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COMPARISON OF FLIPPED CLASSROOM AND TRADITIONAL EDUCATIONAL METHODS ON KNOWLEDGE REGARDING DEEP VEIN THROMBOSIS PREVENTION AMONG NURSING STUDENTS

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PhD IN NURSING (SURGICAL NURSING)

Advisor

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Name of the student: Khalid AL-Mugheed

Mentor:PROF. DR. NURHAN BAYRAKTAR

Department: Nursing

Comparison of Flipped Classroom and Traditional Educational Methods on Knowledge Regarding Deep Vein Thrombosis Prevention among Nursing Students

SUMMARY

Aim: The main objective of the study was determination the effectiveness of the flipped classroom educational method on venous thromboembolismprevention knowledge among the nursing students. In the first and main stage of the research, comparison of the flipped classroom and traditional educational methods on attainment of knowledge regarding venous thromboembolism prevention among first- and second-class nursing students who had not received education regarding venous thromboembolism in previous course was aimed. The aim of the second stage was evaluation of the effectiveness of the flipped classroom method on venous thromboembolism prevention knowledge among third- and fourth-class nursing students who had educated regarding VTE in previous courses with traditional methods. In addition, evaluation of the opinions of the nursing students regarding flipped classroom educational method was the secondary aim of the both stages**.**

Material and Method: This study was performed with two stages; In the firststage study was implemented with a randomized controlled design in the Faculty of Nursing in September and October 2019, with 118 first and second semester undergraduate nursing students (58 students in the flipped classroom, 60 students in the traditional lecture) who had not taken the medical surgical Nursing course. Implementation of the study was conducted in three phases: pre-test, educational intervention, and post-test for both groups.

Second stage of the study was used pre-test and post-test, and interventional design. A total of 100 bachelor-degree nursing students were composed the sample of the study. The Implementation of the study was conducted in three phases including pre-test, educational intervention and post-test. Data were evaluated using the independent-sample t test.

Results: Results of first stage demonstrated no statistically significant difference in any of the mean scores of venous thromboembolism domains between the two groups in the pre-test.

However, the flipped classroom group had higher mean scores of all venous thromboembolism domains compared with the traditional lecture group in the post-test. Mostly, students highlighted four advantages of the flipped classroom, including “Deep motive,” “Engagement,” “Cost-effectiveness,” and “Self-confidence.”

Results of second stage showed statistically significant improvement in the overall mean scores of all venous thromboembolism after the educational intervention through flipped classroom. Students classified the strength points with four themes; deep motive learning, technology support, team-based learning, and satisfaction.

Conclusions: The flipped classroom method proved to have positive effects in venous thromboembolism domains in terms of knowledge, risk assessment, and prophylaxis among nursing students.This method can be recommended as an innovative and student-centered method in the teaching of evidence-based nursing practices.

Keywords: Venous Thromboembolism, Flipped Classroom, Traditional Method, Nursing Students

Öğrencinin adı: Khalid AL-Mugheed

Danışman: PROF. DR. NURHAN BAYRAKTAR

Bölüm: Hemşirelik

Flipped Classroom ve Geleneksel Eğitim Yöntemlerinin Hemşirelik Öğrencilerinin Derin Ven Trombozu Önleme Konusundaki Bilgilerine Etkisinin Karşılaştırılması

ÖZET

Amaç: Araştırmanın temel amacı, flipped classroom eğitim yönteminin hemşirelik öğrencilerininvenöz tromboembolizm önleme bilgileri üzerindeki etkinliğini belirlemektir. Araştırmanın birinci ve ana aşamasında, flipped classroom ve geleneksel eğitim yöntemlerinin önceki derslerde venöz tromboembolizm ile ilgili eğitim almamış hemşirelik öğrencilerinin venöz tromboembolizm önleme konusunda bilgilerine etkisinin karşılaştırılması amaçlanmıştır. İkinci aşamanın amacı, önceki derslerde venöz tromboembolizm konusunda geleneksel yöntemlerle eğitim almış hemşirelik öğrencilerinin venöz tromboembolizmi önleme bilgilerine flipped classroom yönteminin etkililiğini değerlendirmektir. Ayrıca hemşirelik öğrencilerinin flipped classroom eğitim yöntemine ilişkin görüşlerinin değerlendirilmesi her iki aşamada da ikincil amaç olmuştur.

Materyal ve yöntem: Bu çalışma iki aşamalı olarak gerçekleştirilmiştir; İlk aşama, Eylül ve Ekim 2019'da Hemşirelik Fakültesi'nde 118 birinci ve ikinci yarıyıl lisans hemşireliği öğrencisi (flipped classroom grubunda 58 öğrenci, geleneksel derste 60 öğrenci) ile randomize kontrollü bir tasarımla gerçekleştirilmiştir. Araştırmanın ikinci aşamasında ön test, son test ve girişimsel tasarım kullanılmıştır. Araştırmanın örneklemini daha önce iç ve cerrahi hastalıkları hemşireliği dersi alan toplam 100 hemşirelik öğrencisi oluşturmuştur. Çalışmanın uygulanması ön test, eğitimsel müdahale ve son test olmak üzere üç aşamada gerçekleştirilmiştir. Veriler, bağımsız örneklem t testi kullanılarak değerlendirilmiştir.

Sonuçlar:İlk aşamanın sonuçlarında, ön testte iki grup arasında venöz tromboembolizm alanlarının ortalama puanlarının hiçbirinde istatistiksel olarak anlamlı bir farklılık bulunmamıştır. Bununla birlikte, flipped classroom grubunun, son testte geleneksel ders grubuna kıyasla tüm venöz tromboembolizm alanlarında daha yüksek ortalama puanlarına sahipolduğu

belirlenmiştir. Öğrenciler çoğunlukla, flipped classroom yönteminin dört avantajını ifade etmişlerdir: "Derin güdü", "Katılım", "Maliyet etkinliği" ve "Özgüven".

İkinci aşamanın sonuçlarına göre, flipped classroom yöntemi ile eğitimsel müdahaleden sonra venöz tromboembolizmintüm genel ortalama puanlarında istatistiksel olarak anlamlı iyileşme görülmüştür. Öğrencilerinflipped classroom yönteminin güçlüyönlerine ilişkin ifadeleri dört tema ile sınıflandırılmıştır; “Derin güdü”, “Öğrenme”, “Teknoloji desteği”, “Takım temelli öğrenme” ve “Memnuniyet”.

Tartışma: Flipped classroom eğitim yönteminin hemşirelik öğrencilerininVTE genel bilgi, risk değerlendirme ve profilaksi alanlarında olumlu etkileri olduğu saptannmıştır. Bu yöntem, kanıta dayalı hemşirelik uygulamalarının öğretiminde yenilikçi ve öğrenci merkezli bir yöntem olarak önerilebilir.

Anahtar Kelimeler: Venöz Tromboembolizm, Ters Çevrilmiş Sınıf, Geleneksel Yöntem, Hemşirelik Öğrencileri

STATEMENT (DECLARATION)

Hereby I declare that this thesis study is my own study, I had no unethical behavior in all stages from planning of the thesis until writing thereof, I obtained all the information in this thesis in academic and ethical rules, I provided reference to all of the information and comments which could not be obtained by this thesis study and took these references into the reference list and had no behavior of breeching patent rights and copyright infringement during the study and writing of this thesis.

Khalid AL-Mugheed

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Contents

ABBREVIATIONS

Items of Abbreviations	Context
DVT	Deep Vein Thrombosis
PTC	Post-thrombotic Syndrome
PE	Pulmonary Embolism
VTE	Venous Thromboembolism
IPC	Intermittent Pneumatic Compression
GCS	Graduated Compression Stockings
IRB	Institutional Reviews Board
LMWH	Low Molecular Weight Heparin

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1. INTRODUCTION

1.1 Problem Definition

Vascular disorders have emerged as the main issue of occurrence the death and estimated 1 in 4 deaths in the world (WHO, 2016). Venous thromboembolism (VTE) is one of these diseases and includes deep vein thrombosis (DVT) and pulmonary embolism (PE) (CDC, 2016). It has been endorsed as a serious complication among hospital conditions, also, it defined as a 'never event'. Healthcare-associated venous thromboembolism (HA-VTE) refers to a blood clot caused by a long-care treatment, surgery, or other hospital care procedure (CDC, 2019).

In developed countries, VTE still significantly contributes to increased mortality and morbidity. It was estimated that 60,000 to 100,000 Americans die of thromboembolic conditions (CDC, 2016). On another hand, in developing countries such as in Asia, the situation is not reassuring. A study has shown that, despite the common belief that VTE in Asian countries is less common than in Western countries, the incidence rate of DVT in Asia was between 3% and 28% (Lee et al. 2012).

According to the Centers for Disease Control (CDC), DVT increases the possibility of post-thrombotic syndrome and PE, which affect an estimated 50% of DVT cases (CDC, 2016). VTE is associated with prolonged hospitalizations, and incurring costs of more than $7,500 per patient (Gerotziafas et al., 2018). In the US, the monthly cost of treatment for DVT is an estimated $700 to $1400, and the non-pharmacological prophylaxis it estimated to cost $465 to $875 per patient (Dawoud et al. 2018).

Nurses have important roles in the preventive measures (Lockwood et al., 2018). A Canadian study showed that nurses were the most suitable health care providers to provide a daily assessment of DVT prophylaxis (Lloyd et al., 2012). In the US, a study showed that the morbidity and mortality rates of DVT were decreased after the education of patients by nurses (Lavall et al., 2015). However, there are studies in the relevant literature showing a knowledge deficiency of nurses. In one survey, conducted in Northern Cyprus among registered nurses, they demonstrated a poor level of knowledge toward DVT prevention (Al-Mugheed and Bayraktar, 2018). In Lee's study, weak of knowledge was considered to be the main barrier of VTE assessment (Lee et al., 2014). Therefore, nurses should be knowledgeable about VTE prophylaxis because it is one of the most important evidence-based practices.

Today, the impact of innovative approaches on evidence-based nursing practices have been emphasized, which could enhance quality of care, nurse competencies, as well as close the gap between nursing education and practice (Tan et al., 2017). The Institute of Medicine (IOM) (2001) contended that new requirements and updated health profession education approaches would offer the opportunity for students to shift from traditional methods to active methods, as well as increasing their desire to engage in curricula. The principal mission of nursing education is to increase knowledge, skills, and attitudes of nursing students to enhance of the quality care; in this regard, using new teaching methods is important in nursing education(Baumann SL, 2019).

Innovation in nursing education is important for quality education and helps build the requisite enhancement of health-care services (Dehghanzadeh et al., 2018). The flipped classroom approach is one such innovative method allowing nursing students to play a dynamic role in the education process (El-Banna et al., 2017).The flipped classroom is a student-centered

method that allows students to utilize various technologies to understand educational lessons before attending the class; then, they use the understood information under the supervision of their instructors (Tan et al., 2017). Thus, during classroom time, the students can spend valuable time on group discussion, problem solving, and active learning activities(Dehghanzadeh and Jafaraghaie, 2018). The flipped classroom is composed of two main phases: (a) pre-class learning that is often based on online resources and allows students to understand the intended contents and concepts by watching videos and completing assignments, quizzes, and readings and (b) collaboration-based learning, which consists of teamwork that allows students to interact and brainstorm in class activities (Takasea et al., 2019).

The flipped classroom, also known as the inverted classroom, is a blended learning approach that advocates reversing the customary sequence of listening to a lecture in class followed by a homework assignment outside of class, to a model where students watch multimedia lectures on-line before class, followed by completing problem-solving and application exercises in class with the instructor acting as a coach or guide (Chuang et al., 2016; Fisher et al., 2020). The basic premise of the flipped teaching method is to move most of the passive transmission of content out of the classroom so that more class time can be invested in active and collaborative learning activities (Karabulut-Ilgu et al., 2017; Long et al., 2017).

The flipped classroom approach is often selected by instructors with the intent of increasing depth of engagement in the classroom class through active learning, without sacrificing the content and efficiency of the direct instruction featured in a lecture-based approach (Burke et al., 2017). Burford et al., introduced a concept called flipping the classroom in which technology was leveraged to transform the role of the instructor from a presenter of knowledge to a facilitator of active learning (Burford et al., 2017).

Although the traditional teaching methods are the most common methods in nursing schools, nursing students often face difficulties in learning nursing contents and would benefit from alternative teaching methods, even though they possess suitable study skills (Bingen et al. 2019). In a study based on evaluations of nursing courses that use traditional methods, the nursing students found grasping basic pharmacological contents and how to apply it in clinical practice difficult; they also they found it difficult to listen, write, and create new meaning(Hanson, 2016). A study showed that, in medical-surgical nursing course evaluations, students felt that the instruction was poor quality, particularly in clinical areasandwith traditional teaching methods (O'Lynn, 2013). However, there are benefits with the use of flipped classroom approaches, including enhancing problem-solving and decision-making skills, fostering student knowledge, independent learning, academic achievement, and increased student-teacher interactions (Bao-Zhu Li et al., 2020). A systematic review study showed that student achieved satisfaction after applied flipped learning (Betihavas et al. 2016).

In recent years, the number of studies conducted among nursing students comparing the traditional and flipped classroom has increased. A study conducted among Iranian nursing students to compare the effects of traditional lecture and flipped classroom showed that the flipped classroom group had significantly higher mean scores than those of the traditional lecture group (Dehghanzadeh and Jafaraghaie, 2018). A pre- and post-test quasi-experimental study in South Korea, using a flipped classroom approach among undergraduate nursing students, reported that mean scores in the experimental group were significantly higher than in the control group (Kim et al., 2019).

Innovative strategies to offer VTE topics may promote nursing students' knowledge of how VTE prophylaxis is applied, and also prepare them to transition to the clinical arena and

then as healthcare providers. To date there is no study regarding the use of flipped classroom in nursing education in Northern Cyprus. Evaluation of the effectiveness of a flipped classroom method regarding VTE prevention may have important contributions for the development of innovative approaches for evidence-based nursing education.

