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The Effect of Student-Generated Questions Partially Applied in a Pathology Course on Learning Motivation, Communication, and Problem Solving of Nursing Students

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병리학 교과목에 부분 적용한 학습자질문중심학습법이 간호대학생의 학습동기, 의사소통, 문제해결능력에 미치는 효과

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Abstract The purpose of this study was to examine the effects of student-generated questions (SGQs) partially applied in a pathology course on learning motivation, communication abilities, and problem-solving skills in nursing students. A one-group pretest-posttest design was employed to conduct this study with 106 nursing students taking the pathology course in a university-setting. Data were analyzed using a Wilcoxon signed-rank test in SPSS version 20. The results showed that communication and problem-solving skills were significantly improved at the end of the semester compared to the beginning. The findings imply that SGQs could be an effective means to improve nursing students' skills of communication and problem solving. To equip nursing students with such core competencies, teaching-learning methods combined various strategies should be developed and applied to nursing education.

Key Words : Nursing students, Student-generated questions, Learning motivation, Communication, Problem solving

요 약 본 연구의 목적은 병리학 교과목에 부분 적용한 학습자질문중심학습법이 간호대학생의 학습동기, 의사소통, 문제해결능력에 미치는 효과를 파악하는 것이다. 일개 대학 간호학과 2학년 106명을 대상으로 단일군 사전사후 설계를 적용하여 본 연구를 수행하였다. 수집된 자료는 SPSS 20.0 프로그램을 활용하여 Wilcoxon-signed rank test로 분석하였다. 연구 결과 학기 초에 비하여 학기 말에 의사소통과 문제해결능력이 유의하게 향상되었으며, 학습동기의 하위 항목인 주의력과 만족도도 유의하게 향상된 것을 알 수 있었다. 본 연구 결과는 학습자질문중심학습법이 간호대학생의 의사소통과 문제해결능력 향상에 효과적인 방법이 될 수 있음을 보여주었다. 앞으로 이와 같은 간호대학생의 핵심 역량을 계발하기 위해 다양한 전략이 융합된 교수학습방법의 개발 및 적용이 필요하다.

주제어 : 간호대학생, 학습자질문중심학습법, 학습동기, 의사소통, 문제해결능력

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1. Introduction

Rapid social changes characterized by the fourth industrial revolution and digital convergence have brought radical changes in healthcare fields [1], including increased access to information thanks to the universal usage of smartphones and the Internet, divergence of information, aging of healthcare consumers and increased complexity of their health issues, and intensified healthcare knowledge and technology. Such changes require healthcare providers to possess competencies of communication and problem solving to manage unpredictable situations in clinical fields more than ever [2, 3]. Also required is higher education in universities that can cultivate students' ability to respond to such social changes [4, 5], which is also reflected in the declaration of the Korean Accreditation Board of Nursing Education (KABONE) that emphasizes continuous improvement of nursing education to train nursing students having capabilities required for clinical nursing [6].

Under such circumstances, nursing faculties must determine how they can promote students' abilities to learn concepts and knowledge related to various diseases and nursing care, think critically, communicate, and act to resolve the diverse nursing problems found in clinical situations [4, 7]. In particular, increasing students' self-directedness in learning and cultivating capabilities to take in situations and identify and address problems are major tasks of universities, in that higher education seeks to not just provide knowledge or information but also generate knowledge and its application [8].

Thus, the effectiveness of employing student-generated questions (SGQs) in lectures has recently received the attention of educators, in that the method has been proved to enhance proactive learning, learning motivation, communication abilities, and problem-solving skills concurrently among students. The use of SGQs, also known as havruta—a famous Jewish education principle—, is grounded on constructionist teaching theories that claim that learners actively construct new concepts from what they learn [9]. Its positive impact on enhancing nursing students' interest in and satisfaction with learning has been proved in recent studies [10, 11].

Having students generate questions based on what they learn is one of the key processes in the havruta method. Forming questions enhances students' concentration on classes, develops critical thinking abilities, and thereby reinforces self-learning by self-summarizing and digesting the information learned [12]. Another key process of the havruta method is peer collaboration. Understanding, analyzing, interpreting, and evaluating what students newly learn is actively associated with what they already knew; confirming, sharing, and discussing what they discover throughout the learning process enhances deep learning as well as skills of self-reflection, communication, and problem solving [13], which are fundamental competencies for nursing students [2, 3].

