

Development and evaluation of flipped learning classes using film clips within a nursing informatics course

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Abstract:

Aim: To develop flipped learning classes by using film clips for undergraduate nursing students in an online nursing informatics course, based on the Analysis, Design, Development, Implementation, and Evaluation model, and to evaluate the effectiveness and students' responses to this method of teaching.

Methods: Sixty-four second-year nursing students participated in the course. The nursing students' knowledge was assessed at the beginning and end of each of the five classes. Moreover, their intention to recommend the classes to other students and additional comments were elicited by using semistructured questionnaires.

Results: Knowledge about each core concept of nursing informatics reflected significant improvement. Regarding the intention to recommend the class to others, 62 (96.8%) students answered "strongly recommend" or "recommend."

Conclusion: Integrating flipped learning classes by using film clips in an online nursing informatics course improved the nursing students' knowledge and is a format that is desired by students.

Keywords: films | learning | nursing education | nursing informatics

Article:

INTRODUCTION

Nursing informatics (NI) has been recognized as a discipline with the potential to enhance the nursing profession and to improve patient care (Honey *et al.*, 2017; McGonigle & Mastrian, 2015). The NI competencies have become an essential requirement for nurses because information and technical skills improve nurses' decision-making processes and help to ensure that nurses provide reliable, evidence-based care (Quality and Safety Education for Nurses, 2016). Although many healthcare institutions have adopted allied informatics courses, a NI course for undergraduate nursing students is not yet a mandatory requirement in South Korea. Therefore, nursing students and recent graduates might have insufficient knowledge of NI concepts (Oh, Shin, & De Gagne, 2015).

Students today are exposed to a variety of information, advanced communication technologies (Acelajado, 2014), and diverse learning methods. Nursing faculty members might have difficulty acquiring or designing tools and methods to teach NI concepts and competencies (Muruganatham, 2015) to these students. Therefore, nurse educators must strive to design innovative instructional strategies to meet students' needs and to help them meet the expectations of the current healthcare environment. Few studies have examined the effectiveness of a NI course with a novel teaching–learning strategy within a nursing curriculum.

Flipped learning, also known as an “inverted classroom” or “flipped classroom” (Bishop & Verleger, 2013; Hamdan, McKnight, McKnight, & Arfstorm, 2013), is an innovative learning method where students learn through assigned materials before class and then deepen their understanding through activities with peers and facilitation with educators in the classroom (Hamdan *et al.*, 2013). With the positive outcomes resulting from the self-initiated learning, this method has generated considerable interest in higher education (Betihavas, Bridgman, Kornhaber, & Cross, 2016). In addition, it is a teaching strategy that could be useful in teaching NI content to nursing students that meets the needs of today's students and the complicated nature of contemporary health care. In the flipped learning approach for a course with an asynchronous online component, the students do not merely participate in the class as a replacement for traditional instructor-led training, but must also participate in complementary offline classes with diverse activities (Acelajado, 2014). Using flipped learning that incorporates novel teaching strategies might enhance the effectiveness of the teaching and consequently the learning. In particular, group discussions during flipped learning are regarded as an active and student-centered learning method (Yoo & Park, 2015).

Films are recognized as effective educational resources to promote the retention of knowledge and promotion of desired behaviors. Commercial films can trigger discussions among students and reinforce a lesson (Oh & Steefel, 2007), thereby fostering applications well beyond written course material. Specific moments in a film stimulate visual areas of the brain and translate abstract concepts into understandable knowledge (Oh, Shin, & De Gagne, 2012). As NI concepts are still unfamiliar to many Korean nursing students, using additional interesting teaching methods might be required for optimal learning. If students gain indirect learning by, for example, watching a commercial film, this could foster an understanding of new concepts, such as NI, and their subsequent translation to practice. Watching films and reflecting on them can involve students in their own learning and enable a deeper understanding of complex concepts (Arveklev, Berg, Wigert, Morrison-Helme, & Lepp, 2018).