1.2 The Aim of the Study

The main objective of the study was determination the effectiveness of the flipped classroom educational method on VTE prevention knowledge among the nursing students. In the first and main stage of the research, comparisonof the flipped classroom and traditional educational methods on attainment of knowledge regarding VTE prevention among first- and second-class nursing studentswho had not received education regarding VTE in previous courses was aimed.

The aim of the second stage was evaluation of the effectiveness of the flipped classroom method on VTE prevention knowledge among third- and fourth-class nursing students who had educated regarding VTE in previous courses with traditional methods. The reason for second stage was to confirm the results of the first stage with extensive sample. In addition, evaluation of the opinions of the nursing students regarding flipped classroom educational method was the secondary aim of the both stages.

1.3 Research Hypotheses

Hypothesis for the first stage:

H1.1Nursing students who had not previous education on VTE and completed the educational program on VTE with flipped classroom method will have higher levels of general, risk and prevention knowledge regarding VTE compared with the traditional learning group.

Hypothesis for the second stage:

H1.2 Nursing students who had educated regarding VTE in previous courses with traditional methods and then completed the educational program on VTE with flipped classroom method, will have increased knowledge levels of VTE general, risk and prevention in post-test compared with pre-test.

2. BACKGROUND

2.1 Definition of Venous Thromboembolism (VTE)

Venous thromboembolism (VTE) is defined as the disease entity that includes primarily two conditions, deep vein thrombosis (DVT) and pulmonary embolism (PE) (WHO, 2016).DVT is the formation of a blood clot (thrombus) or multiple blood clots (thrombi) in a large vein, typically in the leg. DVTs most commonly form in the lower leg or in the thigh, but can also occur in the upper extremity or other veins (CDC, 2019). PE is a potentially life-threatening complication occurring when a thrombus dislodges and travels through the circulatory system as an embolus (i.e., a piece of material capable of causing a blockage) until it partially or completely blocks a pulmonary artery or one of its segmental branches (Clark et al., 2019)

2.2 Epidemiology of VTE

In the United States, VTE has been highlighted as a health concern and highly significant. It recorded that more than 100,000 Americans die of the vascular disorder (Benjamin et al., 2017). The incidence rate is generally highest among African-Americans (2.6 per 1,000 person-years or greater depending on the region), and lowest among Asian-Americans and Native

Americans(Heit, J. et al 2016). The incidence rate is about 20% higher in men than women overall, but women experience a higher rate than men during childbearing years (National Center for Health Statistics, 2018). VTE increases substantially with age; hospital discharge diagnoses of VTE increased from 0.6 per 1,000 person-years among those aged 18–39 years to 11.3 per 1,000 person-years among those 80 years or older in the U.S. from 2007 to 2009(CDC 2018). Discharges for DVT are slightly more common than PE (DVT: PE ratio is 1.26:1), although they are not mutually exclusive, with 14% of VTE hospitalizations having a diagnosis for both DVT and PE (CDC 2012).

2.3 Morbidity and Mortality from VTE

VTE can have very significant consequences, including major debilitation and death. Serious long-term sequelae experienced by up to half of patients with DVT include post-thrombotic syndrome and venous insufficiency, which can involve pain, swelling, and ulceration (Beckman et al., 2010).One to four months after diagnosis, DVT patients generally report lower on physical health quality of life metrics than the general population, with responses more similar to those with arthritis, chronic lung disease, or angina(Puurunen, et al., 2016). In about one third of DVT patients, often in those who develop post-thrombotic syndrome, quality of life metrics continues to worsen four months after the event(Uchino et al., 2018). Between 2–4% of patients with acute PE will develop chronic thromboembolic pulmonary hypertension, which can result in severe dyspnea and sometimes right ventricular failure and sudden cardiac death (Chai-Adisaksopha et al., 2016). Another important complication of VTE is a higher risk for a recurrent event. Recurrence of VTE is common; ≈30% of VTE patients experience a second VTE event within 10 years, and risk for VTE recurrence remains elevated over the life course (Zakai, et al., 2014).

2.4 Pathophysiology of (VTE)

Venous thrombi are composed mostly of fibrin, red blood cells, platelets and leukocytes. DVT usually begins as a platelet nidus near the venous valves in the lower extremities, where turbulence is present (Jonathan et al., 2017) Thrombi accumulate platelets and fibrin, leading to growth and occlusion of a venous segment or detachment. If the thrombus does not detach, it typically undergoes dissolution by the endogenous thrombolytic system (Abdollahi et al., 2019).

Virchow first described three main causes of thrombosis: stasis of the blood, changes in the blood vessel wall (vessel injury), and a hypercoagulable state (Langford et al., 2016) While thisis an oversimplification of a complex phenomenon, the basic natural history of DVT and PE can be described using this model (Kearon, et al., 2018).

2.5 Stasis of the Blood

Venous stasis impairs the clearance of activated coagulation factors by the liver, thus resulting in an increase in the concentration of these factors throughout the coagulation system (Min et al., 2016). Also, mixing of activated coagulation factors with their inhibitors is decreased when flow is diminished. Stasis of the blood may occur due to venous obstruction, elevated venous pressure, low blood flow or high blood viscosity, or venous dilation (Goodacre et al., 2018). These conditions may be the result of prolonged immobilization, obesity, or other cardiovascular disease states such as myocardial infarction or congestive heart failure (Ganguli et al., 2019). Whatever the reason for stasis, thrombi are prone to remain in the venous system due primarily to the lack of fibrinolytic activity in the blood(Oklu et al., 2017)

2.5 Venous Injury

Blood coagulation may be initiated by damage to the vessel wall. Exposure of the blood to the sub endothelium leads to platelet adhesion and aggregation and activation of the intrinsic coagulation pathway (Streiff et al., 2016). Activation of the extrinsic pathway by the release of tissue thromboplastin from damaged tissue cells occurs as well (Segalet al., 2018). Damage to the venous vessel system is the main contributor to thrombosis in patients undergoing hip and knee surgery (Zakai et al., 2014)

2.6 Hypercoagulable State

A hypercoagulable state may be the result of a number of conditions, inherited or acquired. The most common inherited conditions include deficiencies of protein C, protein S, or antithrombin; resistance of factor V to activated protein C, by the presence of the mutation commonly known as Factor V Leiden; and presence of the prothrombin G20210A mutation (Konstantinides et al., 2018). Protein C, protein S and antithrombin are anticoagulants, and their deficiencies generally lead to greater thrombin production and thus a propensity towards thrombosis. (Connolly et al., 2019). The Factor V Leiden mutation results in a structural change in factor V, making it resistant to the inhibitory effects of activated protein C, thus augmenting thrombin production. (Oklu et al., 2017). Others, however, have not found significant hemostatic changes in transdermal estradiol users, thus the exact mechanism for how exogenous female hormones contribute to increased risk of VTE is still unclear (Grosse, et al., 2016).

2.7 Risk Factors of VTE/DVT

VTE/DVT results from the interplay of general acquired and genetic risk factors in addition to ICU acquired DVT risk factors. General acquired risk factors include age, pregnancy,

puerperium, surgery, cancer, chemotherapy, hormone therapy, previous DVT, heavy smoking, obesity, air travel, and the lupus anticoagulant (CDC, 2016). Genetic risk factors include gender, ethnicity, blood group, and many genetic abnormalities affecting the control of hemostasis that led to excess thrombin generation or decreased fibrinolysis(Minet et al., 2015).

2.7.1 Age

Being over the age of 40 years is the strongest risk factor for DVT (CDC, 2016). This could be due to aging-related increased fibrosis and thickening in the valve leaflet and vein wall and decreased compliance of the vein wall (Barco et al., 2018). Changes in compliance in the vein wall affect venous blood flow, and thickened, stiff leaflets disrupt the normal flow of blood during the valvular cycle (Marshall et al., 2017).

2.7.2 Pregnancy

The risk of antenatal DVT is four- to five times higher in pregnant women than in non-pregnant women of the same age (Springel, 2016). Venous thromboembolism can occur at any stage of pregnancy, but the puerperium is the time of highest risk, with estimates of relative risk of approximately 20-fold (Barco S et al., 2017).

2.7.3 Hormone Therapy

Use of estrogen-containing hormone replacement therapy or oral contraceptives in women also presents an increased risk because exposure to estrogen increases the risk of clot formation. Contraception or hormone replacement therapy that uses both estrogen and progesterone produce DVT at the rate of two to eight times that of the general population (Vinogradova Y 2019). One clinical controlled study, with a follow-up period of seven years, conducted in a cohort of

women using oral hormone therapy, the risk of DVT among women taking estrogen was twice as high (OR = 2.08 [1.02-4.27]) as among women receiving estradiol (Spencer et al, 2014).

2.7.4 Surgeries

All surgical procedures, including abdominal, pelvic, thoracic, or orthopedic surgical procedures such as total knee, hip replacement, and hip fracture are associated with high risk of DVT (Whiting et al., 2016). The nature of orthopedic disorders and diseases, such as trauma or arthroplasties, particularly of the hip and knee, create a higher risk for the occurrence of venous thromboembolism. The positioning of the limb during surgery, localized postoperative edema, and limitations in mobility immediately after surgery all play a role in venous stasis and the consequent reduction of blood flow (Nathaniel et al., 2017). In addition, general anesthesia and duration of immobility, including duration of surgery, both increase risk of DVT (Smilowitz et al., 2017).

2.7.5 Cancer

Malignancy is one of the most common acquired risk factors for DVT, and patients with active malignancy have a fourfold to sevenfold higher incidence of symptomatic DVT than the general population (Nigel et al., 2020). The increased risk of DVT in patients with cancer appears to be because of the effect of malignancy on each component of the Virchow triad, namely, venous stasis, blood components imbalance, and vessel wall damage. Each factor ultimately contributes to the alteration of normal blood flow, thereby increasing thrombus formation (Hisada and Mackman, 2017). Evidence suggests the absolute risk depends on the tumor type, initial cancer stage, biological aggressiveness of cancer, and rate of metastatic spread (Caio et al., 2019).

2.7.6 Obesity

Obese people are at an increased risk for DVT compared with individuals who are of normal weight reported increased body mass index (BMI) >30 Kg/m2 was associated with a rising risk of DVT (WHO, 2018). An elevated BMI can increase levels of coagulation factor VIII and IX possibly contributing to the increased risk of thrombosis (Cristina H 2020). A mechanical exertion also exists that can lead to impairment of the valve system in the deep veins of the lower limbs, with ensuing venous stasis, which is a risk factor for thrombus formation (Ho, et al, 2013; Samuel et al., 2017).

2.7.7 Cardiovascular Conditions

Myocardial infarction (MI), ischemic and nonischemic cardiomyopathy, congestive heart failure (CHF) secondary to valvar disease, stroke, and chronic idiopathic dilated cardiomyopathy can increase the risk of DVT (Serhal and Geoffrey 2019). Features that include increasing age, prolonged immobility, and cardiac or respiratory failure in patients with MI probably account for the well-documented association of DVT with cardiovascular diseases (CDC, 2016).

2.7.8 Inflammatory Bowel Disease

Acute inflammatory bowel disease (IBD) is associated with a two to three times risk of DVT or PE when compared with general population (Cheng and Adam 2020). The main risks for DVT in IBD patients include dehydration, hyperhomocysteinaemia, and active disease with an “inflammatory burden” (Wisam et al., 2020). In addition, in IBD patients, several mechanisms triggered by active inflammation are involved in moving the coagulative balance towards a prothrombotic state, including: (1) increased plasmatic levels and decreased levels of natural anticoagulants; (2) reduced fibrinolytic activity; (3) endothelial abnormalities that are mainly

represented by the downregulation of the anticoagulant thrombomodulin and endothelial protein C receptor, that in turn affects the conversion of protein C into its activated form; and (4) abnormalities of platelets, such as thrombocytosis and increased activation and aggregation (Hansen et al., 2017;Kim et al., 2019).

2.8 Complications of VTE

Pulmonary Embolism (PE) the most serious complication of DVT occurs in up to 50% of cases and has a mortality rate up to 30% (CDC, 2016). PE occurs if a fragment of the clot breaks loose, travels through the heart, and migrates to the lungs, obstructing the pulmonary artery (Melissa et al., 2017). Symptoms of PE include chest pain; sudden cough, rapid breathing, and shortness of breath, rapid heart rate, low blood pressure, lightheadedness, and a feeling of apprehension and in rare cases, the clot may be pumped to the brain, causing cerebral venous thrombosis and stroke (Eno-Obong et al., 2019).

Another complication is Post-Thrombotic Syndrome (PTS), which is defined as a chronic condition characterized by recanalization, a complex process of fibrinolysis, thrombus organization, and neovascularization (proliferation of blood vessels) occurs (Audu et al., 2020). PTS affects up to one-third of persons with DVT, and causes chronic pain, chronic inflammation, cellulitis, and ulceration of the affected limb, where, in severe cases, amputation of the affected limb is required (Appelen et al., 2017; Anthony, 2013). Additionally, recurrence of DVT, renal vein thrombosis, right side heart failure, and paradoxical embolism can cause heart attack and stroke (Metz et al., 2018).

2.9 VTE Prevention Interventions

Treatments and evidence-based interventions for preventing VTE to decrease the risk of DVT and PE, to decrease rates of mortality and morbidity (Adriance & Murphy, 2013). The 9th edition of the American College of Chest Physicians (ACCP) clinical practice guidelines for prevention and treatment of venous thrombosis provides updated recommendations for various subgroups of patients that emphasizes the evaluation of patient risk for DVT and use appropriate thromboprophylaxis according to patient's condition (Guytta et al., 2018).

