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Original Article

Evaluating the impact of jigsaw (Puzzle) cooperative learning model as a new model of education on clinical competency of nursing students

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ABSTRACT

Background and objective: Clinical education is one of the most important and determining parts of nursing education. Success in this path requires the adopting effective approaches, which create required preparation in learners in line with the today's knowledge and in accordance with new needs of clients and patients. The objective of this study was to examine the effect of jigsaw cooperative learning method as a new model of education on clinical competency of nursing students. Methodology: In a quasi-experimental study with pre-test and post-test design, 70 nursing students, studying in semesters 6 and 8, were selected by using census method. Then, each semester students were randomly divided into four groups (each group contained 6 to 10 subjects). Then, they were assigned into two groups of control (n=34) and experimental (n=36). After performing the pre-test of cognitive skills, the students of the control group received clinical education for 15 days using conventional method and students of experimental group received jigsaw cooperative learning method for 15 days. Finally, the students' cognitive skills were tested with a post-test and their behavioural skills were tested with a checklist. Data were analyzed using SPSS 19 software and descriptive statistics (frequency distribution, mean and standard deviation), and inferential statistics (Chi-square test, independent t-test and paired t-test). Results: The results revealed that the jigsaw cooperative learning method is effective in improving students' knowledge and skills. Examining the mean scores of performance before and after jigsaw cooperative learning method showed significant difference. Comparison of clinical competency of nursing students before and after implementing the conventional learning method and jigsaw cooperative learning method showed a significant difference. Conclusion: The jigsaw cooperative learning method provides a high level of learning for students and it seems that this method structure to provide the maximum opportunities for learning and professional development and clinical competency.

Keywords: jigsaw cooperative learning method, clinical experience, competency - nursing students

Introduction

Nursing is a practice-based discipline, in which students' ability to acquire clinical skills as a fundamental principle in clinical education is considered [1]. The integration of theoretical and practical educations for students, especially nursing students, is feasible in a clinical setting. Most learners may believe that the actual learning of theoretical topics is possible only in a clinical setting [2]. The link between theoretical and clinical education in nursing causes nursing students to use their acquired information correctly in real settings [3]. Clinical experience is an integral part of nursing education programs and desirable performance in the expected clinical role is considered in clinical education settings [4]. At current time, all efforts of experts are to provide conditions, which allow students to acquire clinical competency in colleges and clinical education settings [5]. One of these efforts is the increasing emphasis on the humanism paradigm in the learning process and the use of active learning methods, such as cooperative learning methods [6, 7]. The cooperative learning model is based on constructivist theory, which emphasizes on cooperation among the learners to achieve understanding and knowledge with regard to a particular topic [8]. In this model, learners do not merely follow teacher's assignments, but plan

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their own learning through explicit tasks. This creates a sense of learning responsibility for learner and makes learning more interesting [9]. The results of the studies suggest that the use of teaching methods based on this model leads to higher academic achievement in learners. It also enhances the self-esteem and the attitude of students toward educational settings [10, 11]. One of the new cooperative-based learning methods is puzzle method known as jigsaw method [7, 12]. This method was first developed by Arenson in 1970 to develop group working skills in leaners [12, 13] and it is widely used for many scientific areas [14]. This method is an efficient method of learning, in which the educator is not merely provider of knowledge [15], but he or she can enhance learning and improve motivation of students, making learning experiences interesting for them [12].