Roh, Lee, and Mennenga (2014) indicated that although health professions' education has seen an increase in the use of new pedagogical methodologies recently, few studies of such methodologies have reflected a positive educational outcome. As an appropriate instructional design is required to ensure meaningful learning (Morrison, 2015), the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) model, which has been considered essential in the development and evaluation of educational programs (Hadi *et al.*, 2017; Muruganantham, 2015), was adopted. This model has been recognized as effective, attractive, and efficient in delivering educational content in many disciplines (Lu, Cheng, & Chan, 2016; Morrison, 2010).

Therefore, the purposes of this study were: (i) to develop flipped learning classes by using film clips for undergraduate nursing students in an online NI course based on the ADDIE model; and (ii) to evaluate the effectiveness and students' responses to this method of teaching.

METHODS

Research design

This pilot study used a pretest-post-test, one-group, quasi-experimental design based on the ADDIE model. Flipped learning classes using film clips in a NI course were developed and evaluated. For the purposes of this project, development from the ADDIE model included the analysis, design, and development phases of the project, while the evaluation comprised the implementation and evaluation phases. In each phase, dynamic and flexible guidelines for effective and efficient instruction were available (Fig. 1).

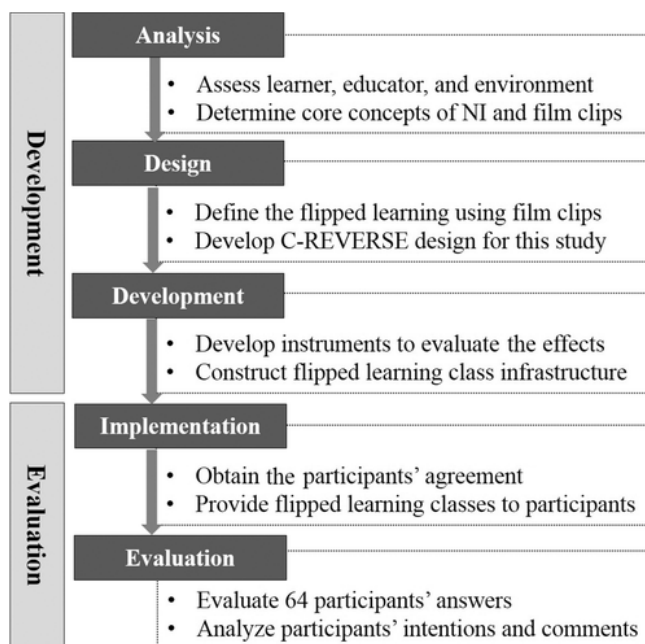


Figure 1. Research design based on the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) model. C-REVERSE is a design that was developed by the authors and named from the first initials of the words or phrases: cinema clips, review, encourage, verify, exchange, reflect, summarize, and evaluate. NI, nursing informatics.

Analysis phase

The first step was to assess the students' characteristics, educator's competencies to manage flipped learning in a NI course, and the educational environment. Moreover, a literature review was conducted to identify NI core concepts that are requisites for the new nurse. The content of the course was derived from several exhaustive discussions among the researchers based on the findings from the literature review.

Design phase

Once the analysis phase was completed, seven experts comprising five nursing professors and two educational specialists agreed to participate in a panel discussion. This panel size was deemed adequate as it fell within Carlsen and Glenton's (2011) methodological study guideline recommendations. After several rounds of in-depth discussion, the panel confirmed the five core concepts of NI to be included: *Ubiquitous health in NI*, *Tele-health*, *Clinical decision support system*, *Patient and family's security and safety*, and *NI in the near future*. Considering the NI core concepts, five films were chosen. A movie expert was consulted as to whether the selected films were relevant to the main concepts of NI and then all the selected films were approved by the research team members.

Development phase

Among the 15 weeks of flipped learning classes for the NI course, five classes were designed using film clips. During this phase, the educational intervention was manualized. The NI course was made available to students via the class registration system.