2.9.1 Mechanical Prophylaxis

Mechanical devices for thromboprophylaxis are characterized as either static or dynamic (Gelder et al., 2018). Static devices include graduated compression stockings (GCS) and placement of an inferior vena cava (IVC) filter, which is an invasive procedure. Static devices include graduated compression stockings (GCS) and placement of an inferior vena cava (IVC) filter, which is an invasive procedure (Afshari et al., 2018). Dynamic methods include intermittent pneumatic compression devices (IPC), sequential compression devices (SCD), and arteriovenous foot pumps. Mechanical compression devices work by creating intermittent sequential pressures on the legs to promote venous blood flow that reduces venous stasis and activates the fibrinolytic pathway (Juliessa et al., 2016). Current guidelines recommend mechanical prophylaxis for patients in whom pharmacological prophylaxis is contraindicated or in combination with pharmacologic thromboprophylaxis in certain sub-populations at higher venous thrombosis risk (Greenall et al., 2020). These significant findings demonstrate that SCDs are effective in reducing DVTs when compared to no DVT prophylaxis.

2.10 Pharmacologic Prophylaxis

Options for pharmacologic thromboprophylaxis include unfractionated heparin (UFH), low molecular weight heparins (LMWH) (i.e., enoxaparin, and dalteparin), and pentasaccharides (i.e., fondaparinux).

2.10.1 Aspirin

Aspirin (acetylsalicylic acid) is an inexpensive, orally administered and widely available medication with a controversial use as a prophylactic agent for VTE.The 2018 ACCP guidelines do recommend the use of aspirin as VTE prophylaxis for patients undergoing total hip replacement, total knee replacement or hip fracture surgery because it appeared that the use of aspirin for VTE prophylaxis in these patients is more effective compared with placebo (ACCP guidelines 2018). Aspirin500 mg is an inexpensive and widely available medication; many studies have proven its efficacy in VTE prophylaxis for patients undergoing surgeries, and was found to be associated with similar efficacy and safety outcomes when compared with anticoagulants (Haykal et al., 2019).

2.10.2 Vitamin K antagonists

VKAs are recommended by the latest ACCP guidelines for VTE prophylaxis in patients undergoing THR, TKR or hip fracture surgery (Gla) on the N-terminal regions of vit K-dependent proteins(ACCP guidelines 2018). Standard treatment of VTE, using low-molecular-weight heparin (LMWH) overlapped with vitamin K antagonists (VKAs), is effective but requires frequent laboratory monitoring and has the potential for multiple drug and dietary interactions. (Saleh et al., 2017).

2.10.3 Unfractionated Heparin (UFH)

UFH is a heterogeneous mixture of glycosaminoglycans that binds to antithrombin (AT) via a unique pentasaccharide sequence and catalyzes the inactivation of thrombin, factor Xa and other clotting enzymes (Saleh et al., 2017). UFH is recommended by the latest ACCP guidelines for VTE prophylaxis in patients undergoing THR, TKR or hip fracture surgery (ACCP guidelines 2018). When administered in therapeutic doses, the anticoagulant effect of UFH is usually monitored using the activated partial thromboplastin time (Jacobs et al., 2017).

2.10.4 Low Molecular Weight Heparin

LMWH is derived from UFH by chemical or enzymatic depolymerization. Their molecular weight is approximately one-third that of UFH (mean, 4000 to 5000 D; range, 2000 to 9000 D). Compared to UFH, LMWH has a more favorable benefit-to-risk ratio in animal models, with superior pharmacokinetic properties (Haac B et al., 2020). The inhibitory activity of LMWH against factor Xa is greater than thrombin and exhibits less binding to cells and proteins than UFH (Dimitrios et al 2018).The use of LMWH is more convenient than UFH, and thus has replaced UFH for almost any clinical indications(Evans et al., 2016). LMWH is significantly superior to both UFH and warfarin for prevention of DVT, and results in significantly less minor bleeding complications when compared to UFH, but significantly more minor bleeding when compared to warfarin' (Haac BE et al ., 2017).

3. Nurses Role in Preventing VTE

3.1 Patient's Assessment

Nurses are key players in the prevention of VTE and its complications. Nurses are with patients at the time of admission and take care of patients throughout their hospital stay (MA et

al., 2018). They are in the ideal position to assess patient risk factors early and implement VTE prophylaxis. Admission assessments are an opportune time to evaluate patient risk factors, such as mobility, age, previous history of DVT, and medical conditions that increase the risk of developing DVT in hospital patients (OH et al., 2016). Patient risk assessment should be ongoing throughout hospitalization, especially when patient condition changes. A worsening of patient condition warrants a re-evaluation of risk factors, just as a significant improvement in condition can signal the need to reconsider previous risk factor assessment (Kim et al 2015).

The nurse should complete an assessment devoting special attention to the presence of any risk factors for DVT upon admission, and at any time when patient'scondition changes (Xu et al., 2018). If the patient exhibits any risk factors, the nurse should use the established risk assessment protocol to determine the level of risk. When the risk level has been determined, the nurse should work cooperatively with the physician and other health care providers to determine the proper DVT prophylaxis method (Silva et al., 2020). Upon determination of the appropriate method, the nurse caring for the patient is responsible for administering the DVT prophylaxis (Ahmed et al., 2020).

3.2 Assessing and Monitoring Anticoagulants

Anticoagulation drugs can be lifesaving. Nurses must carefully assess, closely monitor, and comprehensively educate the patient receiving anticoagulation drugs to the full benefit of anticoagulation therapy and to minimize potential harm(Ma et al., 2018).Nurses should administer the medications properly, monitor the side effects and educate the patients. In adult patients', nurse-driven heparin nomograms for IV heparin administration manage anticoagulation needs(OH etal., 2016). Nurses should obtain baseline labs; calculate and administer the initial

bolus dose; order and evaluate anticoagulation labs; and titrate heparin to therapeutic goal based on clinical algorithm and patient presentation (Kujur et al., 2012).

3.3 Early Ambulation

Early ambulation is an essential intervention to reduce VTE risk. Efforts to improve early mobility of critically ill postoperative patients improve the patient's respiratory status and cardiovascular performance, and it reduces muscle deconditioning and development of DVT (Duff et al 2011). Early progressive mobility of the critically ill patient should occur as soon as possible to maximize the benefits of patient movement. One common misunderstanding is that when the patient begins ambulation, thromboprophylaxis can be held or discontinued. For moderate to high-risk patients, chemical and mechanical thromboprophylaxis in addition to ambulation is most effective when it extends beyond discharge from acute hospitalization (Li et al., 2010; Duff et al 2011).

4. The Flipped Classroom TrainingConcept

In the flipped classroom, lecture-based instruction is transformed to online videos or multimedia presentations which students interact with outside of class creating the opportunity for teachers to guide students as they apply concepts collaboratively in the face-to-face classroom (Fisher et al., 2020). The flipped classroom approach is often selected by instructors with the intent of increasing depth of engagement in the classroom class through active learning, without sacrificing the content and efficiency of the direct instruction featured in a lecture-based approach (Burke et al., 2017).Burford et al., introduced a concept called flipping the classroom

in which technology was leveraged to transform the role of the instructor from a presenter of knowledge to a facilitator of active learning (Burford et al., 2017).

The flipped classroom, also known as the inverted classroom, is a blended learning approach that advocates reversing the customary sequence of listening to a lecture in class followed by a homework assignment outside of class, to a model where students watch multimedia lectures on-line before class, followed by completing problem-solving and application exercises in class with the instructor acting as a coach or guide (Chuang et al., 2016;Fisher et al., 2020).The basic premise of the flipped teaching method is to move most of the passive transmission of content out of the classroom so that more class time can be invested in active and collaborative learning activities (Karabulut-Ilgu et al., 2017; Long et al., 2017).

4.1 Lecture-Based Teaching

Lecturing is one of the most prominent teaching methodologies in colleges and universities today (Fisher et al., 2020). A lecture can be an especially effective way to convey relatively large amounts of content knowledge to numerous students efficiently (McNally et al., 2017), while offering at least some potential for dynamic interaction between the expert instructor and the novice student in a shared environment (Cashin, 2014).While individual and small-group teaching offer considerably more dynamic interaction, such approaches are much more costly and may be impractical to implement at larger scales (Schwartzstein et al., 2017).A skilled lecturer can promote student engagement by conveying a sense of passion for the material that is difficult to communicate other ways (Samuelson et al., 2017). By piquing their interest, an engaging lecture can serve to motivate students to learn more (Joshi et al., 2018). On the other hand, a number of problems have been identified with using a lecture-based approach. Lecturing may not be effective at promoting levels of learning beyond knowledge and comprehension

(Abdelkarim A , 2018). As such, it is not unusual to pair lectures with other learning activities, such as discussions and labs, in order to teach application, analysis and synthesis or to influence attitudes or values (Cashin, 2014). This particular weakness may be exacerbated as access to postsecondary education becomes more open and student populations become more diverse (Cohn et al., 2016). Moreover, during a lecture, instructors may have only limited feedback from which to assess the students' comprehension (Cashin, 2014). Asking questions is usually helpful in this regard (Cashin, 2014), as is being sensitive to nonverbal clues but these techniques fall short of the robust feedback that is intrinsic to individual and small-group teaching. Finally, sustained attention is required for lectures to be effective, however, expecting students to stay focused for extended periods of time may not be realistic (Samuelson et al., 2017).

4.2 Challenges and Benefits

While the importance of active learning strategies as opposed to lecture in higher education is well known, students continue to complain about the lack of guidance within active learning strategies as a hindrance to their perceptions of learning (Della Ratta, 2015; Salyers, Carter, Carter, Myers, & Barrett, 2014). The flipped classroom approach is a compromise between the sole use of lecture and the sole use of active learning strategies; by providing the lecture online prior to class time, students can engage in active learning while still being provided the instructional lectures that they perceive they need (Gilboy et al., 2015). The decrease of notetaking during class time helps students feel that they are multi-tasking less and more able to focus (McLean, Attardi, Faden, & Goldszmidt, 2016), and the focus on discussion versus lecture increases students' feelings of having their questions answered (Peterson, 2016). This method of providing online lectures to students can be especially helpful for students who struggle with material or are culturally or linguistically diverse and will benefit from the ability to listen to

lectures multiple times or at their own pace (Billings, 2016). Utilization of a flipped classroom has also been suggested as a method to increase interest in the current, more technologically savvy generation of students (Gillispe, 2016).

Despite the possible benefits, students still often provide resistance due to a high comfort level with traditional lecture (Chen & Chuang, 2016; Sinouvassane & Nalini, 2016). Researchers also suggest that the flipped methodology may be disliked by students because of required time management skills and self-discipline (McLean et al., 2016). While possibly still able to perceive benefits from the flipped approach, studies have suggested that students do not always feel that the flipped classroom can meet all of their learning needs (Hao, 2016). Educators also tend to cling to more comfortable methods due to a fear of innovation and unfamiliar instructional styles (Hao & Lee, 2016). There is a much greater burden of work for an educator utilizing a flipped classroom versus a traditional lecture as well, further increasing the resistance of faculty (Billings, 2016; Chen & Chuang, 2016; McCarthy, 2016).Even with this resistance, the literature suggests that students and faculty do frequently verbalize positive feelings towards the experience after they have taken part in a flipped course (McCarthy, 2016; Fisher et al., 2020). The possible benefits to critical thinking skills, student engagement, and student perceptions continue to make the flipped classroom style of teaching attractive to many educators(O'Flaherty & Phillips, 2016).

4.3 The Flipped Classroom Training in Nursing

There are several studies that can be found identifying the positive impact a flipped classroom can have on licensed nurses that are pursuing higher education. Buxton, Buxton, and Jackson (2016) identified the impact of flipping the face-to-face portions of several hybrid RN toBSN courses for 64 students. At the completion of the eight-week courses, involved students

were asked to complete an end of course survey that identified their feelings towards the teaching style, specifically in relation to previous experiences in higher education. Upon completion of only one eight-week course, the overall self-identified technological skills of the students increased significantly, and the majority of students believed they were more engaged in the learning process when using the flip (Buxton et al., 2016). In keeping with the literature (Chen & Chuang, 2016; Sinouvassane & Nalini, 2016), negative perceptions were found related to both instructor and student lack of comfort with the new methods of instruction (Buxton et al., 2016).

Although these results focused on licensed nurses seeking higher education, research is growing involving the use of the flipped classroom within core pre-licensure nursing education. Some literature is anecdotal, discussing educators' experiences without supporting research findings. For example, one article discussed nurse educators' experiences and the lessons they learned during a flipped pilot course (Schlairet, Green, & Benton, 2014). Another article described an educator's experience with positive student viewpoints when using a flippedclassroom for maternity and mental health courses (Volpe, 2015).There are an increasing number of studies available in which researchers have begun to delve into the impact of the flipped classroom instructional style in undergraduate nursing education. Both qualitative and quantitative data are available, but similarly to the application in pharmacy education, there are some mixed results.

Some of the available qualitative data shows that students and faculty perceive positive benefits to the flipped classroom approach in nursing. In a study spanning two years and over 350 students, a mental health nursing course provided content through a flipped classroom method with clinical reinforcement (Burden, Hodson-Carlton, Siktberg, & Pavlechko, 2015).

Students prepared for class through readings and online lectures, engaged in active collaborative learning during class time, and completed reflective journaling at the completion of clinical each week to discuss how the learning activities of the week impacted and influenced their clinical experiences. Themes that arose in these journals over the course of the study included students' feelings of being more actively engaged in the classroom, perceptions of increased knowledge acquisition, and perceptions of an enhanced ability to apply knowledge to clinical, while faculty reported an increase in student confidence and abilities on the clinical unit as a result of the class activities (Burden et al., 2015).

A study of 70 associate degree nursing students enrolled in a first-year nursing theory course also showed positive qualitative results (Pence, 2016). Two separate classes of students were followed, with classroom evaluations and individual surveys given at the completion of the flipped course. Although no information was provided regarding any possible changes or improvements in quantitative testing data, and while there was no control group data provided for comparison, the author expressed that the majority of students stated that the flipped classroom design helped to foster their learning and provided them with a positive classroom experience (Pence, 2016).