However, it is particularly challenging for both teaching faculties and students to co-create and actively engage in learning. The unidirectional provision of knowledge via lectures has been the principal method of training among majors including nursing that need to provide an enormous amount of knowledge required by national licensure examinations within a short period. Such learning environments hardly stimulate or maintain learners' motivation or improve students' satisfaction with learning processes. Lecturers are pressed for time due to the volume of information they must convey, whereas students rarely have opportunities to pose and solve personal questions or intellectual challenges and thus just passively receive information delivered in the classroom. Pathology course is a respresentative of such circumstances in nursing schools. The course aims to have students obtain fundamental understanding of underlying mechanisms under which a disease is triggered and affects normal organ functions in human body. However, the course is usually provided in

pre-practicum (before entering senior years), which makes studying the pathology quite challenging for junior students and require complex cognitive functions orchestrated to understand difficult subjects of each week's contents of the course throughout the curriculum. Student-generated questioning methods have been found to be an effective in similar courses in health care sciences such as pharmacy, endocrinology in medical schools [14] and physics, chemistry or biology in university-settings [15]. Therefore, this study aimed to investigate the effectiveness of SGQs on students' motivation, communication abilities, and problem-solving skills in a pathology course for nursing students in a university setting.

2. Methods

2.1 Subjects

The subjects of the study were second-year nursing students of one university who were taking a pathology course in the spring semester of 2018. One hundred six students among 120 agreed to participate in this study and responded to both surveys.

2.2 Design

This study employed a one-group pretest - posttest design to identify the effects of pedagogy involving SGQs. This study was conducted for 15 weeks from March 5, 2018 to June 9, 2018. Data collection took place before the lecture in the first week of class and after the lecture in the 15th week of class using an online survey. This study has its foundations in a previous study that compared team-based learning, traditional lectures, and lectures with SGQs [11]. The results showed that communication was increased significantly in all three pedagogies, however, problem solving had the greatest increase in lecture with SGQ although this increase was not statistically significant. Therefore, the goals of this study were to improve problem solving ability while keeping the SGQ pedagogy. Based on previous study, applying SGQ to all classes were considered to be ethically appropriate.

2.3 Pathology course with SGQs

In previous studies related to college education, pedagogy involving SGQs was categorized into two broad types. The first is to transform the course so that it is centered on SGQs, and the second is to maintain the traditional form of a lecture-centered course while taking SGQs into account partially [16]. This study took the latter standpoint.

The pathology course in this study was a two-credit, two-hour course. After checking attendance, the initial five minutes of the lecture consisted of the students discussing the learning target and if the students themselves, or anyone they knew, had suffered from the disease that was to be covered in that learning target. The purposes of this discussion were to connect the content of the lecture to the students' personal lives and to promote curiosity and interest in the lecture. Subsequently, the lecture was taught from the textbook to provide students an in-depth understanding until the last ten minutes, and the instructor repeatedly asked questions so that the students could associate the pathogenesis, symptoms, and treatment of a disease. The last ten minutes of the lecture consisted of dividing the lecture content by learning target and distributing the learning targets to groups of students so that they could devise potential assessment questions. This distribution by learning target was to avoid overlapping SGQs and to result in a problem set that thoroughly covered the content of the lecture.

After the first week of class, the instructor used a random team-forming application to make groups of four students each. The students were instructed to sit in their assigned groups before the lecture, and these groups were maintained for the rest of the semester. Furthermore, the students were asked to cooperate with their teammates and devise one five-answer multiple- choice question relevant to the assigned

learning target. They were encouraged to ask the instructor additional questions and to discuss parts of the lecture that they found fascinating individually.

A brief orientation on making viable questions was given in the first week of class. The SGQs were turned in to the students in the service group of that lecture. The service group was a rotating role assigned to each group per lecture. Each week, the service group integrated the ten SGQs and emailed them to the instructor by the night after the lecture. The instructor reviewed the questions, corrected wrong answers or left explanations and attached supplementary material as necessary, and shared the questions with all students before the next lecture. Table 1 shows how two-hour lecture was composed.

Table 1. The Composition of Two-hour Lecture

Time(min)	Contents
5	Discussions about the learning targets to be covered
85	Lectures
10	Each group of students makes five-answer multiple- choice question relevant to the assigned learning target

A pool of test questions was made from the SGQs from each section, and students were informed that a portion of the midterm and final exams would be derived from the pool in order to encourage participation in SGQs.

