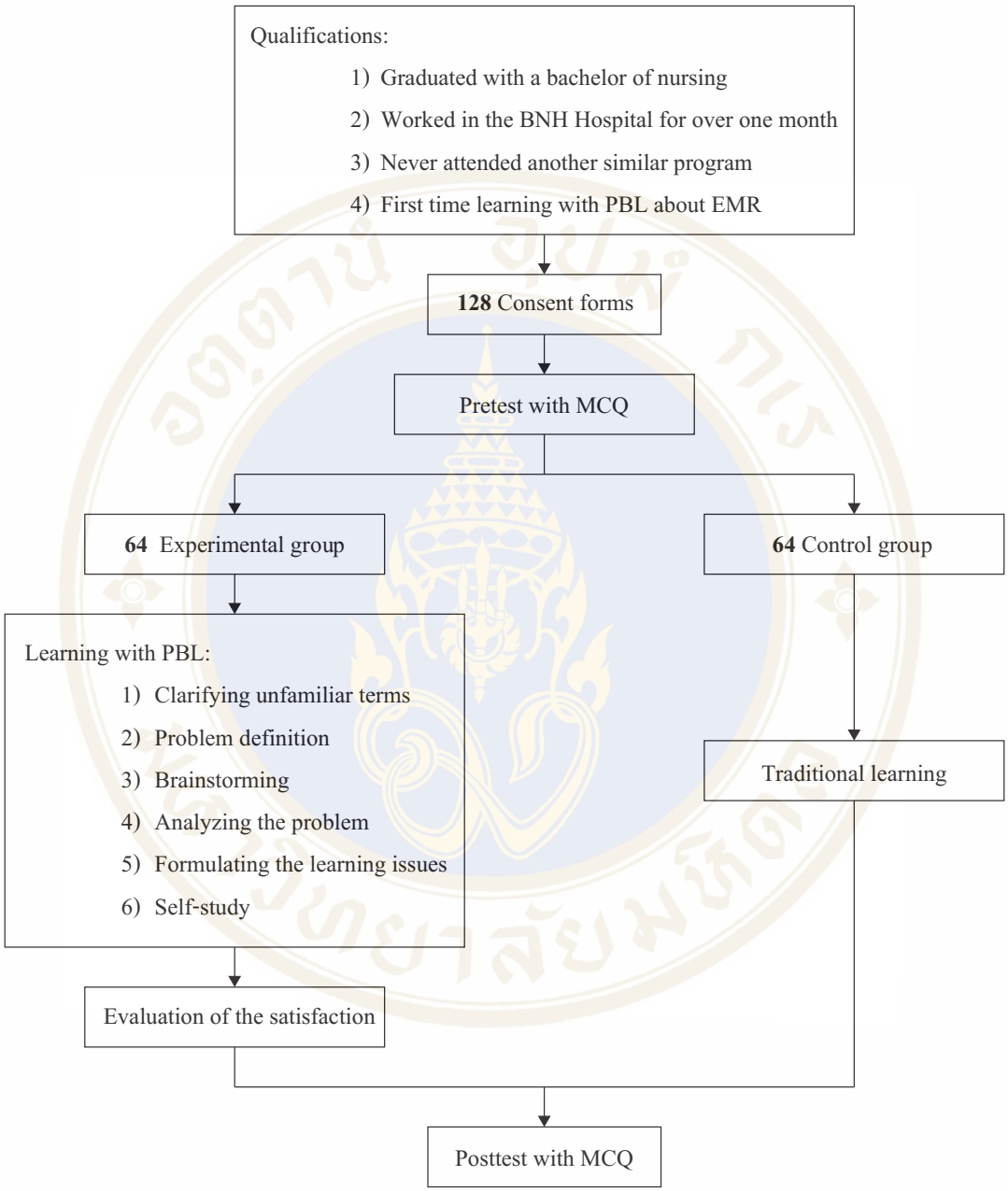
Table of the Specifications of the Test

A choice test was created that determined what content would be measured or evaluated by producing a table of the specifications, which was determined by making the content and level of knowledge content-oriented.

Angoff Methodist

A passing threshold was set using the Angoff method that had the following sequence of steps: 1) the 3 experts assessed that borderline participants (just pass) would answer the question about what percentage was correct; 2) the average of the proportions evaluated by each expert would be found for each item, and 3) the average of the proportions assessed by the experts in each item was added together.