Another advantage of the jigsaw cooperative learning model is the ability to learn more than multiple educational contents, teaching controversial clinical topics during internships, learning new strategies from peers, enhancing the critical thinking in students, enhancing the self-esteem and gaining a sense of self-efficacy, enhancing leadership skills, enhancing social communication skills, and enhancing creative behaviours [16-20]. One of the important concepts emphasized in jigsaw cooperative learning model is the concept of clinical competency and professional competency. Competency is defined as the degree to which individuals can apply their professional skills and knowledge for a wide range of settings, occurring in a particular area, and concepts such as knowledge, skills, and standards are among the core concepts associated with professional competency [21]. The level of performance difference of this type of education with other educational methods can lead to better development of scientific and practical concepts and due to this advantage, it is preferred over other learning methods [22]. Jigsaw cooperative learning model is exactly like a puzzle. In this method, each learner's, as any piece of a puzzle, is necessary to complete and fully understand the outcome and the final result [23]. In the puzzle learning method, learners are divided into several small (n= 3 to n=5) non-homogeneous groups. Then, a part of subject matter is assigned to one person from each group to study, and accordingly, materials are distributed among the individuals in each group. The educator specifies a given time for learners to study. Over time, the subjects of each group that have a common topic are gathered and form a new group. Then, they will share their knowledge of the same topic. Finally, each of the subjects returns to his or her group and presents his item to other members of the group. Accordingly, each item is repeated three times per person. At the end of each educational session, a test is given to each of the groups' subjects and the group total score is obtained group and the groups gained the specified score would be qualified in the given subject matter [24, 25]. While the use of the puzzle educational method leads to positive outcomes such as enhanced sense of responsibility of learners, enhanced social communication skills, enhanced self-esteem and achieving a sense of self-efficacy among learners, some studies have reported that it is a time-consuming method and it is for the disadvantage of stronger students, since much time of education is spent on weak and moderate learners [7, 16, 17]. However, some experts believe that strong learners take advantage of cooperative learning methods as much as weak and moderate learners, since they are encouraged by the group and learn how to educate, so that their morale is strengthened and they acquire self-confidence [6, 7]. The results of the studies emphasize the use of this type of learning method in the teaching of complex clinical concepts [26, 27]. Kolanczyk et al reported that this method is effective have due to developing students-centered learning skills in the areas of diagnosing the disease, diagnostic tests, clinical examinations and drug management of patients with complex clinical / pathologic conditions and they consider its use in other educational topics, especially topics with complex concepts, essential for educators [28]. Karimi et al also recommended using the puzzle teaching method for improving teamwork, interpersonal communication, thinking and problem solving skills in educating the medical students such as nursing and midwifery students [29].

Given many weaknesses observed in the clinical performance of nursing students and gaining clinical competence, rethinking on clinical competency of nursing students, especially in intensive care units, seems to be an essential nowadays due to the critical nature of patients hospitalized [30, 31]. Some researchers argue that, due to the multidimensional nature of the care concept, its main values can be promoted through purposeful and student-centred education during bachelor level of education [32]. Thus, given what was stated above and the increasing developments in clinical nursing education, the necessity of applying new educational methods in transferring concepts to students as well as improving the quality of clinical education and clinical competency in students, the researchers conducted this research to evaluate the effect of puzzle (jigsaw)-based cooperative learning as a new learning model on the clinical competency of nursing students in the intensive care units of the educational centers of Urmia University of Medical Sciences.

Methodology

This research is a quasi-experimental study. The sampling method in this study was census method and research sample included all nursing students (semester 6 and semester 8 students) of intensive care unit during the first semester of the academic year 2017-2018. Each semester students were divided into 4 groups (each group contained 6-10 subjects). The research population consisted of all 6 semester (n=33) and semester 8 (n=37) nursing students in Urmia University of Medical Sciences. The data were collected using one questionnaire and one checklist. To prepare the checklist, Delphi's method was first used to determine the achievements expected from education in internship at the clinical unit of the ICU. A questionnaire containing 20 questions was used to assess the cognitive skills of students. After determining its validity and reliability and coordination made by Nursing Midwifery Faculty with students, they were asked to attend at class in the specified date. At the same session, they were pre-tested and research objectives were explained and students' consent for

participation in the study was obtained. After completing this session, the students were divided into experimental and control groups. The first group as control group received conventional education. Then, experimental group received educational sessions in Imam Khomeini Hospital and Taleghani Hospital. Control group received the educations by conventional method, while experimental group received the educations by puzzle-based cooperative method. Before and after the sessions, evaluation was performed by using a checklist. Finally, after completing the educational program in the experimental and control groups, students were asked to attend a general sessions and they were post-tested at the same session, without being informed. Then, the pre-test and post-test results were analyzed statistically. To evaluate the results of the research, the data obtained from the subjects were encoded and analyzed by spss 19 software. In the first section, to describe the research variables, frequency distribution tables, mean and standard deviation were used for each of the variables studied in the study groups. In the second section, the research hypotheses were tested based on inferential statistics (Kolmogorov Smirnov test, covariance analysis, independent t-test and paired t-tests). Students' scores in both experimental and control groups were calculated in cognitive skills and behavioural skills tests related to learning achievements. Accordingly, score 1 was considered for correct answers in cognitive skills test and score zero was considered for false answers and the total scores of students' cognitive skills was calculated from score 20. In order to calculate the clinical skills scores based on the checklist according to the level of learning and the student's performance, the score 2 was considered to perform the skill is higher than the minimum level of learning expected, score 1 was considered in for incomplete performing of skill, and score 0 was considered in the case of inability in performing the skill or lower than the learning level.

