EFFECTS OF A BLENDED LEARNING MODEL INTEGRATING SITUATED MULTIMEDIA LESSONS AND COGNITIVE APPRENTICESHIP METHOD ON THE CLINICAL REASONING SKILLS OF NURSING STUDENTS

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ABSTRACT:

Background: Current instructional methods have not been successful in equipping nursing students with clinical reasoning skills enabling them to provide quality care to patients. The present research aimed to examine the effects of a blended learning model integrating situated multimedia lessons and cognitive apprenticeship method on the clinical reasoning skills of nursing students.

Methods: In this quasi-experiment and control pretest-posttest study, 56 third year nursing students at the Royal Thai Navy College of Nursing were paired based on their academic performance and then assigned to the experimental group or the control group using a simple random sampling method. The experimental group attended a ten-day class integrating the delivery of situated multimedia lessons containing six instructional stages: introduction, observation of the expert cognitive modeling, practice and reflection, demonstration of knowledge, application, and conclusion. In contrast, the control group took a ten-day blended learning class without the incorporation of situated multimedia lessons and cognitive apprenticeship method. The Script Concordance Test was employed to evaluate the participants' pretest-posttest clinical reasoning skills.

Results: The average clinical reasoning scores at start of experimental and control groups were rather similar. The posttest clinical reasoning score of the experimental group was significantly higher than its pretest score ($Mean \pm SD$=73.07±6.58 and 56.12±9.97; p<.001). The score of experimental group at posttest was significantly higher than the control group ($Mean \pm SD$=73.07±6.58 and 68.83±7.85, p<.05).

Conclusion: A blended learning model integrating situated multimedia lessons and cognitive apprenticeship method can enhance the clinical reasoning skills of nursing students. However, the application of the model should involve the preparation of learners in terms of self-directed learning and thinking skills, which form the basis of clinical reasoning skills.

Keywords: Clinical reasoning, Nursing students, Instructional model, Blended learning, Multimedia lessons, Situated learning, Cognitive apprenticeship

DOI: *Received: February 2016; Accepted: April 2016*

INTRODUCTION

One of the challenges in the 21st century for nurses is the ability to respond to increasing complex healthcare demands, including the application of clinical reasoning skills for effective health management [1, 2]. Clinical reasoning constitutes the intellectual process involved in comprehending a health problem and making a decision regarding the healthcare demands of a

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Cite this article as: Sadhuwong K, Koraneekij P, Natakuatoong O. Effects of a blended learning model integrating situated multimedia lessons and cognitive apprenticeship method on the clinical reasoning skills of nursing students. J Health Res. 2016; 30(6): 421-31. DOI:

patient. It comprises five stages: analyzing the situation, formulating preliminary assumptions, collecting and processing information, making a judgment, and reviewing the decision [3-7]. In clinical reasoning processes, more experienced nurses take both a formal/analytic and an informal/non-analytic method, effectively applying relevant knowledge and experience [8, 9]. In contrast, less experienced nurses, such as nursing students and new graduates, are unable to process information systematically, fail to review the existing information, neglect important information, are indecisive, and make errors in planning or providing healthcare services – any of which could result in unnecessary complications or the loss of life [10, 11].

Not only is clinical reasoning a complex ability that nursing students may find hard to develop [11, 12], but current instructional methods have also failed to equip nursing students with such a skill [13], to link classroom knowledge with clinical practices, and to draw on the experiences of more capable nurses in training novice nurses. To enhance clinical reasoning skills, several methods, such as situated learning and cognitive apprenticeship, have been developed, but none has been proven to be the most effective [14].

Among these, blended learning is a method that integrates situated learning with technology and online instruction to promote hands-on experience and the interaction between learners, instructors, and instructional contents [15, 16]. The method has been successful in bettering the lack of a linkage between classroom knowledge and clinical practices that was once a problem in traditional classrooms [15]. Learners receiving training following a blended learning were found to develop greater skills, and further research in this area is thus advised [17-19].

Instrumental in blended learning is the application of multimedia lessons in an order through which authentic learning is achieved based on pre-determined learning objectives [20]. In designing multimedia lessons, situated learning is a principle that can be followed to ensure authentic learning, expose learners to appropriate role models and a wide variety of professional perspectives, and maximize the chances for reflection and communication through collaborative learning method with instructors serving to provide guidelines, improve learners' professional skills, and carry out authentic performance assessment [21]. A number of multimedia lessons have been shown to be effective in improving nursing students' general professional abilities and clinical reasoning skills [22].