Figure 1. The Flow Chart Shows the Research Procedure



Abbreviations: EMR, electronic medical record; MCQ, multiple-choice question; PBL, problem-based learning.

Instrument Validity and Reliability

The content was validated by 3 experts, who checked the accuracy and coverage of the content and the appropriateness of the language used to meet the set objectives.[4] Researchers made the improvements as suggested. The tools used to find the validity checks were made by calculating the item-objective congruence (IOC) index that comprised MCQ, case scenarios, and satisfaction questionnaires.[5] Then the results obtained from 3 experts were computed using the IOC value according to the formula. This was done to interpret if the average score was from 0.50 to 1.00 points, so it could be concluded if the test could be matched with the required measurement. If the average score were

lower than this measurement, the exam would be revised. Reliability check by the test-retest method took one set of MCQ to test with the same sample 2 times, which was done approximately 2 weeks apart.[6] If too soon, the sample group could remember the exam and answer without producing any new ideas.

Statistical Analysis

This study collected the data from the questionnaires and used the software package with the SPSS statistical software 18.0 (PASW Statistics for Windows, Version 18.0. Chicago: SPSS Inc; 2009).[7] This study performed the following: 1) compared the demographic data of the experimental group and the control group using basic statistics, such as frequency and percentage; 2) calculated the results of the satisfaction questionnaire, in terms of frequency, percentage, mean, and standard deviation (SD); 3) compared the average of the MCQ score differences between the experimental group and the control group and before and after the intervention in the experimental group by using a dependent samples *t* test; and 4) compared the average of the MCQ posttest score differences between the experimental group and the control group before and after the experiment by using an independent samples *t* test.

Results

To find the validity of the MCQ (IOC index), each question had to be evaluated by 3 experts, which were graded +1. The IOC took the sum of the scores in each item by calculating the score and dividing it by the number of experts. That is, the sum of the scores/number of experts equaled 3/3 equals 1.00, and then the results were compared with the criteria. The results of the IOC questionnaire's validity showed that the questions were highly accurate and applicable. There were 23 exams with an average of 1.00 valid values available and 17 exams with an average of 0.6 with a validity value available.

The reliability results of the scores of the same test were performed twice after 2 weeks of trials at different times. The result was that the experimental group scored almost the same on both occasions, thus meaning the test was highly reliable. The value of confidence expressed as 1.00 indicated that the confidence was high. The confidence value was tested using the test-retest reliability method because the same test was performed at a different time. The results also had a high coefficient, so this test demonstrated high confidence.

The experimental group's characteristics presented the gender, age, marital status, and working experience in the BNH Hospital. Most of them (85.90%) were female with a mean age of 30.69 years. Regarding marital status, 59.40% were single. About 51.10% of participants had working experience of more than 5 years, whereas the minority (15.60%) reported working experience of fewer than 2 years (Table 1).

The comparison of the average MCQ scores difference within the experimental and control groups before and after the experiment found that the mean (SD) of the experimental group in the pretest was 17.73 (03.33), and the posttest was 38.91 (1.84), with statistically significant differences ($P < .01$). The mean (SD) of the control group in the pretest was 17.33 (3.39), and the posttest was 27.13 (2.50), with statistically significant differences ($P < .01$) (Table 2).

After the experiment, the average knowledge of the posttest score difference between the experimental and control groups found that the mean (SD) of the pretest in the experimental group was 17.73 (3.33), and that of the control group was 17.33 (3.39), with no statistically significant differences ($P = .50$). The mean (SD) of the posttest in the experimental group was 38.91 (1.84), and that of the control group was 27.13 (2.50), with statistically significant differences ($P < .01$) (Table 3).

Overall satisfaction level of PBL had an average of 4.55 (0.50). To evaluate the satisfaction level as strongly satisfied, the results showed that the time, location, and facilities had an average of 4.56 (0.50) with a mark of strongly satisfied. The EMR course content had an average of 4.55 (0.49) and was strongly satisfied. PBL and applying knowledge had an average of 4.54 (0.49) with a mark of strongly satisfied (Table 4).

