

# Effects of Microlectures on Nursing Students' Understanding of Key Medication Administration Concepts

## *A Quasi-Experimental Design*

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### ABSTRACT

**Background:** Microlectures comprise short audio or video presentations designed to provide a concise explanation of key concepts or topics.

**Purpose:** The study aimed to develop a microlecture module for a nursing course in medication administration and test whether it could improve learning.

**Methods:** The study had a quasi-experimental design. Four classes of sophomore nursing students were divided into the treatment ( $n = 109$ ) and control groups ( $n = 84$ ). Pretests, posttests, integrated examinations, and simulated experiences were employed. Analysis of covariance were used to analyze the students' pretest, posttest, and integrated examination performances.

**Results:** The treatment group performed better than the control group.

**Conclusions:** This study provides nursing educators with a different approach to traditional teaching and sheds light on how to design a microlecture.

**Keywords:** medication administration course, microlecture, nursing students, teaching strategy

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The COVID-19 pandemic changed daily activities worldwide, including teacher-student interactions. Many students switched to distance learning, which altered how teachers present subjects and interact with students. One such alteration is the

use of microlectures, wherein the internet and mobile learning are combined to present key concepts through short videos.<sup>1</sup> The design of instructional materials for courses that can be provided through mobile applications embodies diversified teaching methods.<sup>2</sup>

The concept of microlectures was first presented in 1993 by Professor LeRoy A. McGrew,<sup>3</sup> who proposed a 60-second course on popular organic chemistry. In 1995, T. P. Kee,<sup>4</sup> a professor of chemistry in the United Kingdom, used 1-minute lectures to help solidify core concepts. Since then, research on microlectures has mostly focused on their use as a teaching strategy to enhance learning.

Microlectures are a structured teaching method using online technology for teaching, coursework, design, and evaluation.<sup>5</sup> These lectures are ideal for self-learning and can improve academic performance.<sup>6</sup> Providing concise instructional material that presents key concepts with easy-to-understand descriptions and examples can enhance learning efficiency and enables students to learn at their own pace.<sup>7</sup> Microlectures include a single topic or easy-to-learn concept and combine convenience and real-time interaction.<sup>8</sup> In addition to being used in medicine and nursing courses, microlectures are employed to improve the public's understanding of more complex subjects such as finances.<sup>5,6,9-11</sup>

Medication administration is a fundamental course required for nursing students in Taiwan. Per the Patient

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Safety Reporting System established by the Taiwan Ministry of Health and Welfare, medication errors constitute the highest proportion of factors affecting patient safety.<sup>12</sup> Although most hospitals use computerized medication administration systems, nursing programs still emphasize learning the 3 checks and 5 rights of medication administration to reduce errors.<sup>13</sup> Still, 80% of nursing students do not complete the 5 rights before administering medication, which has a considerable negative impact on patient safety.<sup>14</sup> Thus, guiding students to master appropriate medication administration concepts and operational procedures is a major responsibility of nursing instructors.

Increasing internet access has enabled students to acquire knowledge outside formal classrooms through online courses on mobile phones, tablets, and computers.<sup>2</sup> These internet-based lectures often employ interactive videos designed to allow students to focus on essential topics and absorb them more effectively.<sup>15</sup> Teachers can upload microlecture videos to a teaching platform, which can be accessed by students with no time and space constraints. This model of learning can be useful for skill training and knowledge transfer.<sup>16</sup>

In addition, simulation courses can improve students' communication and critical thinking skills as well as confidence in patient care.<sup>17</sup> Simulation-based education is a field reproduction teaching method that uses environments similar to actual clinical situations.<sup>18</sup> The Society for Simulation in Healthcare refers *simulation* as "the imitation or representation of one act or system by another." Simulation uses actors cast as specific types of patients or fidelity mannequins to replicate real-life clinical situations.<sup>19,20</sup> Standardized patient simulations (SPSs) can enable students to understand patients' thoughts and feelings while developing their knowledge and skills through realistic and concrete experiences. Thus, simulation is an effective strategy for nursing students entering professional practice.<sup>21</sup>

In this study, our aim was to determine the effectiveness of microlectures and simulation teaching strategies. We wanted to suggest an effective method for developing a microlecture module on fundamental nursing courses that can overcome the disadvantages of microlectures, such as the long production time and lack of experience teachers have in developing them.<sup>22</sup>

## Purpose

The study aimed to verify the effectiveness of microlectures on teaching medication administration concepts and skills. We hypothesized that the treatment group would perform better than the control group in the posttest and integrated examination.