An integral element of situated learning is cognitive apprenticeship, an instructional method that centers on learners' observation of the thinking process of experienced role models and their cognitive apprenticeship. In this process, learners engage in reflection, the demonstration of knowledge, and the self-directed application of their learning [23]. Technology-supported cognitive apprenticeship has been adopted to enhance nursing students' knowledge and professional abilities [24], integrated with situated learning and instructional technology to promote clinical skills [25], and administered to better nursing students' clinical reasoning and problem-solving skills [26]. Research has shown that learners undergoing a computer-aided authentic learning and a cognitive apprenticeship method are likely to perform better than those receiving traditional training [27].

The foregoing discussion points to the likelihood that a blended learning model integrating situated multimedia lessons and cognitive apprenticeship method may be effective in solving problems relating to the lack of clinical reasoning skills among nursing students. However, little research has been conducted on the application of the model, particularly in terms of its effects on the development of clinical reasoning skills in comparison with other methods. Furthermore, existing studies are lacking in the incorporation of instructional theories in designing blended learning models and have yielded mixed results.

The objectives of this study are to compare the clinical reasoning skills of nursing students before and after receiving training through a blended learning model integrating situated multimedia lessons and cognitive apprenticeship method, and to compare the clinical reasoning skills of nursing students after receiving training through the blended learning model with those of nursing students undergoing blended learning without the integration of situated multimedia lessons and cognitive apprenticeship method.

METHODS

Study design

Quasi-experiment and control pretest-posttest design was utilized in this study.

Participants

The total of 56 third-year nursing students at the Royal Thai Navy College of Nursing (RTNCN) enrolled in the summer semester of the academic year 2014 were purposively included into the study. Paired was made to ensure comparability in terms of their academic performance before grouping into 2 groups, and then randomly assigned to the experimental and the control group with the resulting number of 28 in each, a figure exceeding the minimum required sample size of 27 based upon 95% confidence level, 80% power and the effect size of .50.

Ethical consideration

The study was approved by the Ethical Review Committee for Research in Human Subjects of the Naval Medical Department (ref. no. COA-NMD-REC009/58). To protect their rights, the participants were free to exercise their discretion in participating in or withdrawing from this research without any consequences to their studies or personal life. All information concerning the participants was kept confidential throughout the research process and presentation of the findings.

Research instruments

1. Blended learning model integrating situated multimedia lessons and cognitive apprenticeship method

The blended learning model was developed based on systematic instructional design processes following four basic principles, namely authentic learning, cognitive apprenticeship, technology-supported instruction, and authentic assessment [21, 23, 29, 30]. The model involved six instructional management elements: instructional content relating to clinical reasoning based on human-caring principles; the nursing students as apprentices developing themselves to enter their profession with basic knowledge and clinical experience; the nursing instructors as teachers and intellectual role models; instructional methods centering on the nursing students' observation of the thinking process of the role models and their cognitive apprenticeship; instructional media and technology promoting authentic learning and cognitive apprenticeship, integrating face-to-face and online instruction with situated multimedia lessons; and authentic performance assessment during and after instruction using the Script Concordance Test [7, 8, 16, 21, 23, 26, 29, 31-33]. The instructional process further comprised six stages, namely the introduction of the instructional activities to prepare the students in terms of necessary content as well as the administration of the pretest; observation of the role models, involving learning the clinical reasoning processes of experienced nurses in 4 different situations through multimedia lessons; practice and reflection, involving the nursing students' practices in the same situations as in the previous stage and their post-practice reflection; demonstration of knowledge, in which the nursing students took part in presentations and group discussions on what they had learned; application, involving the nursing students' practices in new situations through a multimedia lesson without observation of the role model and practice assisting; and conclusion, in which the learning outcomes were summarized and the administration of the posttest was carried out. The quality of the design of the model was approved by five experts.

