

## Effectiveness of Flipped Classroom Approach on Safe Medication Administration Learning Skill among Nursing Students

Samah Zidan<sup>(1)</sup>, Esraa Elsayed Rushdan<sup>(2)</sup>, Engy AbdelRhman Khamis<sup>(3)</sup>

(1) PhD, RN, Lecturer of Adult Health Nursing, School of Nursing, Badr University in Cairo- Egypt

(2) PhD, RN, Lecturer of Nursing Education, Alexandria University, Egypt

(3) PhD, RN, Lecturer of Medical Surgical Nursing, Modern University for Information and Technology Egypt

\*Corresponding Author: samah.zidan@buc.edu.eg

### Abstract

**Background:** safe medication administration is one of the basic important nursing skills that necessitate selecting effective educational methods. The flipped teaching strategy is one of the active learning approaches that encourage students' problem-solving skills needed for safe medication administration. **Objective:** examine the effectiveness of flipped classroom approach on safe medication administration learning skills among nursing students. **Methods:** A quasi-experimental design was applied with pre- and post-test assessments in the study and control groups. **Sample:** A convenience sample of 183 student nurses at one of the Nursing schools affiliated with a private university in Cairo. **The tools:** three tools were used in data collection; an interview questionnaire; Pre & post-test; and an observational checklist for safe medication administration. **Results:** The mean age of the control and study group was  $19.70 \pm 0.73$ ,  $19.55 \pm 0.60$  with no significant statistical difference as the two groups were homogenous. The current study results revealed that the total means of post-knowledge and practices score ( $20.04 \pm 2.0$  -  $29 \pm 1.3$ ) of students who learned safe medication administration by flipped learning approach were higher than students who learned by the standard learning method ( $16.82 \pm 2.6$ ,  $27.7 \pm 1.3$ ) with highly significant statistical differences between the two groups ( $P=0.0001$ ). **Conclusion:** flipped learning approach had a positive effect on increasing students' knowledge and practice mean scores than the standard teaching approach. **Recommendation:** replicating flipped classroom study in other practical nursing courses and involve the flipped learning strategy as a teaching method in the nursing curricula

**Keywords:** Flipped classroom, Safe medication administration, nursing students

### Introduction:

Educational institutions around the world are noticing a significant tendency toward the incorporation of technology within their teaching and learning methodologies as a result of technological advancements and the enlargement of online educational resources (Kintu, et al., 2017). Direct, teacher-centered instruction is being replaced with student-centered learning as the focal point of the educational process (MacKinnon et al., 2017).

Literature illustrated a significant disconnect between nursing education and nursing practice at the start of the twenty-first century, which prompted calls for nursing education to undergo critical reform. This call challenged nursing educators to design educational activities that will adequately equip newly graduated nurses to work in a healthcare system that is rapidly changing. In order to achieve this, MacKinnon et al. (2017) proposed alterations to the educational system, including a shift away from the instruction of knowledge that has been removed from its

context, improved integration of active learning in the classroom, and increased emphasis on the teaching of clinical reasoning. To accomplish these objectives, nursing education must incorporate fresh and cutting-edge instructional approaches (Oliver and Luther, 2020).

The traditional learning method is a learning process where both learners and teachers are bodily attending in the same place at the same time. The process of learning necessitates direct contact between the teacher and the student while the sender here is the teacher, and the recipient is the student, it is not an active way to contact (Asarta & Schmidt, 2017). The traditional lecture-based teaching model is not an efficient way for students to obtain and gain new knowledge and skills. Therefore, nursing educators have stressed the importance of active and dynamic learning strategies that allow students to participate in the learning process and interact with the curriculum's contents through various activities that encourage and promote critical thinking (AlJaser, 2017).

The flipped classroom approach is quickly gaining favor in the healthcare educational system as a way to encourage or facilitate student participation in the teaching and learning process. In this mode of instruction, students read the lecturers' prepared lesson materials ahead of time and jot down any key ideas or queries (**Betihavas et al., 2016**). The use of flipped classrooms in teaching and learning enables students to actively engage in the learning process in order to improve their nursing performance capacity based on clinical field situations (**Kim et-al 2016**).

Traditional one-way teaching methods are replaced in the classroom with student-centered two-way learning activities like discussions, debates, and case studies. The teachers encourage the students to ask questions, clear up any misunderstandings in the classroom to help them establish the right notions, stimulate thinking, provide direction for solving problems, and assist students in applying their knowledge (**Lee & Park, 2018**).