In a basic qualitative study involving 64 baccalaureate nursing students enrolled in a third-year community health course, evaluation results were analyzed before and after the flipped classroom methodology was initiated (Kim, 2015). Questions regarding student perceptions of learning and satisfaction with the courses were compared between the study group and students taking the course taught with a traditional lecture method. Those students in the traditional lecture course viewed the course as slightly more conducive to learning when compared to those in the flipped classroom group, which may be a result of the frequently seen student

dissatisfaction with the additional workload involved with this methodology (Kim, 2015). However, the students in the flipped classroom group did overall have greater feelings of satisfaction with the course as a whole and with their own abilities to apply the knowledge obtained to the clinical setting (Kim, 2015).

Quantitative data also exists supporting the use of the flipped classroom within nursing education. In a study of 82 baccalaureate nursing students during a first-year medical-surgical theory course, researchers divided students into one of two groups, a traditional lecture course or a flipped classroom course, and the same content was expressed in each class (Harrington et al., 2015). Students were provided with the same learning outcomes, quizzes, assignments, and tests between the two groups. The researchers found that there was no significant difference between the scores of the study group and the control group (Harrington et al., 2015). While these statistics do not necessarily argue that there is a need for the flipped classroom to increase knowledge retention specifically, the statistics do show that the flipped classroom and traditional lecture do have the same level of effectiveness in imparting knowledge. If educators believe that critical thinking skills may be impacted positively, and if students overall have a positive view of the learning that occurs within a flipped course, perhaps an increase in testing scores is not the only important measure of success (Tan et al., 2017).

Contrary to the findings discussed by Harrington and associates (2015), a mixed methods study into the flipped classroom approach did result in a significant increase in test scores with the flipped classroom approach, although this occurred with marked student dissatisfaction with this content delivery style (Missildine et al., 2013). For this study, three methods were used in teaching an adult health nursing course: traditional lecture only, classroom lecture with online lecture as a supplement, and a flipped classroom approach. Upon completion of the study

evaluations and test scores were compared from the three groups. Contrary to the findings of Della Ratta (2015), students did not enjoy the flipped classroom methodology, although researchers do agree with Kim (2015) and allow for the assumption that the greater workload may have played a role in these feelings (Missildine et al., 2013). Examination scores were one to two percent higher on average for the flipped classroom group, a percentage increase that, while seeming somewhat insignificant, analysis predicts may have increased the number of the 159 students passing the course by a total of 47 students (Missildine et al., 2013).

5. Methodsof the First Stage

In the first and main stage of the research, effectiveness of the flipped classroom and traditional educational methods on VTE prevention knowledge levels among nursing students who had not received education regarding VTE in previous courses (First and second classes) were compared.

5.1 Study Design

In the first stage,randomized controlled design to determine the effectiveness of the flipped classroom method and a descriptivecontent analysis to examine students' opinions regarding the method were used.

5.2 Setting

This study was implemented in a Faculty of Nursing in Northern Cyprus for both stages. The University, located in Nicosia, is considered to be the largest university in North Cyprus. The total number of students in the program is 250, including international students. The nursing curriculum contains six main nursing courses including Fundamentals of Nursing, Medical-Surgical Nursing, Women's Health and Gynecology Nursing, Nursing for Child Health, Mental

Health Nursing, and Public Health Nursing. The VTE information is mainly included in the Medical-Surgical Nursing course. In the Nursing Bachelor-degree program, general traditional methods including PowerPoint presentations, classroom discussions, and group presentations are mostly used as educational methods.

5.3 Sample Selection

The target group of the study was 130 nursing students from first and second classes who had not received the Medical-Surgical nursing course. Students recruited to join were included in this study. Ten students refused to join the study. A total of 120 students were recruited and randomly assigned to the experimental group or the control group (60 participants in each group) through the census method. Two students have not completed the pre-test in the experimental group. Thus, 118 students were assessed, with 98% assessment rate (58 students) in the experimental group and a 100% assessment rate (60 students) in the control group.

5.4 Study Tools

Study tools included VTE Knowledge Evaluation Form, Qualitative Evaluation Form and Educational Content and used in both stages of the study.

5.4.1 VTE Knowledge Evaluation Form

The VTE knowledge evaluation questionnaire was created and treated by the study authors' following the recent update of VTE prevention from the CDC Prevention-2019, Antithrombotic Therapy, and Prevention of Thrombosis, 9th Ed: ACCP Guidelines 2012. The VTE knowledge evaluation questionnaire consists of two sections; the first section included five questions related to subject demographics such as class level, gender, age, CGPA average, and prior attendance to the external VTE course. The second portion composed three domains of

VTE knowledge with 50 true/false items. The first domain was regarding basic knowledge includes (13 items) all of the items were true except two of them were false. The second domain was risk factors with (13 items) without false items. The last domain related to VTE prophylaxis with (24 items) 20 items were true items, and the 4 remaining were false items. A good internal consistency (Cronbach's alpha > 0.8) was determined for all domains of the tool.The VTE knowledge evaluation questionnaire content was assessed and revised by three expert panels including a cardiovascular diseases doctor and academicians from the medical-surgical nursing field. In addition, a pilot study was performed with 15 nursing students for clarity of the tool. There was no revision needed and these students were included in the main sample.

5.5 Form for Determination of Students' Opinions Regarding Flipped Classroom Method

The interview guide included two open-ended questions about advantages anddisadvantages points about the flipped classroom method. The questions were "what are the advantages of the flipped classroom method?" and "what are the disadvantages of the flipped classroom method?"

5.6 Educational Content

The educational content included the following three domains as an overview of VTE and the concept of VTE prevention:***Appendix 2***

Module 1: Basic knowledge regarding VTE, DVT, and PE

Module 2: Risk factors of VTE

Module 3: Evidence-based practices for VTE prevention including basic, physical, and pharmacological prophylaxis;Centers for Disease Control and Prevention 2019, American College of Chest Physicians (ACCP) 2012.

The content items were reviewed and revised by three academic and clinician panel experts of medical-surgical and internal medicine lecturers to provide their feedback regarding tool accuracy, grammar, and readability. The syllabus was the same for the study and control groups of the first stage and second stage. For the study group of the first stage and second stage, flipped classroom and online discussion were used to teach the content; and, for the control group of the first stage, PowerPoint presentation slides were used. Since all of the international nursing students in the university can speak English, the content was prepared in English.

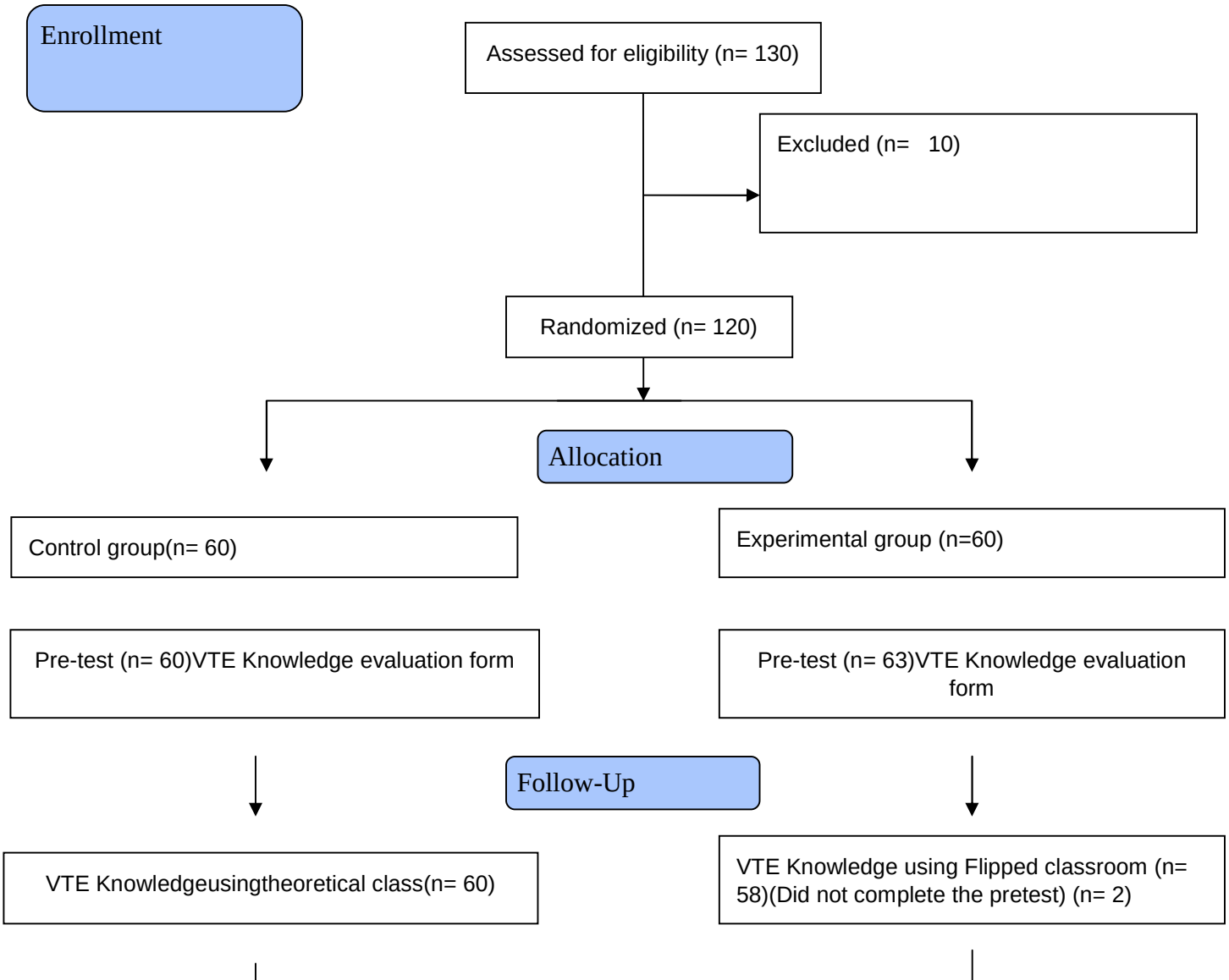
5.7 Implementation

In the implementation part of the study, the study was announced using posters including information about the study to make students aware of the study. Next, the researchers held a meeting to explain the aim of the study and what flipped classroom learning is. After agreeing to participate, participants were divided into groups randomly. Finally, implementation of the study was conducted in three phases, including pre-test, educational intervention, and post-test for both groups.

During implementation of the study, midterm and final exam periods were avoided to prevent an effect on the students' exams. Also, in the interest of full confidentiality and privacy, each participant was given a different name so that their real name would not be used. Each participant voluntarily joined the study without any incentives. They also had the right to withdraw from the study at any phase, and the exam results would not affect their grades and

future courses. To ensure that participants who withdrew would not face future risk, their results were recorded as missing data. **Figure 1**

Fig 1. CONSORT Flow Diagram for First Stage



5.8 Experimental Group

5.8.1Pre-phase: The experimental group received a link to create an account in the online program. The first and second parts of the VTE knowledge evaluation form were implemented in September 2019, on the first day of the course. The exam took approximately 45 minutes to complete. In order to increase the students' knowledge and activation, students were received VTE education videos weekly before they started session to enable watch and re-watch.

5.8.2Intra-phase: For the experimental group, VTE education videos was presented in the flipped classroom teaching methods, which contained seven sessions, followed by quizzes and case studies. Each flipped classroom session contain video ranged from 15 to 25 minutes. The videos was prepared by the principle investigator. The video materiel was included pathophysiology of VTE, risk factor, and nursing care. After that, the instructor began an online discussion, dividing students into small groups of 3 to 5 student and providing them with related nursing care of VTE for 10 to 20 minutes. In each session, students were assigned to new small groups to improve their teamwork and communication skills. The total course was held for a 100-minute, session each week for 7 sequential weeks in September and October 2019.

5.8.3Post-test phase: The post-test stage of the study was performed in the last week of the intervention, in October 2019. Students repeated the completion of the second part of the VTE knowledge evaluation form.

5.9Control Group

The class duration, exams,instructor, and time were the same as with the experimental group, but on a different day of the week**.**

5.9.1 Pre-phase: In the control group, the pre-test exam regarding VTE knowledge evaluation form was performed in the classroom.

5.9.2 Intra-phase: The instructor used traditional teaching methods such as PowerPoint presentation slides, and printouts for each topic. At the end of class, each student was given PowerPoints and/or printouts to enable them to revise after class. There were no class activities and interventions provided.

5.9.3 Post-test phase: The pre-test exam on VTE knowledge was repeated in the classroom.

5.10Interviewsfor Determination of Students' Opinions Regarding Flipped Classroom Method

After completing the post-test, online interviews were conducted with participants in both groups. During the interviews, we encouraged the participants to provide clear explanations and further clarifications to prevent ambiguities. The interviews were conducted as group interviews to encourage the participants for sharing their experiences. Each group completed the interview separately from the other groups. The length and time of each group interview regulated based on the intended groups' willingness and preference. Interviews ranged in length from 10 to 15

minutes. The total length of all interviews were 170 minutes with 20 groups, each group included five participants. All interviews were digitally recorded and directly transcribed to words.

5.11Ethical Considerations

Ethical approvals were obtained fromNear East University institutional review board with reference No. 2019\71\879 for first stage and the study were also approved by dean of the nursing faculty. Informed consent was obtained from all students before starting the study.

5.12Data Analysis

All study documents were checked and saved in the study author's locker. After checked the data, the data inserted into the Statistical Package of Social Sciences (SPSS) version 20.0 program. Descriptive statistics frequency and percentages were used to analyze the characteristics of participants. To calculate mean knowledge, the correct answer was scored as 1, and the wrong answer was scored as 0. The false items were converted to the true scored. $P < 0.05$ was considered statistically significant.

In the first stage the independent-sample t-test and T- test was used to comparison between the intervention and control groups.