Implementation phase

The asynchronous online educational environment for implementing the flipped learning using film clips, including the five core concepts, was established. All the participants who enrolled in the NI course were second-year nursing students.

Evaluation phase

The effectiveness of the flipped learning classes using film clips was verified through testing. A pretest was conducted by assessing the students' knowledge of the five core concepts at the beginning of, and a post-test was conducted at the end of, each of the five classes. On completion of the NI course, the participants' intention to recommend this kind of course to other students was surveyed.

Setting and participants

Ninety-six second-year nursing students were recruited from a private university in South Korea to participate in this study. The students had enrolled in liberal arts courses and introductory nursing courses when they were freshmen. The NI course was one of the electives that were

offered by the department of nursing. Among those who were recruited, 72 second-year nursing students enrolled in the NI course. Eight students were excluded from the analysis because of infrequent attendance. In the end, 64 (88.9%) students were included in the study. Using G*Power 3.1.7 (Faul, Erdfelder, Lang, & Buchner, 2007), it was determined that 34 participants were required to achieve a medium effect size of 0.50 and a power of 0.80. For the calculations, a one-group paired *t*-test and a significance level of 0.05 were used.

Stage	Step	Teaching and Learning activities		Time (min)
		Educator	Students	
Pre class --- Asynchronous online class	C – watch cinema clips via Internet	<ul style="list-style-type: none"> Provide learning content and (an) assignment 	<ul style="list-style-type: none"> Participate in online class Watch film clips Take complete assignment 	50
	R - review	<ul style="list-style-type: none"> Review assignment 	<ul style="list-style-type: none"> Submit assignment 	10
In class	E - encourage V - verify E - exchange	<ul style="list-style-type: none"> Facilitate discussion Clarify student perception 	<ul style="list-style-type: none"> Present ideas and opinions Take notes Discuss film clips 	30
	R - reflect S - summarize E - evaluate	<ul style="list-style-type: none"> Wrap up with summary Evaluate students' knowledge 	<ul style="list-style-type: none"> Reflect and look forward Take an evaluation of knowledge 	10
Post-class	<ul style="list-style-type: none"> Analyze test results Answer students' questions and provide feedback 	<ul style="list-style-type: none"> Interact on questions-and-answer bulletin board 	— Option	

Figure 2. Each of the 5 weeks' class design of flipped learning with film clips using C-REVERSE (watch Cinema clips, Review, Encourage, Verify, Exchange, Reflect, Summarize, and Evaluate).

Educational intervention

Each of the five targeted classes that used flipped learning using film clips consisted of three stages, including the preclass (asynchronous online class), in-class (face-to-face class), and the postclass. The eight steps of the C-REVERSE design were allocated to the first two stages; C and R for the preclass; and EVERSE for the in-class, face-to-face in a classroom. Following the steps, the asynchronous online class started with preclass assignments (“C”: *cinema*). The “C” step lasted for 50 min. The educator provided learning content and an assignment via the Internet and the students individually studied and watched short film clips that ran from 60 to 400 s before the face-to-face class. In the “R” step, the students submitted their assignments via the Internet and the educator *reviewed* it and provided feedback. The students participated in the classroom, beginning with the “E” step. During the “E,” “V,” and “E” steps, the educator *encouraged* the students to present and discuss their opinions freely, *verifying* the students' perceptions and understanding of the NI five core concepts. During those sessions, there was information *exchange* between the educator and the students as the educator answered the students' questions and subsequently provided feedback on a question-and-answer (Q&A)

online bulletin board. In the “R” step, the students *reflected* and shared their opinions. The educator *summarized* each concept that was related to the film clips and wrapped up each class in the “S” step. Finally, the educator *evaluated* each student's knowledge in the “E” step (Fig. 2).