The four pillars of FLIP learning, according to **Chuang (2018)**, are F (Flexible learning settings), L (Learning culture), I (Intentional content), and P. (Professional educator), three extra characters were added P-E-D to FLIP (Progressive activities, Engaging experience, Diversified platform). Flipped learning has been employed in a number of domestic and international research that has shown it can improve students' knowledge, skill, attitude, self-efficacy, and learning satisfaction. An excellent opportunity for instructors and students to interact is provided through flipped learning. A flipped classroom can also increase interest in higher education and provide a student-centered learning strategy that addresses the needs of nursing staff members and increases their enthusiasm to learn (**Park and Park 2018**).

Furthermore, **Fan et al. (2020)** demonstrated that flipped classroom combined with a hybrid teaching course outline, provides students with not only a pliable way to learning materials at their own pace before class (autonomy), but also reinforces students' in-class discussion with classmates, reexamines students' strengths and weaknesses, and more (competence). The flipped classroom may also aid students in enhancing

their capacity for self-directed learning and forming lifelong learning habits.

The risk of drug mistakes causing patient damage is a serious concern. Errors in medication administration are more likely to occur as a result of individual health professionals' shortcomings, such as knowledge gaps and poor communication (**Hanson 2016**). The World Health Organization (WHO) reports that unsafe drug practices and medication errors are major causes of injury and preventable harm in healthcare systems worldwide. The main focus of nursing practice training curricula should be patient safety (**La Cerra, et-al 2018**). In this regard, the WHO Patient Safety Curriculum Guide recommends nursing schools emphasize the need to prioritize patient safety before students become healthcare professionals, with a focus on ensuring safe drug administration (**Mariani, et-al 2017**).

There are various subcategories of medication mistakes. According to the point in the pharmaceutical usage process where a mistake occurs, such as during prescription, transcribing, dispensing, administration, or monitoring, this classification approach is most frequently utilized in the hospital field. The second is psychological classification, which divides errors into knowledge-based, rule-based, action-based, and memory-based errors. Due to the various definitions and classification schemes used, it is challenging to estimate the prevalence of drug errors (**Ambwani, et-al 2019**).

In the era of COVID-19 nursing educators and teachers face the challenge of using a variety of learning measures to improve the quality of their instruction in light of the unique needs and goals of each student, including choosing the most effective teaching techniques (**Gu & Sok 2020**). One of these tactics is thus the use of novel teaching techniques. Thus, it is assumed that the flipped classroom approach is one of the new pedagogical models that depend on developing technology, even though such techniques have caused a number of challenges in education, notably in the nursing and medical sciences (**Hew & Lo 2018**).

**Zirpe, (2020)** reported that out of 6705 patient records, 410 drug mistakes were detected, 50% of which were due to incomplete prescriptions, near to 25% were the wrong dose, and 14% were as a result of administration

mistakes. According to the Institute of Medicine (US), between 44,000 and 98,000 deaths in America were attributable to drug errors (Walker 2016). Maintaining a safe medication administration is one of the important, basic and fundamental nursing practices. To accomplish these goals, a study was done to examine the effectiveness of flipped classroom approach on safe medication administration learning skills among nursing students

### Significance of the Study:

The World Health Organization (WHO) has stressed that one in ten hospital patients suffer injuries as a result of mistakes or unfavorable events and that this proportion is significantly greater in developing nations (World Health Organization, 2016). By 2022, the World Health Organization (WHO) wants to cut down on serious, preventable medication-related harm by 50%. Medication administration is one of the important basic concepts and skills taught in the adult health nursing branch and continues to be applied throughout the years of study and practical life after graduation and affects the patient health outcome directly (World Health Organization, 2017).

Modern interactive teaching techniques are needed in nursing education, particularly in theoretical and practical courses, to meet the demands of competency-based curricula. Furthermore, the desire for educational change, especially among undergraduate students, was driven by student learning results that demonstrated students' ability to analyze, solve problems, critically thinking, and put theory into practice. One of the interactive teaching approaches that encourage self-centered learning, use of technology, and develop problem solving skills is flipped learning (Doaa et al., 2018).

Opportunities to enhance competence in nursing schools becomes more limited as a result of the era of COVID-19 in addition to many other factors such as lack of training opportunities in hospitals, limited opportunity for skills demonstration and re-demonstration, and an increase in the number of students enrolled in nursing programs. Thus, these challenges affect the students' readiness to be qualified and skilled. Consequently, the level of students' academic achievement and satisfaction with the educational

process is not satisfactory (Mohammad & Khaleel, 2019).

The implementation of an interactive teaching model enables students to learn more cooperatively and think critically. Therefore, this study was carried out to examine the effectiveness of flipped classroom approach on safe medication administration learning skills among nursing students

### Aim of the Study:

The aim of the current research was to examine the effectiveness of flipped classroom approach on safe medication administration learning skills among nursing students

### This aim was achieved through:

1. Preparing the classroom activities and educational material in both standard and flipped teaching approaches (in the theoretical and practical part of medication administration) and testing its validity.
2. Implementing the two different teaching approaches standard/ flipped approach
3. Examine the achievement of the students subjected to standard teaching methods and students subjected to the flipped approach through a midterm and the examination of the final course for the theoretical part and observational checklist for the practical part.