The strengths and weaknesses of the flipped classroom method analyzed by using qualitative content analysis by grouping them and interpret textual data. Themes were analyzed by two researchers independently regarding strengths and weaknesses of the flipped classroom method by listening to the interviews recorded to obtain a sufficient understanding. Finally, the analysis from the researchers were translated as the main themes.

6.Method of the Second Stage

Second stage included evaluation of the effectiveness of the flipped classroom method regarding VTE prevention knowledge among nursing students who had educated regarding VTE in previous courses with traditional methods (Third and fourth classes).

6.1 Study Design

Second stagewas performed with pre-test and post-test-interventional and qualitative methods.

6.2 Setting

This study was implemented in a Faculty of Nursing in Northern Cyprus for both stages. The University, located in Nicosia, is considered to be the largest university in North Cyprus. The total number of students in the program is 250, including international students. The nursing curriculum contains six main nursing courses including Fundamentals of Nursing, Medical-Surgical Nursing, Women's Health and Gynecology Nursing, Nursing for Child Health, Mental Health Nursing, and Public Health Nursing. The VTE information is mainly included in the Medical-Surgical Nursing course. In the Nursing Bachelor-degree program, general traditional methods including PowerPoint presentations, classroom discussions, and group presentations are mostly used as educational methods.

6.3 Sample Selection

The main study groups were included international nursing students who were in years 3, and 4 of nursing bachelor-degree. These groups received Medical-Surgical nursing course and clinical practice that would for students to report on VTE prophylaxis knowledge. The total number of the students who passed the Medical-Surgical nursing course was 120. The sample size was calculated using Raosoft sample calculator software, with margin of error 0.05, 95% confidence level, 50% response distribution, and recommended minimum sample size was 92.

All of the students who passed the Medical-Surgical nursing course and in years 3, and 4 of nursing bachelor-degree (120 students) was planned to be included in the study. However, fifteen participants disapproved to join the study, five students have not completed the pre-test, thus, 100 students have composed final sample of the study.

6.4 Study Tools

Study tools included VTE Knowledge Evaluation Form, Opinions Evaluation Form and Educational Content and used in both stages of the study.

6.4.1VTE Knowledge Evaluation Form

The VTE knowledge evaluation questionnaire was created and treated by the study authors' following the recent update of VTE prevention from the CDC Prevention-2019, Antithrombotic Therapy, and Prevention of Thrombosis, 9th Ed: ACCP Guidelines 2012. The VTE knowledge evaluation questionnaire consists of two sections; the first section included five questions related to subject demographics such as class level, gender, age, CGPA average, and prior attendance to the external VTE course. The second portion composed three domains of VTE knowledge with 50 true/false items. The first domain was regarding basic knowledge includes (13 items) all of the items were true except two of them were false. The second domain was risk factors with (13 items) without false items. The last domain related to VTE prophylaxis with (24 items) 20 items were true items, and the 4 remaining were false items. A good internal consistency (Cronbach's alpha > 0.8) was determined for all domains of the tool.The VTE knowledge evaluation questionnaire content was assessed and revised by three expert panels including a cardiovascular diseases doctor and academicians from the medical-surgical nursing field. In addition, a pilot study was performed with 15 nursing students for clarity of the tool. There was no revision needed and these students were included in the main sample

6.4.2 Educational Content

The educational content included the following three domains as an overview of VTE and the concept of VTE prevention:***Appendix 2***

Module 1: Basic knowledge regarding VTE, DVT, and PE

Module 2: Risk factors of VTE

Module 3: Evidence-based practices for VTE prevention including basic, physical, and pharmacological prophylaxis; Centers for Disease Control and Prevention 2019, American College of Chest Physicians (ACCP) 2012.

The content items were reviewed and revised by three academic and clinician panel experts of medical-surgical and internal medicine lecturers to provide their feedback regarding tool accuracy, grammar, and readability. The syllabus was the same for the study and control groups of the first stage and second stage. For the study group of the first stage and second stage, flipped classroom and online discussion were used to teach the content; and, for the control group of the first stage, PowerPoint presentation slides were used. Since all of the international nursing students in the university can speak English, the content was prepared in English

6.4.3 Form for Determination of Students' Opinions Regarding Flipped Classroom Method

The interview guide included two open-ended questions about strengths and weaknesses points about the flipped classroom method. The questions were "what are the strengths of the flipped classroom method?" and "what are the weaknesses of the flipped classroom method?"

6.5Implementation of the Second Stage

Prior to implementation of the study, posters were used to announce the study information in the main faculty billboard. After announced, students who agreed to join send an e-mail to the study authors' that meaning the sender would like to include the study. Then, the study authors'

sorted the students according to the inclusion criteria of the study. The study authors explained the aim of the study and how to create an account of the flipped classroom and how it used. Finally, the execution of the study was carried out in three periods; pretest, educational intervention, and post-test. To avert an impact on the students' exams, midterm, and final exam dates were excluded. To ensure full secret and anonymity, each student was used as a naked name during study implementation. Students were informed about the participation or nonparticipation would not jeopardize their academic progress during and after study, also withdrew participant's data were deal as unknown data. Each student who completed all study periods were received a certificate signed from the study authors. **Figure 2**

6.5.1 Pre-phase: First stage of the study was implemented in February 2020. The study authors sent a link for each student to create an account in the flipped classroom, after creating an account the participant's received the pre-test that included demographic characteristics and VTE evaluation questionnaire. The completing of the pre-test was approximately one hour and held in suitable classroom.

6.5.2 Intra-phase: The students received VTE education contents, which were offered in the flipped classroom as a teaching method with five sessions, thereafter, quizzes and case studies were implemented. Before started the online discussion, the instructor distributed students for small categories of 4 to 6 students for each category in order to enhance their engagement and team-based learning.Students were requested to end each session of the flipped classroom at their preferred time through one week. The completing of the whole course was 5 straight weeks, with ranged 30 to 40 minutes duration for each session (150 minutes in total).The flipped classroom account provides a daily monitoring system that observes students' adherence to watching lessons and completing quizzes.

6.5.3 Post-test phase: After completed the five sessions. Students were requested to repeat only the second part of the VTE knowledge questionnaireand held in suitable classroom

6.6 Interviews for Determination of Students' Opinions Regarding Flipped Classroom Method

After completing the post-test, online interviews were conducted with participants in both groups. During the interviews, we encouraged the participants to provide clear explanations and further clarifications to prevent ambiguities. The interviews were conducted as group interviews to encourage the participants for sharing their experiences. Each group completed the interview separately from the other groups. The length and time of each group interview regulated based on the intended groups' willingness and preference. Interviews ranged in length from 10 to 15 minutes. The total length of all interviews were 170 minutes with 20 groups, each group included five participants. All interviews were digitally recorded and directly transcribed to words.

6.7Ethical Considerations

Ethical approvals were obtained from Near East University institutional review board with referenceNo. 2020\77\669 for second stage of the study. The study were also approved by dean of the nursing faculty. Informed consent was obtained from all students before starting the study.

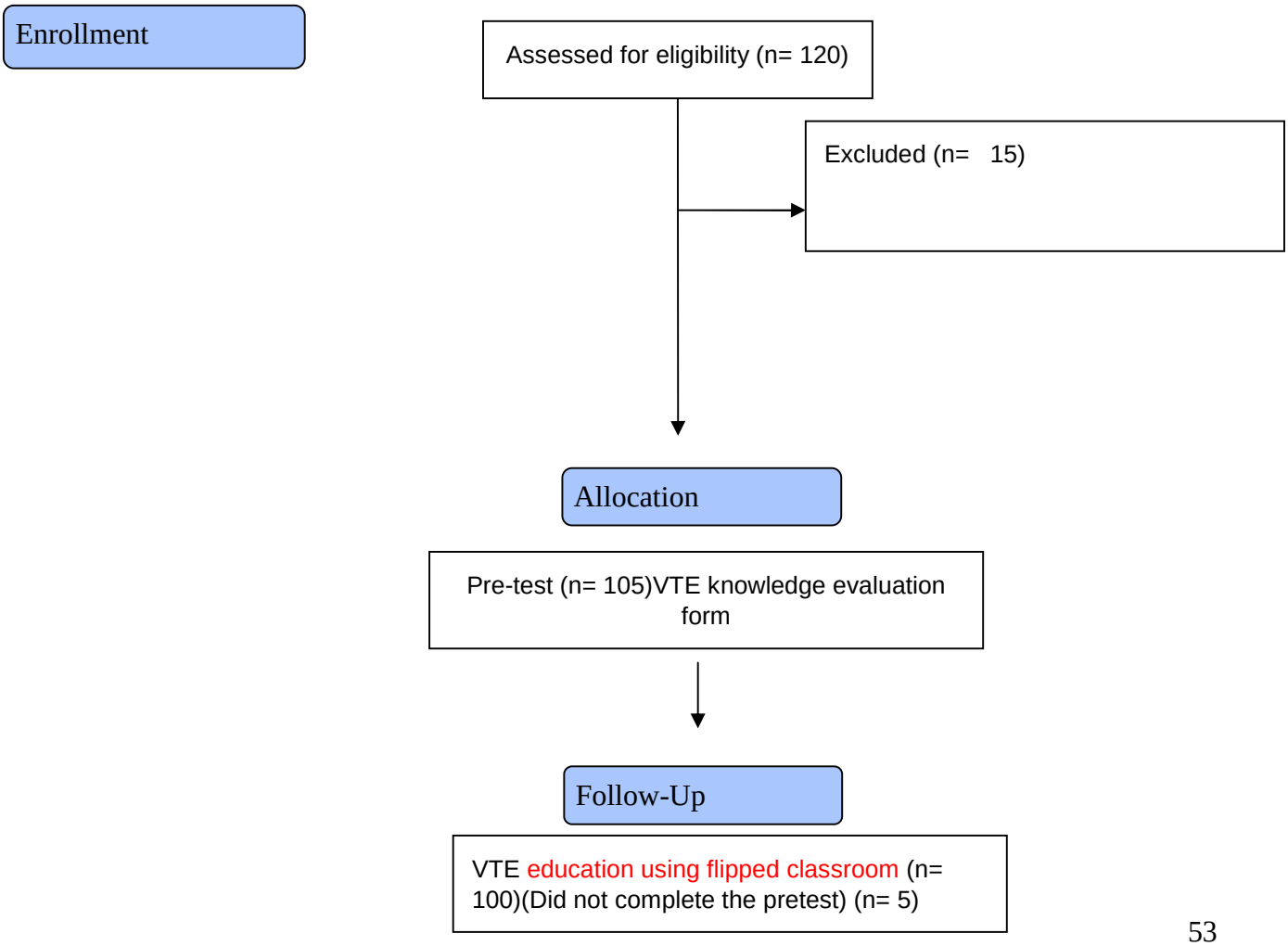
6.8Data analysis

All study documents were checked and saved in the study author's locker. After checked the data, the data inserted into the Statistical Package of Social Sciences (SPSS) version 20.0 program. Descriptive statistics frequency and percentages were used to analyze the characteristics of participants. To calculate mean knowledge, the correct answer was scored as 1, and the wrong answer was scored as 0. The false items were converted to the true scored. $P < 0.05$ was considered statistically significant.

In the second stage the independent-sample t-test was used to compare between Pre-and post- test. Chi-Square Test was used in order to compare the total mean VTE knowledge and students' descriptive information.

The strengths and weaknesses of the flipped classroom method analyzed by using qualitative content analysis by grouping them and interpret textual data. Themes were analyzed by two researchers independently regarding strengths and weaknesses of the flipped classroom method by listening to the interviews recorded to obtain a sufficient understanding. Finally, the analysis from the researchers were translated as the main themes.

Fig 2. CONSORT Flow Diagram for Second Stage



Post-test VTE knowledge evaluation form(n= 100)

7. Results

Table 1. Descriptive Characteristics of the Students' (N= 118)

Characteristics	Traditional lecture (N= 60)		Flipped classroom (N= 58)		P value
	N	%	N	%	
Gender					
Male	15	26.5	12	23.8	0.33[a]
Female	45	73.5	46	76.2	
Nursing Class					
First	33	51.7	30	51.4	0.61[a]
Second	27	48.3	28	48.6	
Previous VTE education					
Yes	5	4.2	2	1.6	0.22[a]
No	55	95.8	56	98.4	
	Mean	**SD**	**Mean**	**SD**	
Last Cumulative Grade Point Average	3.1	1.17	3.33	1.23	0.78[b]
Age	20.2	6.8	19.9	7.6	0.34[b]

a: The chi-square; b: The independent-sample t test

Results showed that the students' mean age was 20.2 ± 6.8 years in the traditional lecture group and 19.9±7.6 years in the flipped classroom group. In both groups, women were the

majority of the participants. The majority of the students were in their first semester, and

VTE domains	Number of items	Groups	Pre-test	Post-test	P value**
			mean score ± SD	mean score ± SD	
Basic knowledge	13	Traditional lecture	7.3±1.3	9.5±2.1	0.16
		Flipped classroom	8.6±2.4	11.7±1.6	<0.001

almost all of the students had not received any previous VTE education. The results also showed that there was no statistically significant difference between study groups with respect to descriptive characteristics (P > 0.05) (Table 1)

Table 2. Comparison of VTE knowledge means scores of the traditional lecture and the flipped classroom groups

		P value *	0.19	<0.003	
Risk factors	13	Traditional lecture	6.2±1.6	8.8±3.1	0.11
		Flipped classroom	7.5±2.1	10.2±1.1	0.001
		P value *	0.27	<0.004	
VTE prophylaxis	24	Traditional lecture	8.2 ±1.5	10.1 ±2.8	0.19
		Flipped classroom	11.2 ±3.5	15.2±1.8	<0.002
		P value *	0.12	<0.001	
Overall	50	Traditional lecture	21.8±1.8	28.4±2.9	0.13
		Flipped classroom	27.3±4.5	37.1±3.8	<0.001
		P value *	0.22	<0.001	

*: The independent-sample t test;

Comparison of the mean scores of VTE domains of the flipped classroom and traditional learning groups with the independent t-test showed no statistically significant difference in all VTE domains mean scores between the two groups in the pre-test (P= 0.19, P= 0.27, P= 0.12, P= 0.22 respectively). However, in the post-test, the results showed a statistically significant difference; flipped classroom group had higher mean scores of VTE domains compared with the traditional lecture group (P= 0.003,P= 0.004,P= 0.001respectively).

