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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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

요약 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 개발하기 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 representative 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

<table>
<thead>
<tr>
<th>Time (min)</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Discussions about the learning targets to be covered</td>
</tr>
<tr>
<td>85</td>
<td>Lectures</td>
</tr>
<tr>
<td>10</td>
<td>Each group of students makes five-answer multiple-choice question relevant to the assigned learning target</td>
</tr>
</tbody>
</table>

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? Table 2 shows how 15 weeks of pathology course was composed.

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

<table>
<thead>
<tr>
<th>Week</th>
<th>Pedagogy</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-7th</td>
<td>Lecture with SGQ</td>
</tr>
<tr>
<td>8th</td>
<td>Exam, students-led presentation on topics related to health or disease</td>
</tr>
<tr>
<td>9-14th</td>
<td>Lecture with SGQ</td>
</tr>
<tr>
<td>15th</td>
<td>Exam, students-led presentation on topics related to health or disease</td>
</tr>
</tbody>
</table>

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

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

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)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Pre</th>
<th>Post</th>
<th>Z</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning motivation</td>
<td>3.64±0.40</td>
<td>3.77±0.40</td>
<td>-1.936</td>
<td>.053</td>
</tr>
<tr>
<td>Attention</td>
<td>3.79±0.53</td>
<td>4.02±0.51</td>
<td>-2.719</td>
<td>.007</td>
</tr>
<tr>
<td>Relevance</td>
<td>4.10±0.43</td>
<td>4.15±0.46</td>
<td>-0.873</td>
<td>.383</td>
</tr>
<tr>
<td>Confidence</td>
<td>3.21±0.44</td>
<td>3.30±0.45</td>
<td>-1.129</td>
<td>.259</td>
</tr>
<tr>
<td>Satisfaction</td>
<td>3.34±0.45</td>
<td>3.47±0.44</td>
<td>-2.010</td>
<td>.044</td>
</tr>
<tr>
<td>Communication</td>
<td>3.70±0.35</td>
<td>3.80±0.50</td>
<td>-2.414</td>
<td>.016</td>
</tr>
<tr>
<td>Information gathering</td>
<td>4.09±0.47</td>
<td>4.18±0.50</td>
<td>-1.487</td>
<td>.137</td>
</tr>
<tr>
<td>Listening</td>
<td>3.70±0.50</td>
<td>4.18±0.50</td>
<td>-2.365</td>
<td>.018</td>
</tr>
<tr>
<td>Overcoming stereotypical thinking</td>
<td>3.84±0.55</td>
<td>3.89±0.57</td>
<td>-0.612</td>
<td>.541</td>
</tr>
<tr>
<td>Creative communication</td>
<td>3.50±0.42</td>
<td>3.44±0.43</td>
<td>-0.855</td>
<td>.392</td>
</tr>
<tr>
<td>Self-exposure</td>
<td>3.59±0.52</td>
<td>3.78±0.53</td>
<td>-2.775</td>
<td>.006</td>
</tr>
<tr>
<td>Self-directed communication</td>
<td>3.38±0.56</td>
<td>3.49±0.58</td>
<td>-1.137</td>
<td>.256</td>
</tr>
<tr>
<td>Understanding other’s perspectives</td>
<td>3.79±0.58</td>
<td>3.94±0.56</td>
<td>-2.049</td>
<td>.040</td>
</tr>
<tr>
<td>Problem solving</td>
<td>3.67±0.43</td>
<td>3.80±0.50</td>
<td>-2.051</td>
<td>.040</td>
</tr>
<tr>
<td>Problem recognition</td>
<td>3.87±0.57</td>
<td>4.03±0.54</td>
<td>-2.218</td>
<td>.027</td>
</tr>
<tr>
<td>Information gathering</td>
<td>3.35±0.52</td>
<td>3.51±0.64</td>
<td>-7.248</td>
<td>.000</td>
</tr>
<tr>
<td>Analysis</td>
<td>3.75±0.52</td>
<td>3.93±0.60</td>
<td>-2.132</td>
<td>.033</td>
</tr>
<tr>
<td>Divergent thinking</td>
<td>3.54±0.60</td>
<td>3.75±0.60</td>
<td>-2.289</td>
<td>.022</td>
</tr>
<tr>
<td>Decision making</td>
<td>3.75±0.59</td>
<td>3.91±0.61</td>
<td>-1.807</td>
<td>.071</td>
</tr>
<tr>
<td>Planning</td>
<td>3.77±0.60</td>
<td>3.86±0.68</td>
<td>-1.086</td>
<td>.277</td>
</tr>
<tr>
<td>Execution/Adventure</td>
<td>3.54±0.61</td>
<td>3.64±0.61</td>
<td>-1.130</td>
<td>.258</td>
</tr>
<tr>
<td>Evaluation</td>
<td>3.74±0.53</td>
<td>3.80±0.61</td>
<td>-0.729</td>
<td>.466</td>
</tr>
<tr>
<td>Feedback</td>
<td>3.72±0.54</td>
<td>3.82±0.61</td>
<td>-1.384</td>
<td>.166</td>
</tr>
</tbody>
</table>
The Effect of Student-Generated Questions Partially Applied in a Pathology Course on Learning Motivation, Communication, and Problem Solving of Nursing Students

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.

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

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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