### Research Hypothesis:

1. The flipped classroom teaching approach will increase the adult health nursing students' achievement in the theoretical part of safe medication administration than the standard method of teaching.
2. The flipped classroom teaching approach will increase the adult health nursing students' achievement in the practical part of safe medication administration than the standard method of teaching.

### Operational Definitions:

Flipped learning is a method where direct instruction is moved from the group learning space to the individual learning space, and the resulting group learning space is transformed into an active-energetic, high-powered, interactive learning environment where the instructor directs students when they apply

concepts and involve creatively in the subject matter.

## Subjects and Methods:

### Research Design:

A quasi-experimental design (study group and control group) was used to achieve the objective of the current research. Level two adult health nursing students were potential participants. All nursing students who register for Adult Health Nursing 1 (Theory – Practice Courses (NUR 2317-NUR 2318) for the first time in the fall semester were divided into 2 main groups (A & B) according to their university identification code using the university management system. Group B was assigned as the control and group A as the study group. To minimize intervention “contamination” between the study and control participants, the study was carried out consecutively with two classes starting with the traditional learning method.

### Study Setting:

The current research was conducted at one of the Nursing schools affiliated with a private university in Cairo. In which the campus is equipped with the newest and most advanced technologies, resources, and learning facilities. The school of nursing's mission aligns with that of the university in order to give undergraduate students a top-notch learning environment that will prepare them to provide excellent, evidence-based nursing care. Students participate in their educational activities (classroom and nursing skills lab) and then apply what they have learned in one of Cairo, Egypt's main teaching hospitals.

**Sample Type:** A convenient sample of (183 students) was used in the study

### Study Subjects:

**Inclusion criteria:** All nursing students registered in Adult Health Nursing 1 (Theory – Practice Courses (NUR 2317-NUR 2318) for the first time in the fall semester of the academic year 2019- 2020 and have fundamental computer skills.

**Exclusion criteria:** Students register for the selected courses for the second time

### Tools of Data Collection:

Data for the study were designed and collected by the researchers in English language. Tools of data collection include:

#### Tool (1) Interview Questionnaire:

An interview questionnaire sheet was applied for both (study & Control) groups. It included students' demographic characteristics such as age, learning experiences, group code, computer skills, current semester credits, and previous-semester grade point average (GPA).

#### Tool (2) Knowledge Assessment Questionnaire for Nursing Students Regarding Safe Medication Administration: (developed by the researchers)

- 1- **Pre/post-tests** : to assess students' knowledge in both groups (study & Control) in safe medication administration. The pre/post-tests consist of (25) questions in the form of multiple-choice questions (MCQs). It consists of 5 sections to assess student's knowledge regarding [1. General basic knowledge of medication administration (5 questions), 2. Factors affecting Safe medication administration (3 questions), 3. medication preparation (7 questions), 4. Types Medication errors (3 questions), and 5. Prevention of medication errors and nursing role (7 questions)]
- 2- **Mid Term and Summative Exam** part of questions related to safe medication administration. Medication administration scored as 5 scores for the midterm and 15 scores for final

**The scoring system of Pre & post-test and examination:** One mark was given for each correct answer and zero for the incorrect one. Knowledge level was considered Unsatisfactory: if the percent score was less than 60%, and Satisfactory: if the percent score was  $\geq 60\%$ .

#### Tool (3) Observational Checklist for safe medication administration:

The observational checklist was developed by the researchers based on an extensive review of literature and articles. The developed observational checklist included 35 action steps divided into three main blocks. Block 1: pre-medication preparation: involves 20 steps. Block 2: technique and medication administration involve 10 steps. Block 3: post-medication administration practice involves 5 steps.

Content validity was completed to examine to which extent the used tools assess what was supposed to be measured .The established tools

were examined by a panel of three adult healthcare nursing experts to be sure that the included items were clear and suitable to achieve the aim of the current research. Reliability was done and the interclass correlation coefficient revealed  $r=0.9$ .

**The scoring system of the student's checklist:** one mark was given if the step was done correctly and zero if the step was done incompletely or incorrectly or was not done step. The total scoring for all 35 Grads. If the student's score is more than 60% it considers a satisfactory level of performance and if less than 60% it considers an unsatisfactory level of performance

#### **Pilot Study:**

The pilot study was carried out on 10% of the study participants. The pilot study was done to ensure clarity, applicability, the feasibility of the study tools, and the time needed for each tool to be filled in. No modifications were needed to the tools of data collection based on the finding of the pilot study. Students included in the pilot study were not excluded from the main study sample because they cannot be excluded from registration for this year.