2. Situated multimedia lessons

The situated multimedia lessons, aimed at enhancing the nursing students' clinical reasoning skills, were designed based on situated learning principles [32]. The lessons comprised four clinical situations, ranging from the most basic to the most complex. For each situation, the practice sequences were as follows. First, the participants observed the clinical reasoning practices of the models as presented in the lesson. After the lesson, they did a drag and drop exercises and a multiple-choice exercises both of which involved the following five stages of clinical reasoning: analyzing the situation, formulating preliminary assumptions, collecting and processing information, making a judgment, and reviewing the decision. Their responses had to coincide with those of the models. Passing more basic exercises was required for more advanced practices. Finally, the participants applied what they had learned in new situations without any form of assist [21, 23, 29, 32]. The situated multimedia lessons had been tried out on 3 fourth-year nursing students of RTNCN who have similar characteristics to the subjects and proven to be effective instructional material. The multimedia lessons were accessible to the nursing students through the website: http://elearningnnc.nmd.go.th/elearning/. The examples of situated multimedia lesson screens are shown in Figure 1-4.

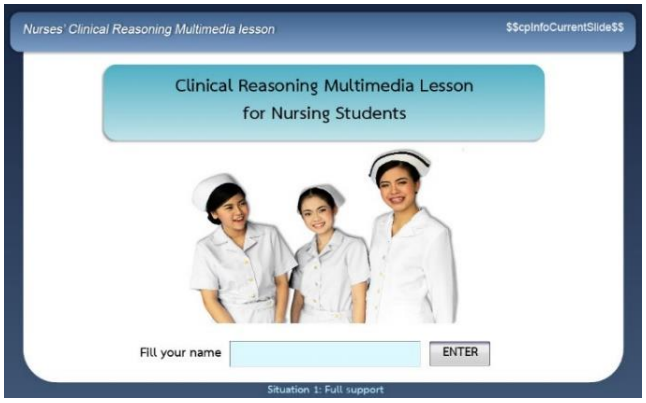

Figure 1 The example of situated multimedia lesson screens: Title

Figure 2 The example of situated multimedia lesson screens: Practical steps

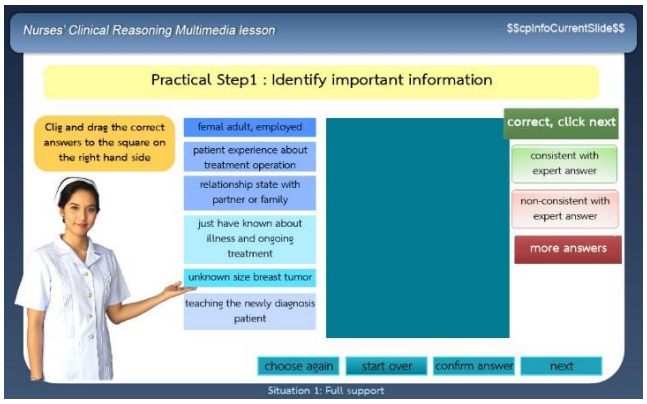

Figure 3 The example of situated multimedia lesson screens: Situation

Figure 4 The example of situated multimedia lesson screens: Practical lesson

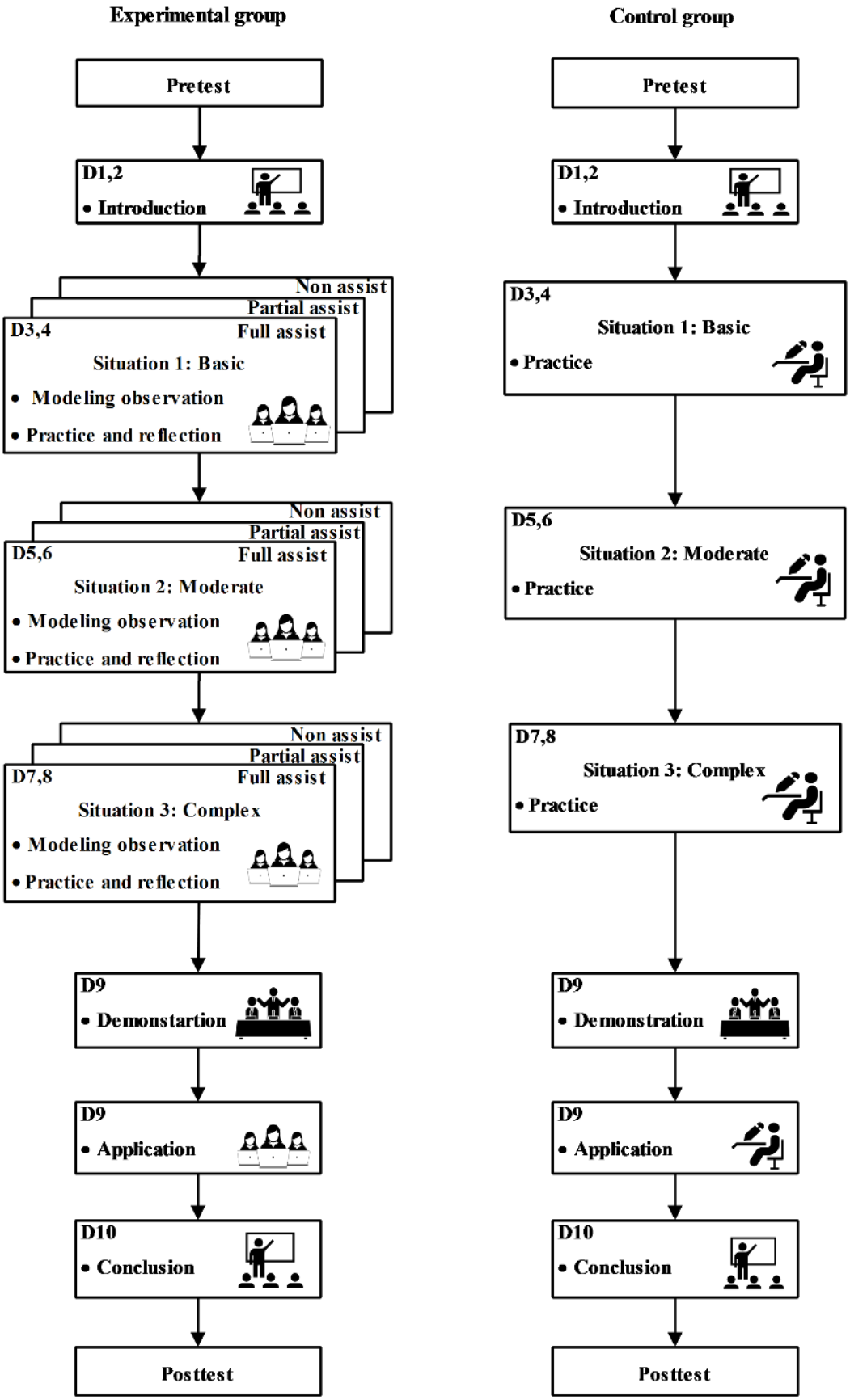

Figure 5 The research procedures

Data collection instrument