In addition, students were organized into separate presentation groups. The presentation groups were tasked with devising a question regarding disease or health, which was emailed to the instructor by the fourth week so that the instructor could validate the scope and the topic addressed by each group and ensure that there were no duplicates. Afterward, the presentation groups conducted research on their topics using scholarly journals, newspapers, and textbooks and summarized it into a presentation no longer than eight minutes. In this process, students were encouraged to contact the instructor whenever they needed help, and some students were given feedback on the scope or the general direction of the research in both online communications and in lectures. Some examples of the student-generated research topics were as follows: Why do the elderly experience joint pains before it rains? Does wearing a bra have any effect on the pathogenesis of breast cancer? How does the blue light from smartphones affect our health? What are the effects of endocrine disruptors released from single-use plastics on the body? Tabe 2 shows how 15 weeks of pathology course was composed.

Table 2. The Composition of 15-week of pathology course

Week	Pedagogy
2-7th	Lecture with SGQ
8th	Exam, students-led presentation on topics relelated to health or disease
9-14th	Lecture with SGQ
15th	Exam, students-led presentation on topics relelated to health or disease

Students were notified that the presentation would involve peer reviews to prevent free riders, and groups graded each other's presentations for peer learning. Peer review scores, group grades, and the instructor's grades were equally valued in the final grade.

2.4 Instruments

2.4.1 Learning motivation

Learning motivation was measured by Keller's Course Interest Survey [17], translated and edited by Park [18]. Total items were 31, consisting 4 subcategories; attention, relevance, confidence, and satisfaction. The scores are using a five-point Likert-type system with the most pessimistic response scoring one point, and the most optimistic response scoring five points. A higher score indicates a higher learning motivation. The scoring for negative questions was reversed when calculating the final score. This

instrument's reliability in Park's study was .76 and .91 in the current study.

2.4.2 Communication

Communication was measured using a questionnaire for college students and adults developed by Lee et al. [19]. The subcategories are information gathering, listening, overcoming stereotypical thinking, creative communication, self-exposure, self-directed communication, and understanding others' perspectives. There are seven questions per subcategory for a total of 49 questions. The scores are assinged using a five-point Likert- type system with a higher score correlating to a higher level of communication. The scoring for negative questions was reversed when calculating the total score. The Cronbach's α of the questionnaire was .80 at the time of its development and .95 in this study.

2.4.3 Problem solving

Problem solving was measured using a questionnaire for college students and adults developed by Lee et al. [19]. The subcategories are problem recognition, information gathering, analysis, divergent thinking, decision making, planning, execution/adventure, evaluation, and feedback. Each subcategory has five questions for a total of 45 questions. A five-point Likert-type scale is used for scoring, and a higher score indicates a higher ability in problem solving. The Cronbach's α of this questionnaire was .94 at the time of its development and .93 in this study.

2.5 Analysis

The collected data were analyzed using SPSS version 20 software [20]. Frequency analysis was performed on general characteristics apart from age, and descriptive statistics were used to analyze age, learning motivation, communication, and problem solving. To identify the normal distribution of the dependent variables, a Shapiro-Wilk test was done and resulted in $p < .05$. Therefore, a Wilcoxon signed-rank test was utilized to compare the values of the dependent variables. The significance level was set to $p < .05$.

2.6 Ethical consideration

The authors explained the purpose and process of this study to the participants, confirmed that collected data would be used only for research purposes, and clarified that their decision to participate/not participate in this study would not affect their grades. The survey was conducted online and distributed by the class president on social media so that only willing students could fill it out autonomously.

3. Results

3.1 General characteristics

The mean age of the participants was 20.03 years, and 84.9% of them were female. The percentage of students who responded that they were religious was 58.5% and 30.2% of them had a GPA between 3.5 and 4.0. Regarding major-related satisfaction, 68.8% of students were satisfied with their current major, and daily study hours were 1-2 hours for 32.1% of them. 83 percent of the students responded that they had experience in team-based learning, pedagogy involving SGQs, and problem-based learning. Table 3 shows the general characteristics of the participants.