#### **Validity of the Tools:**

The content validity of the tools was revised by 3 experts in Adult Health Nursing to test content validity and according to their opinions; no major modifications were carried out to the content.

#### **Administrative and Ethical Considerations:**

The final approval for undertaking the study was gotten from Badr University ethical committee, BUC. Also, approval was obtained from the Dean of the nursing school to conduct the research on level two nursing students before starting the study. In addition, the aim, benefits, and risks of the study were clarified to the students involved, and informed consent was taken. Participants were informed that the obtained data will be confidential.

#### **Procedure:**

**The current research** procedure was completed through three phases; preparatory; implementation; and evaluation phase. The preparatory phase started with reviewing the available literature, different studies, evidence-

based research, and theoretical knowledge related to the current research in order to develop and prepare the data collection tool. Also, preparing instructional and teaching material regarding safe medication administration (theory and practice) which includes module objectives, videos, recorded presentations, clinical scenarios, quizzes, and problem-solving exercises.

Furthermore, training sessions were applied for clinical instructors regarding flipped classrooms, problem-solving, clinical scenarios, and problem-solving skills in order to prepare them for the practical sessions with the study group. Also, several faculty-training sessions on the campus learning management system (LMS) to ensure consistency in content and teaching materials, including quiz questions used in standard-based learning SBL (in-class), the simulation scenario (in-class), the assignment format (post-class), and reading materials (pre-class).

**Implementation Phase:** was carried out from October 2019 to January 2020. In the adult health nursing department, school of nursing.

All nursing students who register for Adult Health Nursing 1 (Theory – Practice Courses (NUR 2317-NUR 2318) for the first time in the fall semester were 257 students divided into 2 main groups (A & B) according to their university identification codes using the university management system. Group B included 129 students assigned as the control (SBL) and group A included 128 as the study group (FC). As well each main group is divided into 9 sub-groups. To minimize “contamination” between the study and control participants, the study was carried out consecutively. As in the first month, medication administration was taught for the control group using the standard teaching method while at the same time the study group taught another topic. A pre-test was introduced for the two groups before starting.

The topic of safe medication administration represents a basic part of two courses (Adult Health Nursing Theory 1 NUR2317- Practice 1 Course NUR2318) these courses are allocated in a bachelor program for level two undergraduate students (8 credits). The total teaching hours of safe medication administration according to nursing curricula is four theoretical contact hours and 28 practical contact hours.

## Flipped classroom

A flipped classroom: In this phase, a flipped classroom was implemented in teaching safe medication administration as part of two courses (Adult Health Nursing Theory 1 NUR2317-Practice 1 Course NUR2318). It incorporated face-to-face traditional-based learning (TBL) and simulation activity and online self-directed learning (via the “learning management system LMS-campus” platform).

The flipped classroom (FC) topic involved three sections: first, online activity, second, establishing a learner-centered flipped classroom, and third, simulation activity.

**The first phase:** started two weeks before the scheduled class, the first part of FC activity consisted of posting study materials in the form of web sources, a brief explanation of the lecture topic, case descriptions for simulation exercises, assignments, reflection, evaluation forms and prerecorded videos and presentation linked to the allocated topic online in the campus learning management system (LMS) platform. The students could access the resources for that week by following the instructions posted in LMS.

**The second phase** (face to face) of the FC activity started with the distribution of an objective-type written pretest with multiple-choice questions (MCQs) related to the session. To encourage group interaction, the class was divided into 9 subgroups, each sub-group received handouts containing a series of questions for problem-solving, Twenty minutes were allotted to each subgroup for discussion among the group members.

The third and last phase was face to face simulation activity in the skills lab, a series of case studies and questions for critical thinking and problem-solving were introduced for each subgroup. clinical cases were used to guide the debate that was followed by the students. The facilitator presented each case scenario and selected a group member at random to respond to

each question. The class as a whole debated the solution. The last phase also concerned fulfilling a post-class assignment on the campus LMS. The students were asked to submit all requested activities on the LMS platform and write their questions and comments on the LMS platform if any.