In pre-test and post-test comparison of the mean scores of VTE domains in traditional learning group, the paired t-test showed no statistically significant improvement. However, in the flipped classroom group, the results showed statistically significant improvement in mean scores of all VTE domains in post-test, compared with the pre-test (Table 2).

Table 3. Students' VTE/DVTbasic knowledge domain correct answer rates

Item No	**Basic Knowledge**	**T/ F**	**Study group (N=)**		**P value ***	**Control group (N=)**		**P value***
			Pre-test %	**Post-test %**		**Pre-test %**	**Post-test %**	
1.	Deep vein thrombosis (DVT) is a clinical manifestation of Venous thromboembolism (VTE).	T	51.8	90.2	**0.01**	44.1	77.1	0.11

2.	Pulmonary embolism (PE) is a clinical manifestation of VTE.	T	44.9	52.4	0.12	38.7	51.2	0.09
3.	PE is the most severe complication of DVT.	T	31.9	65.4	0.18	46.4	61.2	**0.02**
4.	Decreased blood flow velocity is 1 of the 3 main causes of VTE formation.	T	41.7	67.1	**0.003**	34.1	66.3	**0.04**
5.	Blood vessel injury is 1 of the 3 main causes of VTE formation	T	55.0	82.4	0.22	46.3	77.3	0.12
6.	A high blood coagulation state is 1 of the 3 main causes of VTE formation.	T	23.9	74.6	**0.01**	51.7	87.5	0.16
7.	Hyperlipidemia is 1 of the 3 main causes of VTE formation.	F	10.7	27.8	0.11	12.3	55.9	**0.01**
8.	Limb redness, swelling, heat, and pain are clinical manifestations of acute DVT	T	45.9	58.0	**0.02**	29.9	59.7	0.11
9.	Dyspnea is a clinical manifestation of acute DVT	F	13.9	71.5	0.07	25.7	49.0	0.22
10.	Chest pain is not a clinical manifestation of acute DVT.	T	22.7	54.7	0.09	34.9	61.9	0.15
11.	Chest pain is a clinical manifestation of acute PE	T	33.6	54.3	0.14	55.7	81.5	0.21
12.	Dyspnea is a clinical manifestation of acute PE.	T	50.8	70.2	0.10	33.5	62.9	0.12
13.	Syncope is a major clinical manifestation of acute large area PE.	T	18.4	47.0	**0.00**	41.4	61.3	0.19

* Chi-Square Test

Table 3 showsstudents' knowledge levels of basic knowledge domain in pre-and post- test. In the pre-testof the study group; "Deep vein thrombosis (DVT) is a clinical manifestation of Venous thromboembolism (51.8%)", "Blood vessel injury is 1 of the 3 main causes of VTE formation (55.0%)", and "dyspnea is a clinical manifestation of acute PE (50.0%)", items received the highest correct answer rates. "Hyperlipidemia is 1 of the 3 main causes of VTE formation (10.7%)", "dyspnea is a clinical manifestation of acute DVT (13.9%)", and "Syncope

is a major clinical manifestation of acute large area PE (18.4%)"items received the lowest correct answer rates.

In the post-test of the study group; "Deep vein thrombosis (DVT) is a clinical manifestation of venous thromboembolism (VTE) pulmonary embolism (PE) is a clinical manifestation of VTE (90.2%)", "Blood vessel injury is 1 of the 3 main causes of VTE formation (82.4%)", "A high blood coagulation state is 1 of the 3 main causes of VTE formation (74.6%)", and "Dyspnea is a clinical manifestation of acute DVT (71.5%)"items received the highest correct answer rates. In another hand, "Hyperlipidemia is 1 of the 3 main causes of VTE formation" (27.8%), and "Syncope is a major clinical manifestation of acute large area PE" (47.0%) items received the lowest correct answer rates.

In study group there were statistically significant improvements in knowledge levels of the students regarding VTE/DVT basic knowledge in posttest items; "Deep vein thrombosis (DVT) is a clinical manifestation of venous thromboembolism (VTE)", "Decreased blood flow velocity is 1 of the 3 main causes of VTE formation", "A high blood coagulation state is 1 of the 3 main causes of VTE formation", "Limb redness, swelling, heat, and pain are clinical manifestations of acute DVT", and "Syncope is a major clinical manifestation of acute large area PE".

In control groupthere were statistically significant improvements in knowledge levels of the students regarding items; "PE is the most severe complication of DVT", "Decreased blood flow velocity is 1 of the 3 main causes of VTE formation", and "Hyperlipidemia is 1 of the 3 main causes of VTE formation".

Table 4. Students' VTE/DVT risk assessment domain correct answer rates

* Chi-Square Test

Items	Risk assessment	T/F	Study group		P value*	Control group		P value*
			Pre%	Post%		Pre%	Post%	
1.	Age is a risk factor for VTE.	T	49.1	66.1	**0.01**	33.8	77.9	0.12
2.	History of malignancy is a risk factor for VTE.	T	33.1	54.7	0.12	34.5	56.3	0.09
3.	Inflammatory bowel disease is a risk factor for VTE.	T	13.5	50.5	0.21	22.6	45.6	0.14
4.	Leg swelling is a risk factor for VTE.	T	17.1	33.8	0.09	21.4	41.2	0.17
5.	Chemotherapy is a risk factor for VTE.	T	22.8	53.2	**0.03**	23.4	44.3	0.15
6.	Acute myocardial infarction is a risk factor for VTE	T	11.4	35.2	**0.01**	10.3	22.9	0.19
7.	Congestive heart failure is a risk factor for VTE.	T	10.6	41.3	0.21	18.9	44.9	**0.02**
8.	Leg plaster or splint fixation is a risk factor for VTE.	T	61.2	88.2	0.11	23.8	55.8	0.12
9.	Pregnancy or<1 month postpartum is a risk factor for VTE.	T	25.3	52.6	0.19	19.9	43.7	0.16
10.	Septicemia (<1 month) is a risk factor for VTE.	T	50.1	79.0	0.12	45.6	61.9	**0.01**
11.	Severe lung disease, including pneumonia (<1 month) is a risk factor for VTE.	T	44.5	82.4	**0.04**	33.6	61.5	0.11
12.	Pulmonary dysfunction (e.g., COPD) is a risk factor for VTE	T	29.1	65.4	0.17	22.1	51.9	**0.01**
13.	Existing tumor is a risk factor for VTE	T	31.1	56.1	0.10	19.0	49.9	0.07

Table 4 shows knowledge levels of nursing students related to VTE risk assessmentin pre- and post- test. In the pre-test of the study group; “Leg plaster or splint fixation is a risk factor for VTE (61.2%)”, “Septicemia (<1 month) is a risk factor for VTE (50.1%)”, and “Age is a risk

factor for VTE (49.1%)"items received the highest correct answer rates.In another hand,"inflammatory bowel disease is a risk factor for VTE (13.5%)", "Acute myocardial infarction is a risk factor for VTE (11.4%)", and "congestive heart failure is a risk factor for VTE (10.6%)" items received the lowest correct answer rates.

In the post-testof the study group; "Leg plaster or splint fixation is a risk factor for VTE (88.2%)", "severe lung disease, including pneumonia (<1 month) is a risk factor for VTE (82.4%)", and "septicemia (<1 month) is a risk factor for VTE (79.0%)" items received the highest correct answer rates. In another hand,"Leg swelling is a risk factor for VTE (33.8%)", "acute myocardial infarction is a risk factor for VTE (35.2%)", and "congestive heart failure is a risk factor for VTE (41.3%)", items received the lowest correct answers rates.

In study group there were statistically significant improvements in VTE/DVT risk assessment levels of the students regarding items; "Age is a risk factor for VTE", "Chemotherapy is a risk factor for VTE", "Acute myocardial infarction is a risk factor for VTE", and "Severe lung disease, including pneumonia (<1 month) is a risk factor for VTE".

In control group there were statistically significant improvements in VTE/DVT risk assessment levels of the students regarding items;"Congestive heart failure is a risk factor for VTE", "Septicemia (<1 month) is a risk factor for VTE", and "Pulmonary dysfunction (e.g., COPD) is a risk factor for VTE".

Table 5.Students' VTE/DVT prophylaxis domain correct answer rates

Items	Prophylaxis	T/F	Study group		P value*	Control group		P value*
			Pre%	Post %		Pre%	Post%	

1.	It is helpful to instruct bedridden patients in lower limb exercises to prevent VTE.	T	21.7	50.9	0.15	21.8	33.9	0.13
2.	Regularly moving bedridden patients is helpful for preventing VTE	T	33.3	79.5	**0.02**	29.0	55.8	0.09
3.	Adequate hydration can prevent the occurrence of VTE.	T	28.7	70.2	0.11	16.9	56.9	0.12
4.	Giving up smoking and drinking has no effect on preventing VTE.	F	21.8	54.3	0.17	18.7	49.9	0.15
5.	Controlling blood glucose and blood lipids can help prevent VTE.	T	33.1	62.6	0.09	21.8	51.2	0.08
6.	Helping hospitalized patients to perform out-of-bed activity as soon as their condition allows does not prevent VTE.	F	22.0	65.1	**0.01**	17.3	45.9	0.12
7.	Graduated compression stockings (GCS) can be removed at night to relax muscles, with no effect on VTE prevention.	F	12.2	27.6	0.06	14.8	25.3	0.09
8.	GCS require regular sun exposure for sterilization.	F	22.4	41.3	0.21	19.0	40.9	0.11
9.	Alkaline detergent should be used to clean GCS.	F	10.1	35.2	0.14	11.8	29.0	**0.01**
10.	If GCS are too long, they can be folded down at the top of the thigh.	F	25.2	51.6	**0.02**	19.8	44.8	0.10
11.	The right way to put on GCS is to roll them from distal to proximal limb gradually.	F	10.3	22.5	0.07	17.9	22.2	**0.01**
12.	GCS should not be worn folded.	T	21.4	30.6	0.18	15.3	28.0	0.12
13.	The right side of the patient's GCS is wearing correctly.	F	15.4	33.8	0.12	11.9	29.1	0.10
14.	With wearing GCS, the pressure injury can be ignored because of low incidence	F	21.9	45.1	**0.01**	20.1	33.7	0.10
15.	Accurate measurement should be made when choosing the size of GCS	T	31.2	67.1	**0.02**	27.8	55.4	0.11
16.	GCS cannot continue to be applied when a patient presents VTE.	F	34.3	88.5	0.13	31.3	61.2	**0.02**
17.	Intermittent pneumatic compression devices can be used after the occurrence of VTE.	T	25.2	52.4	0.14	21.9	48.7	0.10
18.	Intermittent pneumatic compression devices should be used 24 hours a day for bedridden patients.	T	31.9	65.4	0.06	22.8	51.1	0.12
19.	It is not important to be alert for complications during use of GCS or intermittent pneumatic compression devices.	F	11.7	28.5	0.21	10.4	27.6	**0.02**

20.	The correct needle puncture angle for subcutaneous anticoagulant injection is 90 degrees.	T	11.5	51.9	0.12	9.6	41.3	0.10
21.	Before the injection of pre-filled anticoagulant drugs, the air in the needle tube should be exhausted.	F	22.9	51.7	0.08	18.7	44.4	0.06
22.	The most common injection site for anticoagulants is the umbilicus.	T	28.4	58.8	0.14	20.7	50.6	0.08
23.	Hemorrhage is the most common complication after anticoagulant therapy.	T	11.8	40.5	**0.02**	10.6	33.5	0.10
24.	Allergic reaction is the most common complication after anticoagulant therapy.	F	29.6	66.1	0.10	21.2	51.2	0.20

* Chi-Square Test

Table 5 shows knowledge levels of nursing students related to VTE/DVT prophylaxis in Pre-and Post- Test. In the pre-testof the study group; “GCS cannot continue to be applied when a patient presents VTE (34.3%)”, “Regularly moving bedridden patients is helpful for preventing VTE (33.3%)”, and “controlling blood glucose and blood lipids can help prevent VTE (33.1%)”, items received the highest correct answer rates. In another hand,“the correct needle puncture angle for subcutaneous anticoagulant injection is 90 degrees (11.8%), “The right way to put on GCS is to roll them from distal to proximal limb gradually (10.3%)”, and “Alkaline detergent should be used to clean GCS (10.1%)”, items received the lowest correct answers rates.

In the post-test of the study group; “GCS cannot continue to be applied when a patient presents VTE (88.5%)”, “regularly moving bedridden patients is helpful for preventing VTE (79.5%)”, and “Adequate hydration can prevent the occurrence of VTE (70.2%)”items received the highest correct answer rates. In another hand,“the right way to put on GCS is to roll them from distal to proximal limb gradually (22.5%)”, “graduated compression stockings (GCS) can be removed at night to relax muscles, with no effect on VTE prevention (27.6%)”, and “GCS should not be worn folded (30.6%)”items received the lowest correct answer rates.

In study group there were statistically significant improvements in VTE/DVT prophylaxis levels of the students regarding items; “Regularly moving bedridden patients is helpful for preventing VTE”, “Helping hospitalized patients to perform out-of-bed activity as soon as their condition allows does not prevent VTE”, “If GCS are too long, they can be folded down at the top of the thigh”, “With wearing GCS, the pressure injury can be ignored because of low incidence”, “accurate measurement should be made when choosing the size of GCS”, and “Hemorrhage is the most common complication after anticoagulant therapy”

In control group there were statistically significant improvements in VTE/DVT prophylaxis levels of the students regarding items;“alkaline detergent should be used to clean GCS, “The right way to put on GCS is to roll them from distal to proximal limb gradually”, “GCS cannot continue to be applied when a patient presents VTE”, “It is not important to be alert for complications during use of GCS or intermittent pneumatic compression devices”.