The Script Concordance Test (SCT) is an instrument for the evaluation of nursing students' clinical reasoning skills following Watson's theory of human caring. The use of the test was authorized by its authors [33, 34]. To ensure equivalence to the original in terms of language and meaning, the test was translated into Thai and then back-translated. It was also verified in terms of content validity with three human caring experts and piloted with 10 fourth-year nursing students of RTNCN (reliability coefficient=0.87). The SCT is consisting of 4 parts, 1) 29 Nursing situations requiring nurse to perform clinical reasoning for problem assessment or planning the nursing care 2) Examples of hypotheses or alternatives including 3-4 hypothetical items derived from each situation 3) Additional information for each hypothesis 4) Assessment of consistent level between each hypothesis and their additional information using a five-point Likert scale: -2, -1, 0, +1, +2, with "-2" representing no correspondence and "+2" representing highest correspondence. The scoring grid for each item was conducted with 15 nursing experts who carried out the same SCT earlier, then the expert responses were calculated by the method "the number of the experts who selected the choice divided by the highest number of the experts in each item", so the score "1" was assigned for the choice which being chosen by the most of experts and the score "0" for the choices which being chosen by no experts. The respondents had 100 - 120 minutes of testing period. The total score of 92-item SCT was computed to 100 and the clinical reasoning level was evaluated by comparing the scores of each respondent with the experts' mean score. The passing criteria for the nursing students was set at not lower than -4*SD* of the experts' mean score, the respondent who had high clinical reasoning skills referred to those whose scores were close to the expert's mean score. [33, 34].