## Standard Teaching:

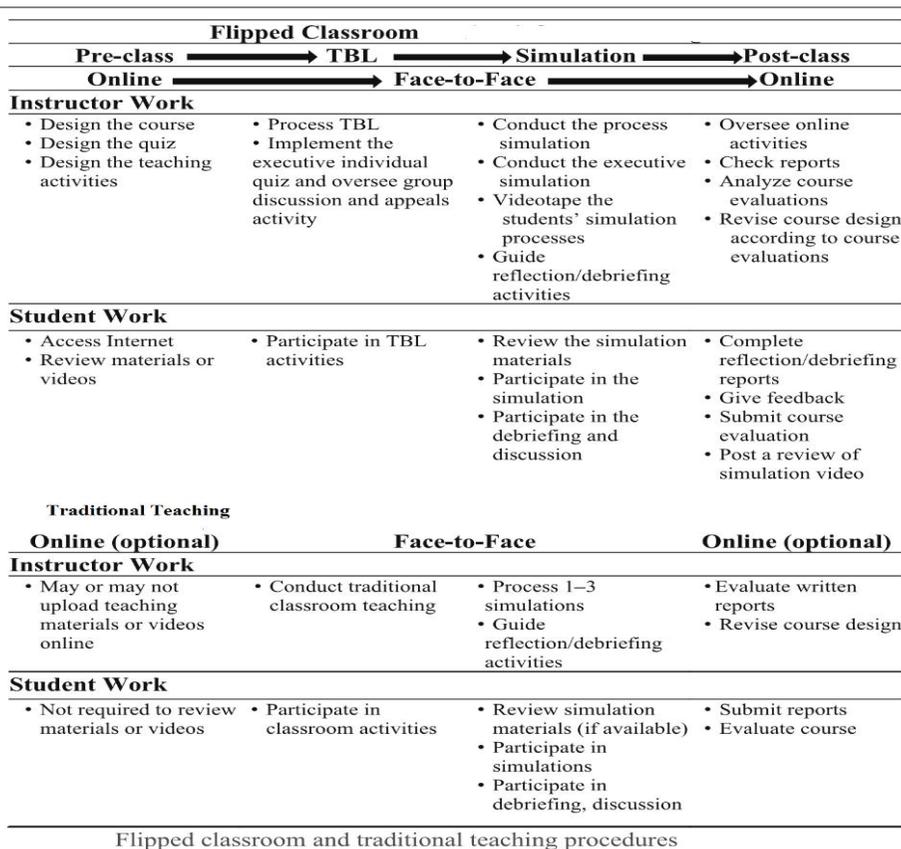
**In the first phase**, 2 weeks before the topic schedule began, it was optional for the instructor to upload teaching materials or videos online and the students were not required to review materials or videos before the course began. **The second phase** was face-to-face standard classroom teaching during which the instructor delivered the knowledge mostly using slides. **The third phase** was a face-to-face simulation activity (at least 1 simulation activity). The students participated in the classroom and laboratory activities in both face-to-face phases. The last phase, the instructor completed a written evaluation of the course in the form of a written report and/or revised the course design for the next semester. The students were asked to submit homework reports and evaluate the course. **Figure (1)** shows the flipped classroom and traditional/standard teaching procedures.

## Evaluation Phase:

In this phase, the researchers collected the pre/post-test scores and checklist scores of practical skills for all students in both groups. Finally, the mid-term and final exams for safe medication administration-related questions were used to evaluate students' achievements regarding theoretical content and Clinical evaluation and procedures checklist scores to assess practical skills.

## Limitations of the Study:

- Only short-term knowledge was evaluated when lectures were turned to virtual videos. The flipped classroom strategy utilizes active learning techniques, which could help enhance students' long-term memory.



Flipped classroom and traditional teaching procedures

**Fig (1):** The Flipped Classroom and Traditional Teaching Procedures.

Chen, F., Lui, A. M., & Martinelli, S. M. (2017): A systematic review of the effectiveness of flipped classrooms in medical education. *Medical Education*; 51(6), 585–597. <https://onlinelibrary.wiley.com/doi/10.1111/medu.13272>

**Statistical Analysis:**

Data entry and statistical analysis were done using the Statistical Package for Social Science (SPSS), version 18.0, a statistical software package. Results were presented in frequencies and percentages. Independent–samples t-test analysis was used to test statistical significance of some variables and to test effectiveness of the intervention between the two groups. Statistical significance was considered at  $p \leq .05$ .

**Results:**

Table (1) shows that the groups are homogenous and there are no statistically significant differences between the control and study groups regarding the demographic characteristics

Table (2) displays that the total mean post-test knowledge score (20.04±2.0) of the study

group is higher than the total post-test mean knowledge score (16.82±2.6) of the control group with highly significant statistical differences between the two groups ( $t=9.254/0.000$ ).

Table (3) illustrates that the percentage of the post-test satisfactory knowledge level (92.3%) of the study group is higher than the percentage of the post-test satisfactory knowledge level (84.7%) of the control group with highly significant statistical differences between the two groups ( $\chi^2/P=21.147/0.000$ ).