Results

The highest percentage of subjects (54.8%) in the control group and (51.5%) in the intervention group were male. However, in terms of gender distribution, the Chi-square test did not show a significant difference between the two groups. It is also observed that 6.5% of the control group students had a history of clinical work and 93.5% of them did not have any clinical experience. Moreover, 9.1% of the students in the intervention group had clinical experience and 90.9% of them had no clinical experience. Thus, based on the Fisher's exact test, the students' clinical experience status was not statistically significant at the confidence interval of 0.95 ($p = 1$).

Intra-group and inter-group comparison of mean of cognitive skills

Table 1: intra-group and inter-group comparison of mean of cognitive skill in pre-test and post-test stages

	group	Pre-test SD ± mean	Post-test SD ± mean	Paired t-test results (p-value)
Cognitive skill	control	12/81±1/833	14/10±2/022	0/0001
	intervention	13/54±1/252	17/30±1/447	0/0001
	Independent t-test (p-value)	0/067	0/0001	-

The pared t-test results in Table 4-10 showed that there was a significant difference in the mean scores of subjects within the control and intervention groups before and after cognitive skill intervention ($p \leq 0.001$), so that by observing the means, we realize that the post-test cognitive skill score in both the control and intervention groups is greater than the pre-test cognitive skill score, and this difference in the intervention group is much higher than that in the control group. On the other hand, according to the independent t-test, pre-test mean scores of cognitive skill are not significantly different in control and intervention groups ($P > 0.05$). However, the post-test mean scores of cognitive skills were significantly different in control and intervention groups ($P \leq 0.05$).

Table 2: inter-group and intra-group comparison of post-test mean clinical skills in control and intervention groups

Clinical skills	Group	Pre-test SD ± mean	Post-test SD ± mean	Paired t-test results (p-value)
Physical examination of the patient in terms of pulmonary disease	Control	0/310±0/175	0/474±0/215	0/0001
	Intervention	0/313±0/231	0/903±0/24	0/0001
	independent t-test (p-value)	0/944	0/0001	-
Nursing orders and giving drug based on kardex	Control	1/116±0/195	1/581±0/198	0/0001
	Intervention	1/242±0/351	1/871±0/155	0/0001
	independent t-test (p-value)	0/079	0/0001	-
	Control	1/223±0/151	1/338±0/174	0/0001

Examining blood circulatory system (continuous cardiac and pulmonary monitoring)	Intervention	1/17±0/180	1/710±0/219	0/0001
	independent t-test (p-value)	0/206	0/0001	-
	Control	0/548±0/356	1/234±0/353	0/0001
Determine patient's level of consciousness based on GCS	Intervention	0/644±0/400	1/886±0/208	0/0001
	independent t-test (p-value)	0/318	0/0001	-
	Control	0/439±0/201	1/139±0/169	0/0001
considerations related to patient connected to the ventilator	Intervention	0/488±0/154	1/506±0/169	0/0001
	independent t-test (p-value)	0/274	0/0001	-
	Control	1/016±0/238	1/149±0/205	0/0001
Nutrition of the patient according to the order of the physician through NGT	Intervention	1/081±0/232	1/765±0/117	0/0001
	independent t-test (p-value)	0/274	0/0001	-
	Control	0/432±0/248	1/168±0/327	0/0001
Examining the urinary system and absorption and excretion control	Intervention	0/533±0/290	1/406±0/280	0/0001
	independent t-test (p-value)	0/139	0/003	-
	Control	0/727±0/089	1/068±0/184	0/0001
Suction of the upper airways of patients isolated and connected to the ventilator	Intervention	0/771±0/099	1/557±0/125	0/0001
	independent t-test (p-value)	0/066	0/0001	-
	Control	0/465±0/237	0/626±0/264	0/0001
Nursing care to prevent irreversible complications and long-term hospitalization	Intervention	0/530±0/230	1/730±0/202	0/0001
	independent t-test (p-value)	0/271	0/0001	-
	Control	0/523±0/152	0/942±0/118	0/0001
Nursing care of patients with tracheal tube	Intervention	0/573±0/112	1/245±0/170	0/0001
	independent t-test (p-value)	0/137	0/0001	-
	Control	0/477±0/136	0/580±0/181	0/007
Arterial blood taking for arterial blood gas studies	Intervention	0/521±0/115	0/664±0/146	0/0001
	independent t-test (p-value)	0/168	0/045	-
	Control	1/262±0/188	1/300±0/229	0/118
PIE reporting	Intervention	1/326±0/233	1/415±0/248	0/0001
	independent t-test (p-value)	0/236	0/060	-
	Control	0/711±0/096	1/050±0/087	0/0001
Clinical skills (total score)	Intervention	0/751±0/098	1/467±0/092	0/0001
	independent t-test (p-value)	0/103	0/0001	-