## Materials and Methods

### Design

This study had a pretest and posttest design. Four classes of sophomore nursing students were recruited from the

nursing department of a technical university in Taiwan through purposive sampling and divided into the treatment and control groups. The intervention administered in this study involved a microlecture module (microlecture video, SPS, and debriefing). The control group was taught using only traditional online teaching methods, whereas the treatment group had access to microlecture modules.

### Procedure

Following course completion, a pretest was conducted using the ZUVIO Interactive Response System, a cloud-based platform. The treatment group was then given an account with which they could download microlecture videos. After 2 weeks, both groups received the same posttest. Two weeks after the posttest, the treatment group underwent SPS, followed by a debriefing session by the teacher. Both groups completed an integrated examination 2 weeks after the SPS. The study procedures are presented in Supplemental Digital Content Figure 1 (available at: <http://links.lww.com/NE/B211>).

### Participants

Of the 193 students who participated, 84 (2 classes) were assigned to the control group and 114 (2 classes) to the treatment group. Five did not finish all tests. All students provided informed consent to participate in the study. This study was reviewed and approved by the institutional review board (IRB) of the study hospital (IRB Chang Gung Memorial Hospital 201901294B0).

### Instruments

Fundamental nursing teaching staff formed an interdisciplinary teacher group for the microlecture design. Each teacher designed 3 to 5 questions (total 25 questions) for the microlecture content. Two other teachers reviewed the questions and selected the most relevant based on validity. The final test included 6 questions. The reliability of the 6 questions was 0.634 (Cronbach  $\alpha$ ), and the content validity index (CVI) was more than 0.9. Students answered these questions using the cloud-based ZUVIO Interactive Response System. Each correct answer was worth 1 point.

Students' satisfaction with the microlecture content was assessed using a 7-item questionnaire developed by the researchers. Items were scored on a 5-point Likert scale (1 = highly unsatisfactory to 5 = highly satisfactory). Five medical education experts were invited to assess the content of the questionnaire. The CVI was higher than 0.9, and the reliability was 0.973 (Cronbach  $\alpha$ ).

At the end of the course, both groups completed a multiple-choice test (including fill-in-the-blank items) with 20 questions and a maximum score of 100. The test was designed to measure the groups' learning effectiveness with respect to the overall concepts of the medication administration unit.

## Components of the Microlectures

The medication administration unit encompasses 3 hours of theory and 9 hours of clinical practice. The 3-hour course covers the basic concepts and methods, yet also requires students to obtain a significant amount of information by reading outside of class. In contrast, the portion on clinical practice is completely informatized and administered online.

The microlecture components were determined through focus group interviews with clinical nurses, teachers, and third- and fourth-year nursing students. Clinical nurses and teachers were asked to describe the difficulties students and new nurses often encounter during medication administration. Nursing students were asked to describe the problems with medication administration during clinical internships. The students reported 2 areas causing stress at the beginning of their clinical internship: understanding medical orders and the hospital's informatized system. On the basis of these inputs, a group of teachers discussed and planned the microlecture content.

## Development of the Microlectures

The design of microlectures included the following characteristics to enhance students' awareness and curiosity<sup>1</sup>: (1) use of key concepts to provide a brief content outline; (2) demonstration of the problem-solving process or access to gradual instructions for difficult concepts; and (3) an attractive introduction of the theme and learning objective to prompt personal engagement.