Procedures

To evaluate their pre-test clinical reasoning skills, the experimental group and the control group took the Script Concordance Test. To prevent treatment effects, the control group first underwent a blended learning class comprising the following five stages: introduction, practice, demonstration of the knowledge, application, and conclusion, but without the integration of situated multimedia lessons and cognitive apprenticeship method. The ten-day class took place during July 14-23, 2015, lasting 58 hours consisting of 34 hours of face-to-face learning and 24 hours of online learning. Then the experimental group received training in a blended learning class integrating situated multimedia lessons and cognitive apprenticeship method comprising six stages: introduction, observation of the role models, practice and reflection, demonstration of knowledge, application, and conclusion. The ten-day class also lasted 58 hours consisting of 22 hours of face-to-face learning and 36 hours of online learning, taking place during July 24-August 2, 2015. The treatment process of the experimental group was different from the control group in term of the additional steps of expert modeling observation in clinical reasoning process and reflection through computer based multimedia lessons. In contrast of the control group, the multimedia lessons, modeling observation and reflection process were removed and the practice was conducted through paper based lessons. The two groups were taught by the principal author of this research. To assess their posttest clinical reasoning skills, the experimental group and the control group took the Script Concordance Test again. The model of research procedures is presented in Figure 5.

DATA ANALYSIS

Kolmogorov-Smirnov test was performed to validate normality of the pretest and posttest clinical reasoning scores of the experimental and control groups. Levene's test was used to examine the homogeneity of variances between the two independent sets of data. Paired *t*-test was applied to compare the difference between the pretest and posttest scores of each studied group and Independent *t*-test was adopted to validate the difference of the pretest and posttest scores between the experimental and control group. The significance level was set at 5%.

RESULTS

According to the results of the Kolmogorov-Smirnov test and the Levene's test demonstrated that the pretest and the posttest clinical reasoning of the two groups were normally distributed and homogenous in terms of variance ($p>.05$). The average clinical reasoning scores at start of experimental and control groups were rather similar (M=56.12±9.97 vs. M=56.89±10.40; $p>.05$). The posttest score of the experimental group was significantly higher than its pretest score (M=73.07±6.58 vs. M=56.12±9.97; $p<.001$) and the

Table 1 Comparison of the clinical reasoning scores at pretest and posttest, and difference of pretest and posttest score between the experimental group and the control group

	Control (28)		Experiment (28)		*p*-value[1]
	Mean	***SD***	***Mean***	***SD***	
Pretest	56.89	10.4	56.12	9.97	0.780
Posttest	68.83	7.85	73.07	6.58	0.033
Diff.=(posttest-pretest)	11.94	8.86	16.95	9.72	0.049
p-value[2]	<.001		<.001		

( ) sample size, [1] independent samples *t*-test, [2] paired *t*-test

score of experimental group at posttest was significantly higher than the control group (M=73.07±6.58 vs. M=68.83±7.85; p<.05), that made the change of the average score of experimental group was significantly different from the control group (p<.05), as the detail shown in Table 1.

DISCUSSION

It was found that the nursing students in the experimental group achieved a statistically higher posttest score both within the group and in comparison with those in the control group, thereby confirming the research hypotheses and the effectiveness of the blended learning model integrating situated multimedia lessons and cognitive apprenticeship method.

As for situated multimedia lessons, the present findings are consistent with those of past research on the application of computer-supported instruction in developing the clinical reasoning skills of nursing students, including interactive computerized decision support framework [3], online case studies and web tools [26], and interactive multimedia simulation [22]. The effectiveness of situated multimedia lessons is perhaps attributable to their infusion of authentic learning through the presentation of real healthcare planning and problem-solving processes undertaken by expert nurses from basic to more complex situations which nursing students can observe and learn from. In each situation, various forms of assistance are provided that resemble authentic clinical practices in which more experienced nurses supervise less experienced ones. Assistance is fully provided at first prior to being reduced to no assistance at all when learners can perform increasingly demanding tasks without suffering cognitive load. In addition to their strengths in terms of authenticity and assistance, situated multimedia lessons also promote learners' interaction through the incorporation of in-depth questions, follow-up and feedback features, and on-demand practice and revision functions [29, 30].