Ethical considerations

Study approval was granted by the Inje University's Institutional Review Board for Human Subjects (2-1041024-AB-N-01-20130814-HR-006-02) in accordance with the World Medical Association's Code of Ethics. All the students were assured that participation was voluntary, participation would not affect their academic progress, and that their confidentiality would be preserved. After the potential participants received an explanation of their human rights, information about the purposes and procedures to be used in the study, assurance that there would be no negative consequence related to non-participation, and assurance that the data would only be reported as an aggregation was provided. In addition, to maintain confidentiality of the participants' responses, the researchers used the students' birth dates to match and measure changes in scores between the tests.

Instruments

Knowledge

A preliminary test that was developed by the study authors based on suggestions by Quality and Safety Education for Nurses (2016) consisted of five items that were related to the definitions of each core concept, pros and cons of using NI in healthcare settings, and use of the core concepts. Five experts, including three NI professors, one physician, and one nurse, validated each question by using a Content Validity Index (CVI). The questions that were adopted were those for which agreement was >0.80 . If the CVI of an instrument is $>80\%$, it is considered to be acceptable (Polit, Beck, & Owen, 2007). Finally, the participants' knowledge of the NI core concepts was assessed twice by using the same tool (before and after the course ended). Each question was scored either 0 (“incorrect”) or 1 (“correct”), with higher cumulative scores indicating a higher level of knowledge, with a possible cumulative score ranging from 0 to 5 for each student. The internal consistency reliability was assessed; the Cronbach's alpha was 0.92.

Intention

Each student's intention to recommend this class to others was queried by using a 5-point Likert scale, ranging from 1 (“never recommend”) to 5 (“strongly recommend”). A higher score indicated a stronger intention to recommend this type of course.

Feedback

At the end of the NI course, the participants' feedback regarding the flipped learning classes with film clips was elicited by using semistructured questions such as, “What do you think about participating in a flipped learning-with-film clips online classroom?” The participants were encouraged to reply uninhibitedly and multiple responses for each item were recorded

electronically. The feedback was classified by themes and categorized based on the strengths and weaknesses that were identified.

Data collection

The participants completed the pretest and post-test after each of the five classes by using multiple-choice questionnaires that had been developed by the study's authors. The questionnaires were distributed electronically by a research assistant and could be completed within the given time limit of 50 min. The comments related to the NI course were collected after the course was completed.

Data analysis

Descriptive statistics, including percentages, means, and standard deviations, as well as paired *t*-tests, were used to compare the differences between the pre- and post-test scores for the knowledge questionnaire; analyses were carried out by using IBM SPSS for Windows (v. 22.0; IBM Corporation, Armonk, NY, USA). The reviewers used directed coding to examine the feedback from the students regarding the flipped learning classes with film clips and each reviewer independently recoded the transcripts. To arrive at a consensus on the identified themes, the researchers discussed and reviewed the merged data for discrepancies. The extracted themes were returned to the participants for accuracy and validity checking (Rubin & Rubin, 2005).

RESULTS

Development of the nursing informatics course

Phase 1: Analysis

Assessment of the students' characteristics. Most nursing students in Korea can easily access a computer or mobile device and can immediately retrieve a variety of video material due to advanced information technologies (Oh, Shin, & De Gagne, 2015). Almost all the students in this study owned a personal computer or laptop and a smartphone. Additionally, they had never participated in online flipped learning or film-based learning before; they were accustomed to the traditional classroom setting.

Assessment of the educators' competencies. The nurse educator who was teaching the course had >15 years' teaching experience in NI courses, as well as in the use of diverse instructional methods, such as blended learning, art-based learning, and active learning, having used these in several nursing subjects, including pediatric nursing, child growth and development, and nursing and art.

Assessment of the educational environment. The study was conducted in a well-established, ubiquitous educational environment that could easily profit from a flipped learning approach with e-learning. The private nursing school location of this study had a Teaching–Learning

Development Center that could support combined e-learning and classroom-based learning. The students could effortlessly participate in online classes.