Paired t-test results in Table 2 showed that within the control and intervention groups, there was a significant difference in mean scores of subjects in all clinical skills (excepted for reporting skills in the control group) before and after intervention (P0.001≤), so that by observing the means, we realize that the score of clinical skills in the post-test of both the control and intervention groups is more than that in pre-test, and this difference in the intervention group is much higher than that in the control. Moreover, based on independent t-test results, there is not a significant difference between the post-test mean scores of clinical skills in the intervention and control groups (P> 0.05). However, post-test mean scores of twelve clinical skills in the control and intervention group (with the exception of the reporting skills) were significantly different (P≤0.05). Given the results of covariance analysis in the above tables, since the calculated p values for all clinical skills (except for reporting) are less than the significance level ($p < 0.05$), the null hypothesis is rejected at this level. In other words, the results of covariance analysis showed that the clinical skills scores of nursing students were significantly different in the post-test. As a result, with 95% confidence, it can be stated that the implementation of the jigsaw cooperative learning model in nursing students in the ICU unit has a significant effect on their clinical skills. Therefore, there is a significant difference between the clinical skills (general score) of nursing students in the post-test in two groups of control and intervention ($\eta^2 = 0.862$, $F = 382.46$, and $p \leq 0.0001$). In other words, jigsaw cooperative learning method improves the clinical skills of the students in the intervention group compared to the control group at the post-test stage. Given the η^2, it could be stated that 86% of these variations can be attributed to the impact of intervention or the implementation of jigsaw cooperative educational model. According to Table 2, the mean scores of

clinical skills in the intervention group (1.467) were higher than those in the control group (1.05).

Discussion and Conclusion

With regard to first specific objective of this study (to determine and compare the mean scores of clinical skills of nursing students in the ICU unit in the control group before and after the implementation of the conventional educational program), the results of the paired t-test showed that the equality of means assumption (except for reporting skills) was significant at a level of 0.05 and the score of 12 skills (except for the reporting skills) increased after the implementation of the conventional education program ($P=0.000<0.05$). In other words, the implementation of the conventional educational method improves the clinical skills of the control group in the post-test. With regard to the second specific objective of this study (to determine and compare the mean scores of clinical skills of nursing students in the ICU unit in the intervention group before and after the implementation of the jigsaw cooperative learning method), the results of the paired t-test showed that the equality of means assumption at was very significant at the level of 0.05 and the scores of 12 clinical skills in the intervention group increased after the implementation of the jigsaw cooperative learning model ($P=0.000<0.05$). In other words, the implementation of jigsaw cooperative learning model increases the clinical skills of the intervention group in post-test stage. Although the results of this study and comparison of the results of the studies conducted in this regard confirm the role of the nursing education program, especially cooperative education, in enhancing the professional competence, more studies are required to be conducted in this regard to determine whether the use of cooperative education in nursing education programs and plans can resolve all shortcomings and weaknesses of classic education and respond to all needs of nursing students, including professional knowledge and skills. Given the results of the research, which revealed a difference in the performance of two control and experimental groups by using the conventional learning method and cooperative learning method, it is recommended that a study to be conducted to examine the causes of the differences in this regard from the students' point of view.

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