Table (4) represents that there are highly statistically significant differences between the control and study groups regarding midterm and summative exam mean scores ( $t/p=8.569/0.000-6.357/0.000$ ) respectively.

Table (5): represents that the total and subtotal mean performance scores of the study

group are higher than the control group with a significant statistical difference ( $p=0.0001$ ).

Table (6) shows that the percentage of satisfactory performance levels in the study group (93.4%) is higher than the control group (90.3%) with no statistically significant differences between the two groups ( $P= 0.431$ ).

Fig. (2): represents that the highest percentage of study group observational checklist scores ranged between good, very good, and excellent (31.9%, 25.2%, 17%) respectively, as compared to the control group where the highest percent ranged between good, and pass (45.7%, 25%) respectively.

**Table (1):** Frequency Distribution of the study sample Demographic Characteristics in (Control & study) (N=183)

Students' characteristics	Control Group N=92		Study Group N=91		Statistical Comparison	
	N	%	N=76	%		p-value
Mean Age (in Years) $\pm$ SD	19.70 $\pm$ 0.73		19.55 $\pm$ 0.60		t=1.58	0.55
<b>Gender:</b>					Chi <sup>2</sup> = 0.1313	0.717
- Female	55	59.8	52	57.1		
- Male	37	40.2	39	42.9		
<b>Learning Experience</b>					Chi <sup>2</sup> = 0.3119	0.576
- Secondary School	87	94.6	87	95.6		
- Technical Institute	5	5.4	4	4.4		
<b>Grade-Point Average Mean <math>\pm</math> SD</b>					Chi <sup>2</sup> = 0.1575	0.691
- >3.0- 4 (%)	19	20.6	21	23		
- 2.4-3	73	79.4	70	77		
Mean Credits Per Semester $\pm$ SD	17.10 $\pm$ 1.15		17.84 $\pm$ 1.37		t=1.83	0.12
<b>Computer Access at Home</b>					Chi <sup>2</sup> = 0.1485	0.699
- Yes	89	96.7	88	96.7		
- No	3	3.3	4	4.3		
<b>Use of smartphones in study</b>						
- Yes	92	100	91	100		
- No	0	0	0	0		
<b>Internet Access at Home</b>						
- Yes	92	100.0	91	100.0		
- No	0	0.0	0	0.0		
<b>Computer Basic Skills</b>						
- Satisfactory	92	100.0	91	100.0		
- Unsatisfactory	0.0	0.0	0	0.0		

**Table (2):** The Total Mean Pre/Post-test Knowledge scores of (Control and Study) Groups Regarding Safe Medication Administration. (N=183)

Group Mean $\pm$ SD	Control Group n=92				Study Group n=91				t-test	p-value
	Pre		Post		Pre		Post			
	N	%	N	%	N	%	N	%		
Mean $\pm$ SD	3.17 $\pm$ 21		16.82 $\pm$ 2.6		3.26 $\pm$ 1.95		20.04 $\pm$ 2.0		9.254	0.000

**Table (3):** The frequency distribution of satisfactory and unsatisfactory knowledge level for (Control and Study) Groups Regarding Safe Medication Administration. (N=183)

Satisfactory level	Control Group n=92				Study Group n=91				Chi-square	p-value
	Pre		Post		Pre		Post			
	N	%	N	%	N	%	N	%		
- Satisfactory	0	0.00	78	84.7	0	0	84	92.3	21.147	0.000
- Unsatisfactory	92	100	14	15.3	91	100	7	7.7		

**Table (4):** The Total Mean Scores of Midterm and Summative Exam Knowledge Scores of the Control and Study Group Regarding Safe Medication Administration. (N=183)