Determination of the core concepts and film clips. The learning content of the NI course was derived from the components from Quality and Safety Education for Nurses (2016). The researchers opted to use film clips during five of the 15 available course weeks, based on the results of Sun and Cheng (2007). They reported that the use of multimedia, such as a film, throughout all the weeks of a course did not sufficiently sustain positive learning outcomes or participant satisfaction. Therefore, considering the previous study's results and after detailed discussion among the researchers, the course was designed for a specified number of flipped learning classes using film clips. The film clips were chosen for their relationship to NI core concepts. The selected film titles and related core concepts are presented in Table 1.

Table 1. Films and core concepts that were addressed

Class	Core concept	Explanation of concept (Darvish <i>et al.</i> , 2014)	Film title (year)	Related scene	Selected scene time (h/m/s)
1	Ubiquitous health in NI	Ubiquitous health is health care that is available to anyone, anytime, and anywhere by removing location, time, and other restraints, while increasing both its coverage and quality	<i>Minority Report</i> (2002)	Street billboards show different advertisements that are suitable for each individual when a person is walking down the street	46:10–47:34
2	Tele-health	Tele-health encompasses broad high technologies and tactics to have networks for nurses and patients. Tele-health is not a specific service, but a collection of means to enhance care and education delivery	<i>Three Idiots</i> (2009)	Three people assist a woman to deliver a baby with the assistance of a doctor who orders treatments via the Internet	2:24:40–2:28:22
3	Clinical decision support system	A decision support system is to assist physicians and health professionals to solve problems that require specific decisions	<i>Wall E</i> (2008)	On another planet, instead of a healthcare professional, an expert computer system makes a healthcare decision	39:33–42:56
4	Patient and family's security and safety	Patient-centered, evidence-based care through the use of informatics tools get informed about the benefits, such as the promotion of safety, quality, and effective clinical decisions	<i>The Island</i> (2005)	In a Smart apartment, a healthcare program screens a resident's urine and prescribes nutrition for breakfast based on the test result	02:31–09:15
5	NI in the near future	The benefits of extending NI strategies directly and indirectly influence patient and persons' health positively	<i>Mission Impossible 2</i> (2000)	A secret agent has a wearable computer (e.g. Smart glasses) and receives instructions from a control tower	09:00–10:00

h:m:s, hour:minute:second; NI, nursing informatics; SF, science fiction.

Phase 2: Design

In Phase 2, the educational intervention was designed and named the “C-REVERSE design,” which represents “watch Cinema clips, Review, Encourage, Verify, Exchange, Reflect, Summarize, and Evaluate.” First, the student participants were asked to adhere to a pledge that was signed prior to the beginning of this NI course. The pledge stated, “I will attend the asynchronous online classes before the offline classes, actively participate in the discussions and

presentations with an open mind and attitude, respect the other students' opinions and listen carefully during classes, and practice good manners in the classes.”

Phase 3: Development

The online components of the course were managed in the School's course management system that was password-protected. Using VMware 5.0 (Hashi Corporation, Palo Alto, CA, USA) over ~2 months in the online preclass stage, self-learning was conducted via the online e-Campus interface (see <http://ecampus.inje.ac.kr>).

Evaluation of the students' knowledge of the nursing informatics core concepts

Phase 4: Implementation

Using the flipped learning approach, the students attended an in-class session for each relevant content area after the e-Campus session (preclass) and participated in activities, including asking questions, having answers provided, as well as engaging in discussions. This occurred for each of the five classes that included the flipped learning using film clips.

Phase 5: Evaluation

Students' knowledge of the core concepts of nursing informatics. An analysis of the effect of the course that was developed using the C-REVERSE design was conducted in order to determine whether the participants' scores that tested their knowledge of the five core concepts improved or not. After each of the five classes, the students' knowledge showed significant improvement ($P < 0.001$): ubiquitous health with NI, tele-health, clinical decision support system, advocating for patients' and families' security and safety, and predicting NI techniques in the near future (Table 2).