Guidance was obtained from experts in the field of animation and information technology. Subsequently, 2 microlectures were designed: (1) understanding medical orders and the 3 checks and 5 rights of medication administration; and (2) the process of informatized medication administration and simplifying the complex system interface into essential items. Animation simulated the operation of the informatized medication administration. Supplemental Digital Content Figure 2 (available at: <http://links.lww.com/NE/B212>) provides an overview of designing and testing the microlectures.

According to the extant literature, integrating a topic with learners' life experiences or backgrounds facilitates the assimilation of new information.<sup>23</sup> Information processing theory stresses the association of learning with experience, whereas Dale's<sup>24</sup> cone of learning theory emphasizes how audiovisual elements can enhance learning outcomes. Combining the essentials of the 2 theories, the microlecture animation presented medication administration as a food delivery service. Food delivery is common in Taiwan, so this was a useful metaphor for completing forms for medication requests (see Supplemental Digital Content Figure 3, available at: <http://links.lww.com/NE/B213>). We also converted the familiar story of the Tortoise and the Hare into 3 parts, with short mnemonic chants describing the 3 checks of medication administration (see Supplemental

Digital Content Figure 4, available at: <http://links.lww.com/NE/B214>). These entertaining segments and mnemonics facilitated memorization while presenting the story. Immediately after the second microlecture, students accessed an online platform with questions about the key components to determine the effectiveness of microlectures.

## SPS and Debriefing

Based on the microlecture content, the fundamental nursing course teachers designed an SPS lesson plan, which was then examined and revised by 3 clinical nursing experts. The simulation involved a microlecture discussing the core concepts taught in the medication administration unit and a clinical scenario in which students interacted with an actor portraying a standardized patient to bridge the gap between theory and practical skills.

The treatment group participated in this SPS activity and a debriefing session guided by an instructor (the primary author). The SPS practice was completed in smaller groups. Before the simulation class, the teacher provided the patient's clinical information on the course website (e-campus). An actor was hired to portray a patient undergoing hemodialysis. Following the lesson plan, another person played the role of a family member and interacted with the students. Every simulation lasted approximately 10 to 15 minutes.

After group 1 completed an exercise, the lecturer played a microlecture video to review the core concepts of medication administration and debriefed them following the SPS lesson plan's guidelines. Debriefing involved interactive teacher-student questions and answers to stimulate the students' thought processes.

After the debriefing session, another group was randomly selected to participate. A total of 5 groups participated in the exercise during the 2-hour class (~5 students per group). All the students were required to write reflections and reports on the exercise and the simulation. The treatment group completed the SPS and provided feedback on their learning outcomes through a debriefing session and written reflections. The feedback was used as qualitative data.

## Data Collection and Statistical Analysis

The average correct answers for pre- and posttest items were compared using paired *t* tests. Analysis of covariance (ANCOVA) was used to compare the posttest scores after adjustment for the pretest scores to control for any effect of the pretest on the 2 groups.

## Results

### Effect of Microlectures on the 2 Groups

For the treatment group, the number of correct responses to all 6 items was significantly higher in the posttest, indicating improvement in their learning of the key aspects of medication administration. The control group scored higher on the posttest than the pretest only for questions

**Table. Pre- and Posttest Comparison of Correct Answer<sup>a</sup> With Paired *t* Test**

Item	Students With Correct Answer (Treatment Group) (n = 109)				Students With Correct Answer (Control Group) (n = 84)			
	Pretest, Mean (SD)	Posttest, Mean (SD)	<i>t</i>	<i>P</i>	Pretest, Mean (SD)	Posttest, Mean (SD)	<i>t</i>	<i>P</i>
1	0.25 (0.44)	0.82 (0.39)	-9.67	<.001	0.39 (0.49)	0.48 (0.50)	-1.26	.21
2	0.48 (0.50)	0.94 (0.23)	-9.10	<.001	0.63 (0.49)	0.67 (0.47)	-0.62	.54
3	0.05 (0.22)	0.63 (0.48)	-12.16	<.001	0.12 (0.33)	0.39 (0.49)	-4.60	<.05
4	0.28 (0.45)	0.67 (0.47)	-6.90	<.001	0.27 (0.45)	0.40 (0.49)	-2.08	<.05
5	0.41 (0.49)	0.70 (0.46)	-4.77	<.001	0.51 (0.50)	0.53 (0.50)	-0.41	.69
6	0.05 (0.21)	0.57 (0.49)	-10.50	<.001	0.08 (0.28)	0.16 (0.37)	-1.83	.07
Total	1.51 (1.00)	4.35 (1.43)	-17.16	<.001	2.01 (1.28)	2.64 (1.46)	-4.62	<.001