Table 6. Comparison of the students’ characteristics and overall VTE knowledge means

Variable	Experimental group				Control group			
	Total VTE knowledgemean Pre-test	**P value***	**Total VTE knowledge mean Post-test**	**P value***	**Total VTE knowledge mean Pre-test**	**P value***	**Total VTE knowledge mean Post-test**	**P value***
Gender								
Male	20.4±1.3	0.12	23.1±2.2	**0.01**	21.3±4.5	0.16	22.7±3.2	0.10
Female	21.1±4.4		23.4±1.1		22.4±9.1		23.2±7.6	
Nursing level								
Third	17.1±2.1	0.13	19.2±1.4	**0.01**	16.7±2.7	0.13	18.5±3.8	0.06
Fourth	20.2±2.2		21.9±2.8		18.4±7.3		19.8±2.5	
External VTE Education								
Yes	18.8 ±1.2	0.09	19.9 ±6.5	0.18	15.1±3.0	0.20	17.3±3.0	0.12
No	18.1±2.4		19.1 ±1.4		17.4±1.9		18.5±2.7	

Age								
18 – 22 Year	16.8±2.4	0.17	18.7±7.7	0.10	15.7±1.2	0.10	16.3±2.1	0.20
≥ 23 Year	18.8±1.9		21.3±1.1		18.1±1.9		19.5±5.5	
Last CGPA								
< 3	12.6±5.3	0.22	14.3±3.3	0.18	11.9±2.5	0.14	13.7±3.3	**0.00**
≥ 3	13.4±2.9		16.8±9.3		13.4±1.1		15.9±7.9	

* Chi-Square Test

Table 6 shows the comparison between both study groups in terms of students' characteristics and overall VTE knowledge means; in the pre-test, the results showed that there was no statistical significance of both study groups.

In the post-test of the study group, the results showed that there were statistically significant differences in terms of gender and nursing class level toward overall VTE knowledge domains (P= 0.01). Female and fourth nursing level of participant's revealed higher mean than others.

In the control group, the results showed that there was statistically significant difference in terms of the last CGPA toward overall VTE knowledge domains (P= 0.00). The participants who had the last CGPA ≥ 3 achieved a higher mean than others.

7.1 Content Analysis Results

The content analysis of the advantages and disadvantages of flipped classroom showed that the majority of students (80%) indicated an advantage of flipped classroom, whereas 55% of them stated disadvantages to the flipped classroom. Four categories were composed from student responses regarding the advantages of flipped classroom, including "Deep motive," "Engagement," "Cost-effectiveness," and "Self-confidence." On the other hand, the disadvantages of flipped classroom were categorized into four categories, as follows: "Time

demands," "Technological requirements," "Interaction challenges," and "Enthusiasm challenges."

7.1.1 Advantage of Flipped Classroom

Deep Motivating

Majority of students reported that used flipped classroom was the new and featured experience and reported that was the first time they were undergoing to such an innovative teaching method. Students reported that they gotten deep motive during the course after used flipped classroom. An example:

"Flipped classroom can force one to get out of the comfort zone {in a good way}. One can be forced to learn navigating the course lectures, downloading materials and effective digital communication which are helpful in today's world"

Engagement and teamwork

A major advantage that emerged was engagement and teamwork, students had demonstrated a positive experience with other students to accomplish their assigned tasks as one group and team-based learning. Examples:

"I gained ideas from others through the chat section, I believe it's beneficial to learn teamwork, since it will be useful when I become a registered nurse later".

"It gives me a chance to reason and share ideas as a team in order to get appropriate knowledge and impart information to others".

Cost-effective

Some students expressed their satisfaction toward saving money because there were no requires from the students to attend into the school and educational materials print-out.

"It's cost effective in terms money, there is no need to pay for transport going to school since I can learn at the comfort of my home."

Self-confident

Some students saw it as an opportunity to show own self-confident. An example:

"As a student who wouldn't be attending school and no constant reminder from the lecturer about doing my school work, I have to be disciplined and do my school work without monitoring".

7.1.2 Disadvantage of Flipped Classroom

Time demands

Several students voiced concerns about time demands and described as, strenuous work and require more effort and time.

"It requires a lot of time on research compared to traditional schooling. In traditional school I usually get all the required information at school, but it's not so with flipped classroom".

Technological requirements

Shortage of technological resources was considered a challenge.However, availability of such resources that may facilitate study and fulfillment toward students learning outcome.

"There are some technological requirements that might not be readily available. Sometimes I use mobile data for connectivity that would mean a lot of spending on data if I am doing an online course".

Interaction challenges

Direct interaction helps in the sense that the lecturer can notice that the students did not understand without a word from them and that would prompt him/her to explain more, this is mostly not found in flipped classroom.

"There is little to no direct interaction with the lecturer"

Enthusiasm challenges

Many students argued that flipped classroom should cost schools less, that teaching from home is less expensive than ramping up campus facilities and labs.

"*There is a lack of enthusiasm because of the interest in direct tuition rather virtual tuition"*.

8. Results of Stage 2

Table 1. Descriptive characteristics of the students (N= 100)

Characteristics	**N**	**%**
Gender		
Male	37	26.9
Female	63	73.1
Nursing Class		
Third	41	44.6

Fourth	59	55.4
External VTE Education		
Yes	15	10.8
No	85	89.2
Age (Mean 22.1 ±3.8)		
18 – 22 Year	63	77.3
≥ 23 Year	37	22.7
Last CGPA (Mean 3.3±1.4)		
< 3	44	38.5
≥ 3	56	61.5

Descriptive characteristics of the students were revealed in Table 1. Female constituted mostly of the participants (73.1%). The predominantly students were in their fourth semester (55.4%), and almost all of the students had not attended any external VTE education (89.2%). Results revealed that students' last mean CGPA was 3.3±1.4, also the mean age was 22.1± 3.8 years.

Table 2. Comparison of the pre-test and post-test VTE knowledge means of the students

VTE knowledge domain	Number of items	Pre-test	Post-test	P value *
Basic knowledge	13	6.7±1.7	9.1±3.3	0.001
Risk factors	13	5.3±2.1	7.6±2.9	0.000
VTE prophylaxis	24	11.3 ±2.2	14.2 ±3.2	0.0001
Overall	50	23.3±2.5	30.9±3.2	0.000

*Independent-sample t-test

The independent-sample t-test indicated that the overall VTE knowledge domains showed a higher mean at post-test than at pre-test followed by statistically significant improvement after the educational intervention (pre-test: 23.3±2.5, post-test: 30.9±3.2) ($P < 0.00$). There were also statistically significant improvements at post-test in terms of all VTE knowledge domains ($P < 0.05$).

Table 3. Students' VTE/DVT basic knowledge domain correct answer rates

* Chi-Square Test

Items	Basic Knowledge	T/F	Pre-test%	Post-test %	P value*
1.	Deep vein thrombosis (DVT) is a clinical manifestation of Venous thromboembolism (VTE).	T	44.1	77.6	0.13
2.	Pulmonary embolism (PE) is a clinical manifestation of VTE.	T	43.6	84.1	0.21
3.	PE is the most severe complication of DVT.	T	21.4	55.3	0.12
4.	Decreased blood flow velocity is 1 of the 3 main causes of VTE formation.	T	65.3	88.8	**0.001**
5.	Blood vessel injury is 1 of the 3 main causes of VTE formation.	T	55.9	77.4	0.11
6.	A high blood coagulation state is 1 of the 3 main causes of VTE formation.	T	23.1	61.2	0.13
7.	Hyperlipidemia is 1 of the 3 main causes of VTE formation.	F	19.3	37.3	**0.01**
8.	Limb redness, swelling, heat, and pain are clinical manifestations of acute DVT.	T	38.5	55.8	0.13
9.	Dyspnea is a clinical manifestation of acute DVT.	F	54.1	79.2	0.09
10.	Chest pain is not a clinical manifestation of acute DVT.	T	54.4	88.1	**0.02**
11.	Chest pain is a clinical manifestation of acute PE.	T	39.8	77.5	0.10
12.	Dyspnea is a clinical manifestation of acute PE.	T	48.6	73.0	0.12
13.	Syncope is a major clinical manifestation of acute large area PE.	T	51.9	82.1	0.18

Table 3 shows students' knowledge levels of basic knowledge domain in pre-and post- test. In the pre-test; "Decreased blood flow velocity is 1 of the 3 main causes of VTE formation (65.3%)", "Blood vessel injury is 1 of the 3 main causes of VTE formation (55.9%)",and "Chest pain is not a clinical manifestation of acute DVT" (54.4%), items received the highest correct

answer rates. In another hand, “A high blood coagulation state is 1 of the 3 main causes of VTE

Items	Risk assessment	T/F	Pre%	Post%	P value*

formation (23.1%)”, “PE is the most severe complication of DVT (21.4%)”, and “Hyperlipidemia is 1 of the 3 main causes of VTE formation (19.3%)”,items received the lowest correct answer rates.

In the post-test; “Decreased blood flow velocity is 1 of the 3 main causes of VTE formation (88.8%)”, “Chest pain is not a clinical manifestation of acute DVT (88.1%)”, “Pulmonary embolism (PE) is a clinical manifestation of VTE (84.1%)”, and “Syncope is a major clinical manifestation of acute large area PE (82.1%)”items received the highest correct answer rates.In another hand, “Limb redness, swelling, heat, and pain are clinical manifestations of acute DVT (55.8%)”, “PE is the most severe complication of DVT (55.3%)”, and “Hyperlipidemia is 1 of the 3 main causes of VTE formation (37.3%)”, items received the lowest correct answer rates.

There were statistically significant improvements in knowledge levels of the students regardingVTE/DVT basic knowledge in post-test in items of “decreased blood flow velocity is 1 of the 3 main causes of VTE formation”, “Hyperlipidemia is 1 of the 3 main causes of VTE formation”, and “Chest pain is not a clinical manifestation of acute DVT”.

Table 4. Students’ VTE/DVT risk assessment domain correct answer rates

1.	Age is a risk factor for VTE.	T	55.8	89.4	0.10
2.	History of malignancy is a risk factor for VTE.	T	36.7	66.2	**0.01**
3.	Inflammatory bowel disease is a risk factor for VTE.	T	45.9	63.1	0.08
4.	Leg swelling is a risk factor for VTE.	T	54.1	88.8	**0.02**
5.	Chemotherapy is a risk factor for VTE.	T	45.6	66.7	0.12
6.	Acute myocardial infarction is a risk factor for VTE	T	33.7	51.6	**0.03**
7.	Congestive heart failure is a risk factor for VTE.	T	58.8	77.9	0.07
8.	Leg plaster or splint fixation is a risk factor for VTE.	T	60.1	84.5	0.11
9.	Pregnancy or<1 month postpartum is a risk factor for VTE.	T	51.3	76.7	0.22
10.	Septicemia (<1 month) is a risk factor for VTE.	T	52.3	89.6	0.19
11.	Severe lung disease, including pneumonia (<1 month) is a risk factor for VTE	T	49.7	77.7	0.13
12.	Pulmonary dysfunction (e.g., COPD) is a risk factor for VTE.	T	54.4	79.3	0.23
13.	Existing tumor is a risk factor for VTE	T	41.3	76.6	**0.01**

* Chi-Square Test

Table 4 shows knowledge levels of nursing students related to VTE risk assessment n pre- and post- test. In the pre-test; “Leg plaster or splint fixation is a risk factor for VTE (60.1%)”, “Congestive heart failure is a risk factor for VTE (58.8%)”, and “Age is a risk factor for VTE (55.8%)” items received the highest correct answer rates. In another hand, “Existing tumor is a risk factor for VTE (41.3%)”, “History of malignancy is a risk factor for VTE (36.7%)”, and

“Acute myocardial infarction is a risk factor for VTE (33.7%)”items received the lowest correct answer rates.

In the post-test; “Septicemia (<1 month) is a risk factor for VTE (89.6%)”, “Age is a risk factor for VTE(89.4%)”, “Leg swelling is a risk factor for VTE(88.8%)”, “Leg plaster or splint fixation is a risk factor for VTE (84.5%)”items received the highest correct answer rates. In another hand, “History of malignancy is a risk factor for VTE (66.2%)”, “inflammatory bowel disease is a risk factor for VTE (63.1%)”, and “Acute myocardial infarction is a risk factor for VTE (51.6%)”items received the lowest correct answer rates.

There were statistically significant improvements in knowledge levels of the students regarding VTE/DVT risk assessment in post-test in items “History of malignancy is a risk factor for VTE”, “Leg swelling is a risk factor for VTE”, “Acute myocardial infarction is a risk factor for VTE”, and “Existing tumor is a risk factor for VTE”.