Table 2. Students' knowledge of the core concepts of the nursing informatics (NI) course ($n = 64$)

Week	Core concepts	Pretest Mean \pm SD	Post-test Mean \pm SD	<i>t</i>	<i>P</i>
1	Ubiquitous health with NI	1.58 \pm 0.793	3.86 \pm 0.687	-18.259	<0.001
2	Tele-health	2.34 \pm 0.718	3.97 \pm 0.712	-12.077	<0.001
3	Clinical decision support system	1.50 \pm 0.617	3.78 \pm 0.654	-20.296	<0.001
4	Advocating for patients' and families' security and safety	2.55 \pm 0.665	4.31 \pm 0.614	-16.624	<0.001
5	Predicting NI techniques in the near future	2.33 \pm 0.714	4.31 \pm 0.500	-21.303	<0.001

SD, standard deviation.

Intention to recommend the course to other students. The students' intentions to recommend this kind of course to others are shown in Figure 3. Forty-two (65.6%) students replied “Recommend” and 20 (31.2%) replied “Strongly recommend.”

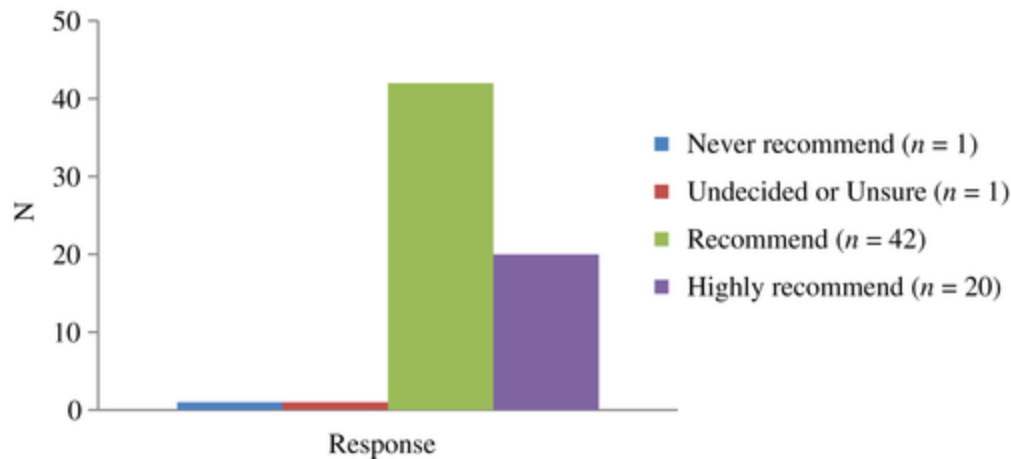


Figure 3. Intention to recommend the class to other students. N = the number of respondents.

Feedback on the flipped learning classes using film clips. Table 3 presents the themes that emerged from the analysis of the open-ended responses regarding the flipped learning classes using film clips. The major comments were classified as either strengths or weaknesses. The strengths included: (i) improving learning efficiency; (ii) watching thought-provoking films; (iii) enhancing understanding; and (iv) inspiring self-directed learning. The weaknesses were: (i) cramming for knowledge; and (ii) the complexity of the infrastructure.

Table 3. Feedback from the students on the flipped learning classes using film clips within a nursing informatics (NI) course ($n = 64$, multiple replies)

Classification	Theme	Content	N (%)
Strengths	Improving learning efficiency	• No restriction of time and place	64 (100.0)
		• Repeated participation in online class	18 (28.1)
		• Learning at one's own pace	6 (9.4)
	Watching interesting films	• Having a chance to learn through a fun, interesting online class that included films • Having an opportunity for contact with new and fresh learning methods • Improving concentration in the online class by including films	62 (96.9) 33 (51.6) 18 (28.1)
Enhancing understanding	• Easy-to-understand NI concepts because of using film clips • Obtaining the key elements of the major NI concepts • Improving memory retention	52 (81.3)	
		5 (7.8)	
Inspiring self-directed learning	• Completing the offline (asynchronous) class thoroughly • Participating in the online class actively • Increased motivation for learning	21 (32.8)	
		4 (6.3)	
Weaknesses	Cramming for study	• Erratic behaviors during the online class; not focusing	29 (45.3)
		• Postponing online class as one pleases	19 (29.7)
• Asynchronous interaction with others during the online class		5 (7.8)	
The complexity of the infrastructure	• Inconvenience of needing equipment • Having difficulty installing the program • Having difficulty finding the online class on the website	3 (4.7)	
		2 (3.1)	
		2 (3.1)	