<sup>a</sup>Correct answer was allotted 1 point.

3 and 4. Scores corresponding with the remaining 4 questions differed nonsignificantly. Nevertheless, the posttest scores of both the groups were higher than their pretest scores, and the difference was significant for 6 items (Table).

To avoid any potential difference in the respondents' levels of knowledge at the beginning of the study, ANCOVA was used to control for the pretest scores before comparing the posttest scores. After adjustment, the mean values of the treatment and control groups differed significantly. Control group mean score was 2.53 (SE = 0.15) and treatment group score was 4.43 (SE = 0.13) after adjustment in the posttest. The treatment group scored higher than the control group on the posttest ( $B = 1.90, t = 9.30, P < .01$ ; see Supplemental Digital Content Table 1, available at: <http://links.lww.com/NE/B215>). Pretest scores were adjusted before analyzing the differences between the groups' integrated examination results. Control group mean score was 63.58 (SE = 1.69) and treatment group score was 88.43 (SE = 1.48) after adjustment in the integrated examination. The integrated examination scores of the groups differed significantly ( $B = 24.85, t = 10.96, P < .01$ ; see Supplemental Digital Content Table 1, available at: <http://links.lww.com/NE/B215>).

### Student Satisfaction With the Microlectures

Students were highly satisfied with the content (average score above 4.7) and animation of the microlectures, and their feedback was mostly positive. Some sample responses were as follows:

The animation was really well made! It was also easy to memorize. I wish there could be more microlecture units to learn.

The mode of teaching was very interesting and could really help us memorize relevant information.

### Themes in Simulation Debriefing

The SPS presented a case of a patient who delayed his medication administration because he needed to undergo a computed tomographic scan. The students were asked to complete an assessment and perform the required procedures to administer the medication according to the physician's instructions. We reviewed the students'

learning reports and used content analysis to extract the following 2 themes: video imprinting and core concept learning. Students expressed the following:

The animated microlecture converted the concept of 3 checks and 5 rights to mnemonic phrases, which helped me remember and complete them correctly during the simulation.

Animated images are easier to understand and remember than text. These images enable me to remember the steps for checking medication more easily.

The SPS was a simulated clinical care scenario that enabled the students to familiarize themselves with essential knowledge and skills before entering a clinical setting. The students commented:

The animated microlectures allowed me to remember the key points of the course and become familiar with the operations of hospital information systems. Because of this, I was less nervous and more self-confident during the simulation.

This learning method enabled me to learn the key points and quickly understand the contents of the entire chapter. The SPSs taught me how to apply the acquired knowledge.

### Discussion

After statistically controlling for pretest scores, the treatment group performed more favorably than the control group in the posttest and integrated examination while the control group performed better in the pretest. Thus, the microlecture module was effective in enhancing students' acquisition of basic nursing concepts. This finding is consistent with the Kong et al<sup>5</sup> conclusion and may be attributed to the short duration of microlectures and emphasis on core concepts. The results indicate that the treatment group achieved more favorable test results because of the microlecture module.

Content designed by teachers should follow the process of Issue-Design-Action-Reflection. Through this, teaching design can become more consistent with students' learning requirements. Common difficulties students encounter during clinical assessment were discussed with teachers and participants before the microlectures were designed; this enabled the teachers to define and refine the theme. The design of the animation videos was based on opinions provided by experienced course lecturers as well as junior and

senior nursing students who had completed the traditional lecture format course. Development of the microlecture included research and pedagogic reflection using the format described by Berrocal et al<sup>11</sup> and Yu.<sup>25</sup> According to their format, the core topic must be clearly stated and videos must be brief, concise, attractive, and informative.