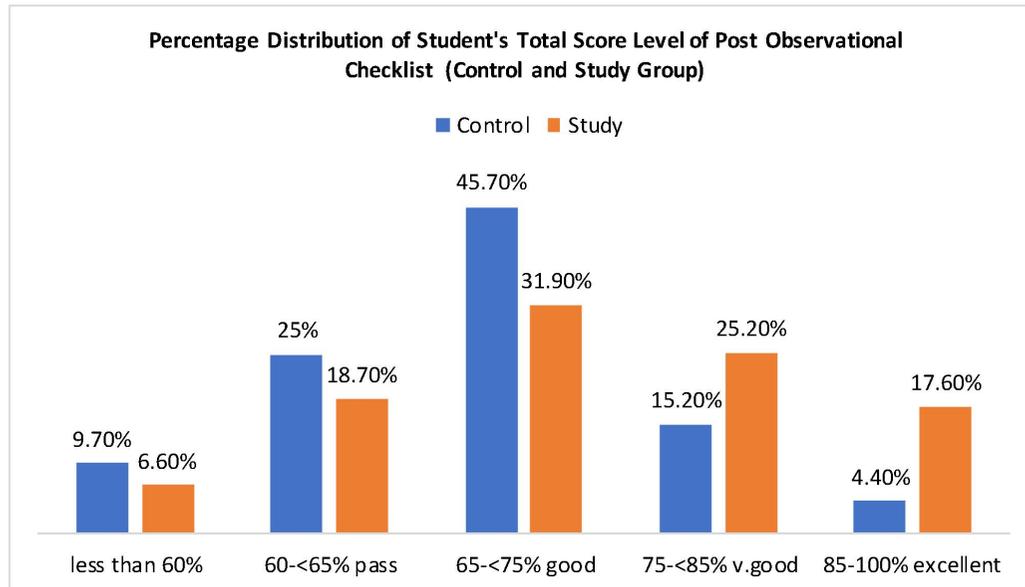
Satisfactory Examination Score	Control Group N=71		Study Group N=76		t-test	p-value
	N	%	N	%		
- Mid Term	3.4±0.6		4.1±0.5		8.569	0.0001
- Summative	10.2±1.6		11.8±1.8		6.357	

**Table (5):** The Total And Sub-Total Post Mean Performance Scores Regarding Safe Medication Administration For The Control And Study Groups. (N=183)

Student's Performance	Control Group n=92		Study Group n=91		t-test	p-value
	N	%	N	%		
Premedication preparation	16.8±1.3		17.9±0.6		7.336	0.0001
During administration	7.1±1.3		8.3±1.1		6.737	
Post medication administration	3.8±0.5		4.1±0.7		35.689	
<b>Total</b>	27.5±1.3		29±1.3		6.764	

**Table (6):** The frequency distribution of satisfactory and unsatisfactory performance levels for (Control and Study) Groups Regarding Safe Medication Administration. (N=183)

Student's Performance	Control Group n=92		Study Group n=91		Chi	p-value
	N	%	N	%		
- Satisfactory	83	90.3	85	93.4	0.618	0.431
- Unsatisfactory	9	9.7	6	6.6		

**Fig. (2):** Percentage Distribution of Students' Total Score Level of Post Observational Checklist (Control and Study Group). N=183

## Discussion

Studies on the effectiveness of Flipped classroom learning strategy in nursing education are few and rarely used in higher education. Lately, the flipped classroom

method has made inroads into medical education and has even been touted “a new model” in health profession education (Ramnanan and Pound, 2017).

*Chuang, (2018)* stated that flipped education is a chance to extend exchange time between educational institutions and learners. It can increase interest in higher education and provide a student-centered learning strategy, which meets the demands of nursing staff and increases their drive to study. This form of instruction aligns with the standards for clinical nurses.

The current study was carried out to compare traditionally versus flipped learning on adult health nursing students' achievement and satisfaction regarding safe medication administration. The current study findings regarding students' demographic characteristics are homogenous in the study and control group with no statistically significant differences in all items which include age, gender, GPA, semester registered credits, the ability of students to use computers, and availability and access of home computer with internet.

The mean age of the current research control and the study group was consistent to some degree with *Fan et al., (2020)* study done in Taiwan found that the mean age of their study sample regarding the outcome of flipped classrooms on 485 adults health nursing students is  $20.18 \pm .59$ , with homogeneity between groups. While *Afzal et al., (2019)* study in Pakistan contradicts the current study result regarding age as they reported that, about half of the study sample was in the age group of 23 years and about two-fifths were in the age of 24 years.

Regarding computer and internet access at home, the current study revealed that the majority of the study sample for control and study groups had computer and internet access at home, with no statistically significant differences between the two groups. Also all students in control and study group had satisfactory level of computer skills

*Yilmaz, (2017)* explain in a study done on 178 undergraduate students to assess their satisfaction regarding flipped classroom strategy that no statistically significant difference between the control & study groups in relation to the availability of computer and internet access at home. Also *Hassona et al., (2019)* support the current study result as they stated in their study done at Benha and Hail University which included 219 nursing students to evaluate their computer self-efficacy and attitudes toward its use in a healthcare setting that most nursing students

at Benha University have an accurate perception of what modern computers can provide for healthcare. However, Hail nursing students were the most likely to have a very good opinion of the use of computers in healthcare.

Furthermore, agreeing with the current study result *Herath & Mathotaarachchi (2018)*, demonstrated that internet information technology can help students develop favorable attitudes toward using computers, increase their exposure to technology, and develop their computer skills, making it easier for them to submit their work, which has a beneficial impact on their level of accomplishment.

Considering the pre/post-test knowledge scores of students regarding safe medication administration. The current study revealed that the total mean post-test knowledge score of the study group is higher than the total post-test mean knowledge score of the control group with highly significant statistical differences between the two groups regarding safe medication administration.