DISCUSSION

The influence of NI is growing in parallel with advances made in nursing practice and technology (Hebda & Czar, 2013). The American Nurse Association (2014), Institute of

Medicine (2003), and Quality and Safety Education for Nurses (2016) emphasize the need to equip nurses with informatics content to aid in their ability to provide safe and effective care to patients. As a result, nurse educators often struggle to design teaching methods to foster an understanding of NI concepts among undergraduate nursing students. The NI courses promote the use of multimedia and high-information technologies. Hence, the authors developed the C-REVERSE design using flipped learning with film clips to promote the learning of NI content among undergraduate students.

Development of flipped learning classes using film clips in a NI course

In Korea, flipped learning has been an evolving learning method and, as discussed in prior studies, has attracted considerable attention due to its self-directed process (Lee, 2013; Lee & Hwang, 2016). Later emphases on students' active classroom involvement have been consistent with current educational policy that emphasizes learner-centered interactions (Acelajado, 2014; Jeyantha, 2016). In this study, the C-REVERSE design that reflected the basic characteristics of flipped learning using film clips was developed. The participants engaged in an asynchronous online class with the advantage of no restriction on time and place, followed by interactive teaching and learning activities during the in-class stage.

The classes that were developed in this study connected flipped learning to film clips that were suitable for promoting the comprehension of NI's core concepts. For some nursing educators, selecting appropriate films for class might be time-consuming and challenging. However, if the information that is provided is accurate, the aesthetic and narrative elements of films can be an effective teaching strategy (Alexander & Waxman, 2000) and worth the effort. Arveklev *et al.* (2018) reported that drama can be used for integrative and experiential learning in nursing education. A dramatic film that is used in nursing education can promote learning by bridging the gap between theory and practice. This study provided five relevant film clips to explain NI concepts. In the participants' comments, most (96.9%) students reported that they had had a chance to learn through a fun and interesting asynchronous online class that included films and half (51.6%) of them reported that they found the course to provide an opportunity for contact with new and fresh learning methods.

These flipped learning classes using film clips provided specific activities for the students and educators to examine all aspects of the content in the preclass, in-class, and postclass stages. Consistent with the C-REVERSE design, the students' knowledge of NI core concepts was assessed before and after each of the five classes. In this study, information delivery and retrieval were considered preparatory for critical thinking and were largely accomplished outside the classroom in the preclass stage. During the in-class time, the students discussed the film clips and interacted either individually or in groups with a facilitator. Although the participants (45.3%) reported that sometimes they could not focus on the film because of their own erratic behaviors during the preclass (online) portion of the class, they eventually completed it thoroughly and watched the films. Some (32.8%) of the participants complained about the complexity of the equipment that was required for the online class. A convenient and user-friendly infrastructure is required for the success of such a teaching strategy.

Evaluation of flipped learning classes using film clips in a NI course

By engaging in an online class before the in-class stage, the students were introduced to new concepts and were able to prepare for the content to be covered in the in-class stage (Hamdan *et al.*, 2013; Hantla, 2014). Five core concepts of NI, based on Quality and Safety Education for Nurses (2016), were identified and planned to facilitate the students' understanding of these core concepts by using film clips during some of the asynchronous online classes. In the current study, the students' knowledge of NI increased significantly. This suggests that, at the beginning of each of the five classes, the students were less acquainted with the core concepts, such as "ubiquitous health" and "clinical decision support systems," and the film clips assisted them in comprehending these NI concepts that were less familiar to them. Well-researched and well-selected film clips can allow students to guide their own intellectual experience (Oh & Steefel, 2007). Film clips can arouse a greater interest in learners, especially when they are popular, commercial movies rather than educational films (Oh, Im, & Roh, 2014).