Liu and Wang<sup>26</sup> suggested that examinations are required to evaluate the effectiveness of microlectures. Thus, the teaching design used here included questions centered on the information in the microlectures. In terms of satisfaction, students' feedback and reactions indicated that the teaching material was concise, stimulating, and associated with their life experience, which enabled better understanding. The microlectures can also be rapidly reviewed during future internships. Moreover, minimal time was required to gather critical core knowledge.

The higher posttest and integrated examination scores observed among the treatment group might be attributed to the ubiquitous access to microlectures through mobile devices. This corresponds with the results obtained by Wen and Zhang,<sup>27</sup> who concluded that microlectures, accessible through cell phones, offer a new means of microlearning. Students who adopt microlecture mobile learning as a supplement to traditional learning methods can achieve higher scores and tend to evaluate their courses more positively.<sup>28</sup> Furthermore, a microlecture model can be combined with a constructivist approach to enable students to reconstruct their mental models based on a more accurate understanding of relevant concepts.<sup>29</sup>

Authentic technology integration is a popular development trend of innovative teaching and a strategy for educational reform; it defines the developmental direction of nursing education.<sup>30</sup> According to the Taiwan Nursing Accreditation Council, general clinical nursing skills comprise basic professional core competencies for nursing students.<sup>31</sup> In addition, medication administration operations require knowledge and skills that are essential for maintaining patient safety. Fan et al<sup>32</sup> reported that competence is difficult to measure and influenced by individual factors. Thus, the microlectures used in this study can serve as a starting point for the development of students' competencies.

By sharing the process of developing these microlectures, we hope to provide teachers with a means of presentation that augments teaching and learning. Further verification of the conception's feasibility and the steps required to implement these teaching strategies can adapt this process to the needs of other courses.

## Conclusion

The COVID-19 pandemic has drawn attention to the importance of distance learning. The initial goal of microlecture design was to enhance student learning through lively and vivid animation and narration. Nursing education

must cultivate nurses who not only have excellent skills but also are knowledgeable. Fortunately, the continuous transformation of the health care environment has increased the demand for innovative teaching approaches. In addition, the need for distance learning using computers or mobile apps in nursing education requires an atmosphere that is favorable toward the exchange of information through collaborations between experts in information technology, nursing educators, and nursing professionals. Microlecture modules could be used to prepare students before their nursing internships with the required knowledge and skills.

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## TEACHING TIP

### Co-creation of Health-Related Social Media Content to Engage Students in Learning

The co-creation pedagogy approach creates a strong learning community that can maximize undergraduate nursing students' learning capacity and shape their higher-order thinking. Currently, most nursing students are familiar in using social media, which can be an effective way to co-create ideas and engage in learning. Therefore, we designed and implemented a project that students and teachers worked together to build a social media channel for health education. Students worked in groups, using the clinical reasoning cycle to develop social media posts and stories that focused on specific population such as older adults with dementia or strokes (see Supplemental Digital Content Instagram Posts, available at: <http://links.lww.com/NE/B185>). Students were required to select a health education-related topic, search relevant evidence-based information, and create posts, visuals, stories, videos, and hashtags that make it easier for public to understand. The social media posts describe elderly patients' needs and made recommendation on using technology products that fostering healthy aging. Through discussion and feedback from teachers, students could reflect on and understand how to identify the needs and make appropriate suggestions. We also developed a series of interactive simulated case scenarios for students' discussion and a rubric as a guideline for teachers to provide feedback. Students felt that this project was inspiring and appreciated the feedback from teachers, which could facilitate their thinking in developing meaningful social media posts in promoting healthy aging. This project also created a learning environment that enhanced peer relationships and teacher-students relationships. By constructing a thought-provoking co-creation environment, students become more engaged in higher-order thinking.

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