From the researcher's point of view, this result came as this method of teaching strategy provided an opportunity to send activities and scientific material in advance for the student to attend the school day and have a background and readiness for what will be discussed. Also, the students were divided into small groups to conduct panel discussions that gave them the opportunity to discuss, analyze, question and answer and apply many activities. As most of the time, the students were active participants. While a large number of students may interfere with focus, interest, control, and limit the chance for active participation.

These findings were consistent with *Ying et-al, (2015)*. A study was done in China, on 165 nursing students to assess the impact of the implementation of an extracurricular educational program and its usefulness in undergraduate nursing students, they found that post-test scores in the study group were higher than in the control group after 18 months of training.

*Moreover, Hew and LO, (2018)* meta-analysis study done in Hong Kong and included 28 comparative eligible studies found that overall, the data testified indicated that most students supported the flipped classroom more than the

traditional learning approach in the health care field.

In addition, the flipped classroom was more efficient than the traditional classroom in improving student learning performance. Along the same line the study carried out by *Zhu et al., (2019)* on 200 nursing, dental and medical students in China to evaluate the effectiveness of flipped classrooms in the ophthalmology module that the post-test knowledge scores especially related problem-solving and critical thinking skills showed a highly statistically significant difference between the control and study group and conclude that flipped learning increase students' achievement.

Regarding the satisfactory knowledge score after the implementation of the two teaching strategies on safe medication administration, the current study found that the percentage of the post-test satisfactory knowledge level in the study group is higher than the percentage of the post-test satisfactory knowledge level of the control group with highly significant statistical differences between the two groups. Also, there were highly statistically significant differences between the control and study groups regarding midterm and summative exam mean scores.

The current study results are inconsistent with *Chen, (2016)* and *Zainuddin et al., (2019)* who have found in their studies no significant difference in students' outcomes between learning using the flipped method and traditional approaches. While *Clark (2015)* acknowledged that a new learning strategy using new technology could lead to short-term enhancements in learner performance. In addition, *AlJaser, (2017)* study done in Saudi Arabia at Princess Nourah bint Abdulrahman University to assess the effect of the flipped classroom on students' self-efficacy and educational attainment agreed with the current study result as it emphasized that academic achievement and self-efficacy for students using flipped strategy is better than the control group.

Regarding the observational checklist for safe medication administration, the current study represents that the total and subtotal mean performance scores of the study group are higher than the control group with a significant statistical difference between the two groups. While no significant statistical difference between the two

groups regarding the satisfactory performance level regarding safe medication administration.

From the researcher's point of view, this result came as the students were provided an opportunity to send recorded video regarding the demonstration of safe medication administration and clinical scenarios that discusses safe administration and prevention of errors in advance for the student to attend the clinical school day and have a background and readiness for what will be applied and discussed. That provides more room for the teacher to focus on the critical steps of application, knowledge, and problem-solving skills during the class time

The current study findings are inconsistent with *Gross et al., (2015)* and *(Day, 2018)* who explained that the flipped classroom had better outcomes on the theoretical course than the practical one. While agreeing with the current study finding *Borges, (2019)* in a study done in Ogden-Weber Technical College to examine the effectiveness of the flipped classroom on tracheostomy care found that flipped teaching has a great positive effect in improving student tracheostomy care practice and reducing failure.

Furthermore, *Turocy (2016)* reported that utilizing flipped learning is crucial for lowering errors in nursing practice and enhancing nursing competency through clinical case studies, core essential nursing skills, self-efficacy, and learning enjoyment. Also, *Whitehair, et-al (2014) & Schneidereith (2014)* explained that naive nurses, as well as undergraduate nursing students, have trouble with safe medication administration, and a lack of clinical reasoning, decision, and problem analysis regarding the medication administration process. These situations can be reduced or controlled by using a teaching-learning strategy that depends on lifelike simulation, a dynamic active interactive, and innovative learning approach such as flipped learning.

### **Conclusion:**

The current study concluded that learning using of flipped classroom approach has a positive effect on nursing students' achievement regarding safe medication administration skills, where the total mean knowledge and practice scores of nursing students learned by the flipped strategy are higher than the total mean knowledge

and practice scores of nursing students learned by the standard method with a highly statistically significant difference between the two groups. Thus, support and accept the current research hypothesis

### Recommendations

Based on the results of this study, the following recommendations were suggested:

- Replicating flipped classroom study in other practical nursing courses.
- Involve the flipped learning strategy as a teaching method in the nursing curricula
- Provide a training program for the clinical instructors and teachers regarding how to apply flipped classroom strategy, advantages, and disadvantage

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