The participants in this study also reported that the commercial film clips were not tedious to watch and they could suppress the impulse to surf the Internet while watching the movie. If the nurse educator wishes to use film clips, well-planned video clips from fiction-based films can be effective. It is important for educators to consider students' preferences and acceptance of the film clips while choosing them (DiBartolo & Seldomridge, 2009).

The participants in a course that is designed in this way might have difficulties with non-immediate feedback related to the nature of the asynchronous preclass stage. To help solve this problem, a Q&A bulletin board between the students and professors was used. Current issues could be discussed on that bulletin board and students could receive feedback or answers by the faculty members daily. Faculty member feedback is essential and perhaps the most important factor in influencing effective learning as it allows students to reflect on their own capabilities (Cant & Cooper, 2009). Students also can learn from individualized supplementary materials that they might access or can do in-depth study based on prior learning (Fulton, 2012). Moreover, Herreid and Schiller (2013) reported that the educator's role is to support students in interactive group discussions, discovery activities, and class presentations. In this study, during the offline classes that corresponded with the in-class times, the students were provided adequate time to debate a topic with each other and the educator. Flipped learning classes using film clips have been found to help learning and promote interaction among teachers, students, and peers (Oh, Kim, Kim, & Vasuki, 2017). The integration of online into offline classes or courses can help educators to expand their teaching beyond distributing course content to in addition facilitating or assessing learning outcomes and achievement.

Through the open-ended questions, the students reported that their understanding of NI concepts had improved. Through the flipped learning approach using film clips, an incentive exists for students to prepare for each class and deepen their understanding by focusing on the related concept (Strayer, 2012). More than 90% of the students showed a strong intention to recommend this learning method to other students. This result is similar to that reported by Kim, Chun, and Choi (2014), who found similar teaching strategies had significant effects on student achievement, satisfaction, and participation.

The flipped learning classes using film clips approach might be effective in explaining NI core concepts to the next generation and might be applied in other nursing courses, as well. More evidence is required to form a consensus regarding the instructional design of flipped learning and the use of film clips to teach NI and other nursing concepts and to validate the effectiveness of its application.

Limitations

This study provides preliminary evidence for the effectiveness of flipped learning classes using film clips, but there are some limitations that could inform future research. First, because the limited number of second-year nursing students in the target university was a convenience sample, it would be difficult to generalize the results on a nationwide scale across Korea. Future studies could address this issue by including a larger sample that includes different geographical regions and districts across the nation. Second, as this was an explorative group study, there was no control group with which to compare knowledge scores. Future studies should use a control group by using typical teaching methodologies in order to compare the effectiveness of flipped learning classes using film clips. Third, although the knowledge instrument's reliability and validity were examined, it should be further tested and its psychometric properties should be examined. A replicated study that addresses these limitations could make an important contribution to this area of nursing education research.

CONCLUSION

Film clips could provide unexpected teaching moments to help students to gain an understanding of vague or complex concepts and also could provide an enjoyable learning strategy within the flipped learning environment. The C-REVERSE design that was developed in this study provided the students with an opportunity to be better equipped for using NI in the clinical setting, as they are likely to interact with increasingly more advanced information technology in the future. This study shares valuable ideas for nursing educators and provides rational advice for selecting instructional strategies to guide flipped-learning online-class development. Further studies might not only include experimental studies that apply the design developed here, but also qualitative studies, such as narrative accounts from students' subjective interpretations of flipped learning classes or courses using film clips.

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DISCLOSURE

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

J. O. and R. B. were responsible for the study's conception and design, made critical revisions to the study, and led the drafting of this manuscript; S. -J. K. conducted the data analysis and participated in the drafting of this manuscript; S. H. K. conducted the data collection and

participated in a revision of this manuscript; K. -A. K. carried out the data analysis and provided a critique of the intellectual content; J. S. K. planned the educational method and provided a critique of the educational strategy; and R. B. substantially revised and edited the manuscript.

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