Table 1. Demographic Characteristics of Participants in the Experimental Group

Feature	No. (%)
Gender	
Male	9 (14.10)
Female	55 (85.90)
Age, y	
20 - 25	14 (21.90)
26 - 30	19 (29.70)
31 - 35	18 (28.10)
36 - 40	13 (20.30)
Marital status	
Single	38 (59.40)
Married	26 (40.60)
Working experience, y	
< 2	10 (15.60)
2 - 5	20 (31.30)
> 5	34 (51.10)

Table 2. Comparison of the Differences in the Pretest and Posttest Score

Group	Test	Mean (SD)	*P* Value*
Experimental	Pretest (n = 64)	17.73 (3.33)	< .01
	Posttest (n = 64)	38.91 (1.84)	
Control	Pretest (n = 64)	17.73 (3.39)	< .01
	Posttest (n = 64)	27.13 (2.50)	

Abbreviation: SD, standard deviation.

*A significant difference was set at the level of $P < .05$.

Table 3. Comparison of the Differences in the Pretest and Posttest Scores of the Study Between the Experimental and Control Groups

Test	Group	Mean (SD)	*P*-Value*
Pretest	Experimental (n = 64)	17.73 (3.33)	.50
	Control (n = 64)	17.33 (3.39)	
Posttest	Experimental (n = 64)	38.91 (1.84)	< .001
	Control (n = 64)	27.13 (2.50)	

Abbreviation: SD, standard deviation.

*A significant difference was set at the level of $P < .05$.

Table 4. Overall Satisfaction Level of PBL

Topic	Mean (SD)	Satisfaction Level
Content of the EMR course	4.55 (0.49)	Strongly satisfied
PBL	4.54 (0.50)	Strongly satisfied
Applying knowledge	4.54 (0.50)	Strongly satisfied
Time, location, and facilities	4.56 (0.50)	Strongly satisfied
Total	4.55 (0.50)	Strongly satisfied

Abbreviations: EMR, electronic medical record; PBL, problem-based learning; SD, standard deviation.

Discussion

Regarding the results of the pretest scores between the experimental and control groups, following the prior studies of PBL, the aim of this study focused on direct experience, in which the emphasis was placed on practice and problem-solving thinking skills. Additionally, PBL helped to motivate learning and could promote the development of analytical thinking skills, problem-solving ability, and communication skills.[8] Therefore, all of these skills could provide opportunities for group work. The study results showed no significant difference when comparing the pretest scores between the experimental and control groups.

Regarding the results of the posttest scores between the experimental and control groups, this study found a difference in posttest scores between the experimental and control groups. At the same time, the analysis results showed that the experimental group was able to answer the questions after the experiment and received more test scores than the control group with the control learning. The examinations governed their knowledge and helped motivate the registered nurses to learn. They also gained different experiences, such as studying at work depending on their schedule. Furthermore, self-paced, relevant learning may allow a wide range of experiences to affect the knowledge level of the registered nurses and help build good thinking and problem-solving skills.

The experimental group results of the pretest and posttest results of the experimental group were significantly different. This could be because the registered nurses had proficient skills in EMR, and PBL encouraged them to increase their practice of thinking skills, problem-solving situations, and planning for the examination.

As to the control group, although the pretest and the posttest results of the control group showed a statistically significant difference, the difference between the scores was not large due to the high scores on the pretest results. The scores before studying were not too different from the results after looking.

PBL findings in EMR are a learning process starting from problems that arise, which must be closed and faced daily. Registered nurses would be able to recognize these and find ways to create knowledge by using the necessary process. Working as a group to solve the problem, the problem itself was the focus of this form of learning management with the critical aspects of PBL management and with that learning management.[9] Problem-based knowledge would require problem-based activities, so appropriate problem formulation would be at the heart of this form of learning management. Guidelines for choosing the problem would apply to this form of learning. PBL also has its limitations: it is suitable for a profession where applied science cannot be applied to all courses, and in its use, it must be well planned and prepared. Group teaching skills would also be required, and registered nurses must be responsible for their learning and cooperate in co-learning, open classrooms, and learning resources that would be conducive to learning.[10]

Concerning the results of assessing the readiness for the adoption of electronic health records, the hospital should have management and leadership readiness, operational readiness, supervision, and the availability of the EMR system.[11] This showed that the estimates for adopting essential electronic health records (EHRs), comprehensive EHRs, and the computerized physician order entry (CPOE) were also computed from relevant information technology (IT) supported functions for cross-study comparisons.[12]

The results supported the study's findings, which surveyed "developing a theoretical model and a questionnaire survey tool to measure the success of the EHRs in the care of the elderly". For the research to be effective, this should assess the quality of the data quality system and the satisfaction assessment of the EHRs.[13]

There were some limitations related to the interpretation and application of the findings from this study. The methodological limitations and the performance of the findings in this study should be identified for the benefit of future research with sample size calculation recommendations. Further research may be possible with various sample sizes. A comparison of peer and group reviews could be conducted. Investigators may choose an inappropriate randomization method because the distribution of participants' characteristics may affect the effectiveness of the scores. However, this study did not have any bias or stake in the experimental group in this study. Therefore, these are suggestions for development in future research and the information could be presented in each aspect according to the specification.