Regarding cognitive apprenticeship method, the findings of this study suggest that the observation of cognitive model is likely to enhance clinical reasoning skills of the students. This findings emphasize the important role of the cognitive modeling for training the less experienced and less knowledgeable learners about critical and complex cognitive skill tasks as the clinical reasoning requiring concrete cognitive modeling before self-reliant practices [35]. This is probably because their observation of cognitive models will enable them to depict the thinking process of and the application of knowledge by experts in real-life situations [35], which is more effective than trial and error practices without the cognitive modeling [36]. Such a postulation coincides with the opinions of 2 participants in the experimental group, who gave the following comments: "Observation demonstrates the mindsets of experts from the outset" and "The way experts think is more comprehensive and complete, and we still fail to consider the issues that they do." On the other hand, the practices without expert modeling of the control group seemed to be more complicated relating to one participant complained that "As inexperienced nurses, we should turn our hand to new cases only after seeing an example."

Another element of cognitive apprenticeship method that helps to enhance clinical reasoning skills is their concrete provision of guidance and feedback relating to mistakes that learners can later employ for self-development [31, 37]. In this study, it was found that most of the nursing students in the experimental group were able to pass more complex tasks providing less assistance following the first demonstration of the role models. The success gaining through their task with the expert assistance and guidance during the exercises will motivate the learners to complete the next challenges [36]. In contrast, for solving the complex situations without the expert modeling and advice, the control group

had to make their own decision with their insufficient cognitive abilities which caused anxiety and frequent errors during performing their tasks. This finding is in line with that of previous studies indicating that success in increasingly complicated exercises with reduced assistance can promote self-confidence and hence further learning effort [35, 38]. Additionally, it supports the opinions of 3 participants in the experimental group who gave the similar opinions to: "Tasks providing partial assistance are more challenging requiring more thorough consideration, while those with no assistance at all are quite stressful as mistakes can be made only once, so we need to think carefully" and "Assistance aids us in beginning tasks and makes us more proficient in more advanced exercises".

In cognitive apprenticeship method, learners' post-practice reflection and discussion of their performances in different situations as compared to those of experienced nurses or fellow students also entail the schematization of knowledge into long-term memory and intellectual ability that they can later draw on [3, 5], thereby creating meaningful learning [31, 37]. According to past research, reflection is an effective means for enhancing the clinical reasoning skills of nursing students[39]. Similarly, the demonstration of knowledge and application stages provide nursing students the chance to express their ideas through argumentation in group discussions and presentations which strengthens their internal cognitive process and hence their clinical reasoning skills [40, 41], while the evaluation stage lays the foundation for further development of their expertise [23, 35].

Despite the apparent benefits of the cognitive apprenticeship method, it is interesting to note about the effects from the repeated practices in a similar situation and cognitive modeling which may induce rote memorization and less challenging practices to the learners instead of promoting cognitive rehearsal. For this matter of fact, the role of teacher in directing and facilitating the learners' thinking process and the multimedia lesson procedures administered from the basic to the complex situation and providing less assistance were effective strategies to manage that problem regarding students' inattentive practice.

Although, the effectiveness of this instructional model on clinical reasoning was found for all participants in the experimental group, there were comments from 2 participants having high scores in practical lessons as "Observing the role models before practice made me feel I couldn't think freely as I needed to follow the thinking process of the experts". Subsequently, an issue was raised concerning whether these highly learner support procedures of the model were appropriate to an independent learner. Regarding the study about the learners' learning styles informing that the independent learners' learning outcomes may depend more on their effective self-directed learning than the external learning support, then the cognitive modeling and assistance might not necessary since they usually persevere with their efforts to develop their own skills with little reliance on assistance or expert opinions which likely to be opposite to the dependent learners[42]. However, the characteristics of students participating in this study were novice learners with less experiences in clinical setting and less knowledge supporting to clinical reasoning skills, then the process of expert modeling and fully guided practice were highly recommended for this group of students [43]. For this reason, to promote the effectiveness of the learning model to all learners having different learning styles, the further study should be address on learner analysis and designing the appropriate instructional activities which meet the learner needs and learning styles such as beginning practice with more difficult situation and less learner support for independent learners.