Table 3. General Characteristics of the Participants
(N=106)

Variables	Categories	n	%
Age (year)	Mean±SD	20.03±2.04	
	Range	19-33	
Gender	Male	16	15.1
	Female	90	84.9
Religion	Yes	72	58.5
	No	44	41.5
GPA*	<3.0	16	15.1
	3.0~3.5	28	26.4
	3.5~4.0	32	30.2
	>4.0	30	28.3
Major satisfaction	Not satisfied	5	4.8
	Moderate	28	26.4
	Satisfied	73	68.8

Study hours (hour/day)	<1	29	27.4
	1-2	34	32.1
	2-3	22	20.8
	3-4	15	14.2
	4>	6	5.5
Experienced learning method	Lecture with SGQ†	47	44.3
	Team-based learning	32	30.2
	Problem-based learning	9	8.5
	None	18	17.0

*GPA: grade point average
† SGQ: student-generated questions

3.2 Comparison of learning motivation, communication, and problem solving

3.2.1 Learning motivation

Learning motivation was 3.64±0.40 in the first week of class and increased to 3.77±0.40 in the 15th week, but showed no significant difference (Z=-1.936, p=.053). However, there was a significant difference in attention and satisfaction when the subcategories were analyzed (see Table 4).

3.2.2 Communication

Communication was 3.70±0.35 in the first week of class and significantly increased to 3.80±0.50 in the 15th week (Z=-2.414, p=.016). In particular, there was a significant difference in the listening, self-exposure, and understanding others' perspectives subcategories (see Table 4).

3.2.3 Problem solving

Problem solving was 3.67±0.43 in the first week of class and significantly increased to 3.80±0.50 in the 15th week (Z=-2.051, p=.040). There was a significant difference in the problem recognition, information

Table 4. The Comparison of the Dependent Variables (*N*=106)

Variables	Pre	Post	Z	p
	Mean±SD	Mean±SD		
Learning motivation	3.64±0.40	3.77±0.40	-1.936	.053
Attention	3.79±0.53	4.02±0.51	-2.719	.007
Relevance	4.10±0.43	4.15±0.46	-0.873	.383
Confidence	3.21±0.44	3.30±0.45	-1.129	.259
Satisfaction	3.34±0.45	3.47±0.44	-2.010	.044
Communication	3.70±0.35	3.80±0.50	-2.414	.016
Information gathering	4.09±0.47	4.18±0.50	-1.487	.137
Listening	3.70±0.50	4.18±0.50	-2.366	.018
Overcoming stereotypical thinking	3.84±0.55	3.89±0.57	-0.612	.541
Creative communication	3.50±0.42	3.44±0.43	-0.855	.392
Self-exposure	3.59±0.52	3.78±0.53	-2.775	.006
Self-directed communication	3.38±0.56	3.49±0.58	-1.137	.256
Understanding other's perspectives	3.79±0.58	3.94±0.56	-2.049	.040
Problem solving	3.67±0.43	3.80±0.50	-2.051	.040
Problem recognition	3.87±0.57	4.03±0.54	-2.218	.027
Information gathering	3.35±0.52	3.51±0.64	-7.248	.000
Analysis	3.75±0.52	3.93±0.60	-2.132	.033
Divergent thinking	3.54±0.60	3.75±0.60	-2.289	.022
Decision making	3.75±0.59	3.91±0.61	-1.807	.071
Planning	3.77±0.60	3.86±0.68	-1.086	.277
Execution/Adventure	3.54±0.61	3.64±0.61	-1.130	.258
Evaluation	3.74±0.53	3.80±0.61	-0.729	.466
Feedback	3.72±0.54	3.82±0.61	-1.384	.166

gathering, analysis, and divergent thinking subcategories. Table 4 shows the changes in learning motivation, communication, and problem solving.

4. Discussion

The importance of different types of pedagogy is being emphasized recently, especially in evaluating the accreditation of nursing education. Accordingly, SGQs were applied to a pathology course that many nursing students perceive as difficult, and this study identified the effect of SGQs on the learning motivation, communication abilities, and problem-solving skills of nursing students.

Regarding learning motivation, it showed an insignificant increase toward the end of the semester as a result of applying SGQs to a pathology course. However, when the analysis of each subcategory was taken into account, there was a significant difference in attention, which is the basis of learning, and in satisfaction, which propels students to keep learning. On the other hand, the relevance subcategory, which measures if the content of the course is aligned with the students' interest or future, had the highest average score but did not have a significant difference. In addition, the confidence subcategory, which measures if students think they can succeed on their own, did not have a significant difference either. This result is in agreement with that of Ahn et al. [10] who also applied SGQs to courses for students in a department of health. In addition, this study is similar to that of Davis [21], who reported that as a result of transforming basic medical courses such as biology, physiology, and anatomy by applying SGQs, the students showed increased learning motivation and could better connect previously learned topics with current topics in lectures. In this study, confidence was the lowest-scoring subcategory among those within learning motivation. Confidence was 3.21 at the beginning of the semester and 3.30 at the end. The study of Ahn et al. [10] also reported the same trend with confidence, and the score was slightly lower at 3.12 at the beginning of the semester and 3.19 at the end. It is crucial to clearly inform students of the evaluation standards and give them an opportunity to excel based on their efforts in order to increase their confidence and enable them to experience achievement. There seems to be a need to adjust the difficulty of the mid-term and final exam so that the students can experience achievement depending on their effort.