Moreover, study sample issues were limited by having only one sample group: registered nurses. Therefore, this research could not sum up the total hospital service-learning experience. Hence, the same method of learning should be tested among other groups, such as doctors, to reach more accurate conclusions about the effectiveness of PBL methods. This study sample was chosen using purposive sampling, thus resulting in an unequal distribution of the experimental group's diversity. Therefore, further studies should select an appropriate randomization pattern.

Regarding instrumentation issues, despite the acceptable reliability of the pretest and posttest knowledge in the English version, there were no localized tools provided by this study, so only the fundamentals of the registered nurses were translated. For future research in this form of study, the tests should be translated to suit the context of each hospital and further specialize the knowledge to improve the assessment.

Conclusions

This study encouraged learners to use their existing knowledge or experience to solve problems. PBL resulted in registered nurses being more involved in learning EMR than in traditional learning and having a good satisfaction with learning.

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ผลของการเรียนรู้โดยใช้ปัญหาเป็นฐานต่อความรู้ในเวชระเบียนอิเล็กทรอนิกส์สำหรับพยาบาลวิชาชีพ

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บทนำ: โรงพยาบาลเอกชนได้เปลี่ยนระบบเวชระเบียนจากการใช้กระดาษเป็นเวชระเบียนอิเล็กทรอนิกส์เพื่อให้เป็นไปตามมาตรฐานสากล โดยเริ่มจากการฝึกอบรมในระดับหัวหน้าพยาบาลและพยาบาลวิชาชีพ เพื่อให้เกิดความมั่นใจในการเปลี่ยนแปลงรูปแบบเวชระเบียน และเป็นไปอย่างต่อเนื่อง

วัตถุประสงค์: เพื่อศึกษาผลของการเรียนรู้โดยใช้ปัญหาเป็นฐานทางเวชระเบียนอิเล็กทรอนิกส์สำหรับพยาบาลวิชาชีพ

วิธีการศึกษา: การออกแบบการวิจัยกึ่งทดลอง เก็บข้อมูลจากกลุ่มตัวอย่างพยาบาลวิชาชีพของโรงพยาบาลบีเอ็นเอช กรุงเทพฯ ประเทศไทย จำนวน 128 คน ประกอบด้วย กลุ่มทดลอง จำนวน 64 คน และกลุ่มควบคุม จำนวน 64 คน แต่ละช่วงที่ได้รับมอบหมายคือ 6 ชั่วโมง เครื่องมือที่ใช้ประกอบด้วย คำถามแบบปรนัย กรณีสถานการณ์ และแบบสอบถามความพึงพอใจ

ผลการศึกษา: คะแนนเฉลี่ยของการเรียนรู้โดยใช้ปัญหาเป็นฐานพบว่าหลังการทดลองคะแนนในกลุ่มทดลองสูงกว่าเมื่อเทียบกับกลุ่มควบคุม โดยมีความแตกต่างอย่างมีนัยสำคัญ (Mean [SD], 38.91 [1.84] และ 27.13 [2.50] คะแนน ตามลำดับ, $P < .05$) โดยภาพรวม ระดับความพึงพอใจของการเรียนรู้โดยใช้ปัญหาเป็นฐานอยู่ในระดับที่น่าพอใจ (Mean [SD], 4.55 [0.50] คะแนน)

สรุป: การเรียนรู้แบบใช้ปัญหาเป็นฐานส่งผลให้พยาบาลวิชาชีพมีส่วนร่วมในการเรียนรู้ในเวชระเบียนอิเล็กทรอนิกส์มากกว่าการเรียนการสอนแบบเดิม และมีความพึงพอใจที่ดีต่อการเรียนรู้โดยใช้ปัญหาเป็นฐาน

คำสำคัญ: การจัดการเรียนรู้โดยใช้ปัญหาเป็นฐาน เวชระเบียนอิเล็กทรอนิกส์ พยาบาลวิชาชีพ

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