Moreover, it is worth noting that blended learning alone also proven effective in the development of clinical reasoning skills. In this research, the nursing students in the control group achieved a statistically higher posttest clinical reasoning scores compared to their pretest scores, a finding supporting previous studies of the integration of blended learning in the area of nursing [17, 19]. However, for the best contribution to clinical reasoning outcomes, it is recommended that blended learning should be delivered in conjunction with the administration of online instructional materials that promote authentic learning and the interaction between learners, instructors, and content [15, 16].

RECOMMENDATIONS FOR FURTHER RESEARCH AND APPLICATION

1. Studies should be conducted on instructional methods that help nursing students to develop the thinking strategies involved in clinical reasoning processes, for example, the formulation of assumptions, the collection and processing of

information, and logical introspection, which form the basis of clinical reasoning skills. Another interesting line of research is the means to promote learners' intellectual ability required for their clinical reasoning practice with the compliment of technology based learning, such as the stimulation of reflection, self-directed reflection and practice, and self-generated motivation for the nursing students' successful learning. Finally, studies should be carried out to explore the effects of blended learning integrating situated multimedia, authentic learning, and cognitive apprenticeship elements on learners with different learning styles and strategies.

2. Nursing and nursing education administrators should attach importance to the clinical reasoning skills of nurses and nursing students. For instance, clinical reasoning skills may be designated as a performance indicator of nursing graduates. Additionally, a learning environment that promotes such skills should be created through the collaboration between clinics and educational institutions, the training and development of nursing instructors and clinical experts, and the integration of instructional technology, for instance.

3. Regarding instructional management, content relating to clinical reasoning skills should encompass related important nursing principles, such as the prevention of patient complications during hospital stays, rescue measures, and medication. Another important consideration is the timing of clinical skill training. As the present findings show, it should be organized during summer semesters to avoid interference with the already tight teaching schedule of regular semesters. Alternatively, should clinical skill training be administered during regular semesters, it should be ensured that the content is appropriately incorporated into the theoretical or practical components to prevent excessive burden on instructors and nursing students. This may be run in the form of self-directed learning through online media under instructors' supervision complemented by group discussions and presentations with should have online learning time available at least 30-79% of total time complied with the recommendations of learning time allocation for blended learning [16].

4. To maximize the effectiveness of blended learning methods, learners should be well prepared in terms of the abilities and attributes required for self-directed learning and clinical reasoning ability, including thinking analytically, formulating hypotheses, collecting and processing information, and making a judgment, enthusiasm, determination of self-development, and learning autonomy. The development of these essential skills should be conducted in the introductory phase, in case the learner analysis displays that the learners in group or individual have less essential abilities, the preparation phase may be extended to assure that the learners meet all basic requirements. Likewise, instructors should also be prepared in terms of instructional content, authentic learning, cognitive apprenticeship, evaluation of clinical reasoning skills, and the use of instructional technology. Moreover, communication between learners and instructors should be reinforced by making it possible for the two parties to interact with each other both in and out of classrooms and clinics.

5. The administration of blended learning integrating instructional technology should take into account the context, the preparedness of learners, the readiness of internet networks, and other related factors, as well as the strengths and weaknesses of the technology to be employed. The multimedia lessons used in this research were developed using the Sharable Content Object Reference Model (SCORM), a technology enabling the installation of instructional content on websites or other instructional management systems, the configuration of various levels of learning complexity and assistance, the record of learning activities and performances, and the incorporation of authentic learning components. Since the design, development, and application of this type of multimedia lessons are complex, experts are required throughout the process.

CONCLUSIONS

This study proves the effectiveness of blended learning model integrated situated multimedia lessons and cognitive apprenticeship method for enhancing the nursing students' clinical reasoning skills. The instructional model implementation must be completely consistent with all the basic learning principles, the instructional elements and the processes of the model. In addition, the learner analysis and preparation of the nursing students' basic cognitive abilities required for clinical reasoning process before commencing the instructional processes are necessary for better learning outcomes in technology based learning.

ACKNOWLEDGEMENTS

The author would like to express gratitude to Chulalongkorn University for granting 'The 90th Anniversary of Chulalongkorn University Fund (Ratchadaphiseksomphot Endowment Fund)' and the 43rd class nursing students of the Royal Thai Navy College of Nursing for participating in the study.

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