Focusing on the changes in communication, there was a significant increase at the end of the semester compared to the beginning. This result is supported by the study of Ryu et al. [11]. Communication is a core ability of nurses that is emphasized especially in a clinical environment where multidisciplinary cooperation is essential for the best patient care outcome [22]. Among the subcategories of communication, there was a significant difference in listening, self-exposure, and understanding others' perspectives. The reason for this seems to be the discussions within teams when the students made the five-answer multiple-choice questions after the lectures each week for 12 weeks in total, as the discussions required listening to others, proposing one's ideas constructively, and accepting others' different ideas. The students in the presentation groups had to communicate with their teammates to decide on a presentation topic originating from their own curiosity and maintain that level of communication until the end of the presentation, which contributed to their increase in communication. The students reported that they could better understand the lecture content and make friends by making SGQs. This is consistent with two earlier studies by Abraham [14], and Gooi and Sommerfeld [23], which claimed that the SGQ activity for review purposes helps to improve students' communication, understanding of the lecture, and thinking abilities.

Problem solving increased significantly at the end of the semester compared to the beginning. This matches

the results of the study of Park and Woo [24] where the problem solving of students who took a fundamental nursing course that implemented flipped learning utilizing massive open online as well as SGQs for five weeks improved significantly. Likewise, this result agrees with the study of Ko et al. [25] where the creativity and problem solving of students in child education were improved significantly when SGQs were applied to their educational psychology course two hours a week for 13 weeks. Rational and reasonable thinking as well as creativity, intuition, and imagination are needed in the problem-solving process [19]. The subcategories of problem solving that increased significantly were problem recognition, data gathering, and analysis, which correspond to rational and reasonable thinking; and divergent thinking, which was the sole factor in creativity, intuition, and imagination. This was a consequence of making SGQs for review purposes, since cognitive problem solving was effective, but the questions did not address applications or alternate solutions, which stimulate creativity. This study referenced the studies of Abraham [14] and Davis [21] to determine the presentation topics so that the students could convert related news articles or curiosities in real life into questions for research, and it seems to be an additional factor in increasing problem solving. However, more attention on the creativity, intuition, and imagination aspects of problem solving may be needed in future pathology courses.

In previous studies, SGQ activity and answering the questions that students made themselves were known to help facilitate learning as well as course performance [15, 26]. Analysis about quality of student questions and academic performance should be taken into account next time. In addition, it is necessary to investigate that which level of students gain particular benefit from peer learning through SGQ.

Nursing students' teaching evaluations for the semester's pathology course showed that they were very satisfied with the current pedagogy of maintaining traditional lecture-based learning with SGQs applied. Furthermore, there was a high degree of interaction between the instructor and the students and among fellow students. Specifically, interaction between the instructor and the students happened frequently when they devised SGQs, received instructor feedback, and determined a presentation topic and scope. It is considered that the strength of a course originates from the relationship between the instructor and the students. Despite the fact that one instructor was teaching a lecture-based course to many students at once, applying SGQs to a lecture can stimulate mutual interaction between the students and the instructor, making it a good teaching method and resulting in a memorable course for the students. Nevertheless, this study has its limitations, in that there was no control group and it was conducted in one university and therefore is difficult to generalize.

5. Conclusion

This study examined the effects of SGQs being applied to a pathology course. It was identified that the students' communication abilities and problem-solving skills were improved significantly and that their learning motivation was improved partially when SGQs were applied to a lecture-based course for all but three weeks of the 15-week semester. This study was meaningful, in that SGQs increased students' communication and problem-solving skills and improved instructor - student and student - student interaction.

With that said, the following recommendations are suggested. Firstly, SGQs applied to lecture-based courses may be viable in other subjects beyond pathology, and the authors foresee its widespread usage. Secondly, there is a need for the instructor to become not just a teacher who focuses on delivering knowledge only but also a facilitator who promotes instructor - student and student - student interaction and provides students guidance and counseling.

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