Table 5. Students’ VTE/DVT prophylaxis domain correct answer rates

Items	VTE Prophylaxis	T/F	Pre%	Post%	P value*
1.	It is helpful to instruct bedridden patients in lower limb exercises to prevent VTE.	T	51.7	88.4	0.10
2.	Regularly moving bedridden patients is helpful for preventing VTE	T	44.5	77.4	0.14
3.	Adequate hydration can prevent the occurrence of VTE.	T	33.6	61.2	0.15
4.	Giving up smoking and drinking has no effect on preventing VTE.	F	23.4	49.2	0.19

5.	Controlling blood glucose and blood lipids can help prevent VTE	T	39.6	68.9	**0.02**
6.	Helping hospitalized patients to perform out-of-bed activity as soon as their condition allows does not prevent VTE.	F	44.3	66.1	0.10
7.	Graduated compression stockings (GCS) can be removed at night to relax muscles, with no effect on VTE prevention.	F	21.3	51.3	**0.01**
8.	GCS require regular sun exposure for sterilization.	F	31.2	53.8	0.21
9.	Alkaline detergent should be used to clean GCS	F	19.6	61.2	0.18
10.	If GCS are too long, they can be folded down at the top of the thigh.	F	22.1	68.5	0.13
11.	The right way to put on GCS is to roll them from distal to proximal limb gradually	F	17.3	55.1	0.15
12.	GCS should not be worn folded	T	51.9	77.3	**0.01**
13.	The right side of the patient's GCS is wearing correctly	F	23.8	52.9	0.29
14.	With wearing GCS, the pressure injury can be ignored because of low incidence	F	46.7	77.5	0.11
15.	Accurate measurement should be made when choosing the size of GCS	T	61.2	88.6	0.13
16.	GCS cannot continue to be applied when a patient presents VTE.	F	34.4	61.9	0.15
17.	Intermittent pneumatic compression devices can be used after the occurrence of VTE.	T	66.8	81.3	0.12
18.	Intermittent pneumatic compression devices should be used 24 hours a day for bedridden patients.	T	46.7	87.5	0.19
19.	It is not important to be alert for complications during use of GCS or intermittent pneumatic compression devices.	F	31.5	66.8	**0.02**
20.	The correct needle puncture angle for subcutaneous anticoagulant injection is 90 degrees	T	47.8	89.9	0.33
21.	Before the injection of pre-filled anticoagulant drugs, the air in the needle tube should be exhausted	F	33.4	55.2	0.21
22.	The most common injection site for anticoagulants is the umbilicus.	T	51.2	91.2	0.10
23.	Hemorrhage is the most common complication after anticoagulant therapy	T	44.4	71.2	0.21
24.	Allergic reaction is the most common complication after anticoagulant therapy	F	21.6	61.4	0.17

* Chi-Square Test

Table 5 shows knowledge levels of nursing students related to VTE/DVT prophylaxis in pre-and post- test. In the pre-test; "Intermittent pneumatic compression devices can be used after the occurrence of VTE (66.8%)", "Accurate measurement should be made when choosing the size of GCS (61.2%)", "GCS should not be worn folded (51.9%)", and "It is helpful to instruct bedridden patients in lower limb exercises to prevent VTE (51.7%)"items received the highest correct answer rates. In another hand, "Graduated compression stockings (GCS) can be removed at night to relax muscles, with no effect on VTE prevention(21.3%)", "Alkaline detergent should

be used to clean GCS (19.6 %)", and "The right way to put on GCS is to roll them from distal to proximal limb gradually (17.3%)"items received the lowest correct answer rates.

In the post-test; "The most common injection site for anticoagulants is the umbilicus (91.2%)", "The correct needle puncture angle for subcutaneous anticoagulant injection is 90 degrees (89.9%)", and "Accurate measurement should be made when choosing the size of GCS (88.6%)"items received the highest correct answer rates. In another hand, "GCS require regular sun exposure for sterilization (53.8%)", "Graduated compression stockings (GCS) can be removed at night to relax muscles, with no effect on VTE prevention (51.3%)", and "Giving up smoking and drinking has no effect on preventing VTE (49.2%)" items received the lowest correct answer rates.

There were statistically significant improvements in knowledge levels of the students regarding VTE/DVT prophylaxis in post-test in items "Controlling blood glucose and blood lipids can help prevent VTE", "Graduated compression stockings (GCS) can be removed at night to relax muscles", "with no effect on VTE prevention, GCS should not be worn folded", and "it is not important to be alert for complications during use of GCS or intermittent pneumatic compression devices".

Table 6. Comparison of the students' characteristics and overall VTE knowledge means

Variable	Total VTE knowledgemean Pre-test	P value *	Total VTE knowledge mean Post-test	P value *
Gender				
Male	21.9±3.5	0.19	25.9±1.2	0.22
Female	22.3±3.4		28.4±2.4	
Nursing level				

Third	19.5±1.3	0.12	22.7±1.7	**.0001**
Fourth	21.4±1.6		24.4±2.3	
External VTE Education				
Yes	17.8 ±1.1	0.10	20.3±1.4	0.15
No	20.3±2.4		21.4±1.9	
Age				
18 – 22 Year	15.3±1.2	0.13	21.8±3.2	0.17
≥ 23 Year	17.1±2.2		19.6±1.9	
Last CGPA				
< 3	13.9±2.3	0.09	15.2±2.5	
≥ 3	12.6±3.1		14.8±1.1	**.0001**

*independent-sample t-test

Results of independent-sample t-test (Table 6) showed that there were no statistically significant differences between the overall VTE knowledge domain and gender, external VTE education, and age of students (P > 0.05). On the other hand, nursing class groups, and last CGPA groups, revealed significant variations toward overall VTE knowledge domains (P< 0.001). Nursing students in fourth class achieved higher total mean VTE knowledge than third class (24.4±2.3). The students who had less than 3 last CGPA showed higher total mean VTE knowledge than more than 3 CGPA (15.2±2.5).

8.1 Content analysis Results

Regarding the strength and weakness points of flipped classroom illustrated that 75% strength an advantage of flipped classroom and 50 % weakness of the flipped classroom were stated by the students. Students classified the strength points with four themes; deep motivelearning, technology support, team-based learning, and satisfaction.On the other hand, themes of the weakness points were including “Lengthiness of the videos, time-consuming”.

8.1.1 Strength of flipped classroom

Deep motive learning

One student noted, “This method facilitates memorization, I feel that I can remember them more clearly”.

Technology support

Regarding technology support, a student stated; “The use of technology has provided a positive experience for me because of the variety, which tends to keep my attention”.

Team-based learning, and satisfaction

Students noted regarding team-based learning and satisfaction;

“For me the forums have also been an excellent way to interact with fellow students through the sharing of opinions and feedback”.

“It made me feel like I was learning collectively with other students, much like a classroom situation”.

8.1.2 Weaknessof flipped classroom

Lengthiness of the videos, and time-consuming

One studentstated, *“I had to both watch the electronic contents and study the book. This took me a great deal of time. We would have more time and would be able to watch electronic contents more carefully if the teacher had given us the DVDs three weeks before the course onset”.*

9. Discussion

Modern innovative education approaches are crucial to incorporated into nursing education, that leads to improving evidence-based teaching strategies, and closes the gap between theory and practice, as well as to prepare the nursing students to their future workplaces (Njıe-carr et al., 2017). The flipped classroom is a pedagogic technological revolution that shifts from teacher-center to student-center approach and provides opportunities to improve students' engagement with the class (Tan et al., 2017). Nursing care is significantly changing, requiring nurses to deal with complex and various patient comorbidities(Njie-Carr et al., 2017). VTE is one of the health problems that increases morbidity and mortality an in which nurses have crucial roles in prevention. Nursing education teaching innovative pedagogic strategies is necessary to foster nursing practice in the future(El-Bannaa et al, .2017). This study is considered one of the earliest studies in North Cyprus to compare the traditional method and a flipped classroom method among nursing students.

In the first stage of this study, randomized controlled design was used to compare the flipped classroom and traditional educational methods on attainment of knowledge regarding VTE prevention among nursing students. Our findings showed that there were no statistically significant differences in the descriptive characteristics of the students between both groups. Thus, the homogeneity was confirmed in the flipped classroom and traditional education groups.In the second stageof the study a pre-test and post-test, interventional design was used to evaluate effectiveness of the flipped classroom method.

9.1 Discussion Regarding Knowledge Levels of the Students

9.1.1 Pre- test results

Comparison of the mean scores of VTE domains of the flipped classroom and traditional learning groups showed no statistically significant difference in all VTE domains mean scores

between the two groups in the pre-test. The first and second stages results showed low means of VTE overall and domains' knowledge of in the pre-test among the nursing students. Especially items in the first stage group such as "Hyperlipidemia is 1 of the 3 main causes of VTE formation (10.7%)", "dyspnea is a clinical manifestation of acute DVT (13.9%)", and "Syncope is a major clinical manifestation of acute large area PE (18.4%), and A high blood coagulation state is 1 of the 3 main causes of VTE formation (23.1%)", "PE is the most severe complication of DVT (21.4%)", and "Hyperlipidemia is 1 of the 3 main causes of VTE formation (19.3%)", items in the second stage group were the lowest known items. In the first stage, low level of knowledge in pre-test is an expected result, since the students had not any education regarding VTE. However, for the second stage, the low knowledge is referring the lack of comprehensive VTE training in the nursing curriculum and usage of traditional teaching methods as main instruction methods in the faculty. Our findings were similar to our previous study, which showed a low level of VTE knowledge prevention among nurses (AL-Mugheed, Bayraktar 2018). On the contrary, a quasi-experimental study held in Iraq among nurses to evaluate the educational program with respect to VTE, the study showed that nurses had high knowledge scores at the pre-test (Mohammed et al., 2016). These findings are not welcome especially in developing countries, which have a high incidence rate of VTE than developed countries (Lee et al 2012). Several reasons were contributing to these findings such as; the traditional teaching methods are mains instruction methods providing in our faculty, which was the most favorite teaching method among students and not used in the present study, low staff-to-student ratios, and many students are present during clinical experiences at the same site.

9.1.2 Post-test results

In the traditional lecture group of first stage, the results demonstrate no statistically significant improvement in overall mean scores in the post-test. Several reasons for this might be that teachers during traditional lecture offer students an enormous amount of knowledge in a specific time with little direct interaction with the lecturer and other students; thus, students have an inadequate opportunity to participate in classroom activities and group discussions (Bingen et al., 2019). Learning the nursing contents might not be only through traditional methods; thus, nursing instructors should focus on the quality of the context and select suitable teaching methods based on nursing evidence practices that can contribute to improving students' knowledge (Dehghanzadeh et al., 2018).

The main findings of the first stage were that the overall mean of VTE knowledge significantly increased after intervention in the flipped classroom group, compared with the traditional lecture group. Similarly, results of second stage showed thatthe results showed significantly increasing in overall mean of VTE knowledge in post-test. In comparison of the groups, results showed that flipped classroom group had higher mean scores of VTE domains compared with the traditional lecture group. Based on the results of the study hypothesis 1 and 2 were confirmed.Theseresults show the effectiveness of the flipped classroom method in education regarding VTE. It was shown in the previous studies that using the flipped classroom method has a favorable impact on increased knowledge and motivation to obtain further information and improved communications skills of nursing students (Kim et al. 2019; Dehghanzadeh et al., 2018).The significant increases of basic, risk factors and prevention knowledge domains after interventions can be attributed that the flipped classroom method provides students to be self-study learners, also allowing them to use their suitable time to watch

and re-watch the videos without difficulties (Betihavas et al. 2016). The significant improvement of these domains may also be related to the student-centered feature of the flipped classroom method, and by allowing students the opportunity to save, exit, and re-watch the videos at will (Betihavas et al., 2016).

There are several studies in the literature that do not coincide with the results found in the current study. For instance, in a study conducted by Geist et al, no significant difference was reported between the traditional method and the flipped classroom method in the performance on the final exam (Geist et al., 2015). Another study found that there were no significant differences in any of the learning outcome measures in both groups (Harrington et al., 2015). The varied outcomes received about the effectiveness of the flipped classroom method may be attributed to the complexity of the flipped classroom as a form of learning approach, different content, and different methodologies used among studies, as well as the educator's role during the course. All of these challenges may contribute to success or failure of the flipped classroom approach.

9.1.3 Domains of the VTE knowledge

The result of first stage showed that the mean scores of VTE knowledge of the students regarding basic, risk factors and prophylaxis domains were significantly improved after exposure to the flipped classroom method, compared with the traditional lecture method. Similarly, results of second stage showed that, the results showed significantly improvement after interventions the in basic, risk factors and prophylaxis domains. The finding suggests the advantage of applying these innovative, modern instructional methods in nursing educations.

Nurses' knowledge and assessment of the development of PE after DVT in hospitalized patients is critical. Results showed that there were significant improvements in both study group such as "Deep vein thrombosis (DVT) is a clinical manifestation of venous thromboembolism

(VTE)", "Decreased blood flow velocity is 1 of the 3 main causes of VTE formation","PE is the most severe complication of DVT",and "Hyperlipidemia is 1 of the 3 main causes of VTE formation" items of basic knowledgedomain and"Age is a risk factor for VTE", "Chemotherapy is a risk factor for VTE", and "Congestive heart failure is a risk factor for VTE", items of risk factors domain among first stage group. In second stage group, there were significant improvements in "Hyperlipidemia is 1 of the 3 main causes of VTE formation", and "Chest pain is not a clinical manifestation of acute DVT" items of basic knowledge domain and "History of malignancy is a risk factor for VTE", "Leg swelling is a risk factor for VTE" itemsof risk factors domain. Our results coincide with the study conducted by Lee et al., 2014, who reported that the majority of participants had good knowledge about VTE risk factors. Our results also correspond with the study run by Mohammed et al 2016, which revealed participants had high VTE knowledge at post-test. Another study found that most of the participants showed good knowledge in terms of VTE risk factors (Lee et al., 2014). Lee et al, recommended that VTE basic knowledge, risk factors, and signs, and symptoms of VTE considered one of the primary models of nursing practice (Lee et al., 2014). Sufficient knowledge of VTE and risk factors promotes student confidence with respect to nursing practice. Therefore, promoting these two domains is very important in VTE nursing practice.

Studies conducted around the world overwhelmingly endorse that nurses are key actors in thromboprophylaxis (Lee et al., 2014; Al-Mugheed and Bayraktar, 2018). It was found that, there were significant improvements in both study group "alkaline detergent should be used to clean GCS, "The right way to put on GCS is to roll them from distal to proximal limb gradually", and "Hemorrhage is the most common complication after anticoagulant therapy" items of VTE prevention domain among first stage group. In second stage group, there were significant

improvements “Controlling blood glucose and blood lipids can help prevent VTE”, “Graduated compression stockings (GCS) can be removed at night to relax muscles”,in items of VTE prevention domain. Our findings are consistent with the study by Baskin et al who evaluated the effects of venous thromboprophylaxis education and found that participants’ knowledge was increased after CD-ROM-education (Baskin et al., 2008). Our findings were agreed with the study by (Gaston and White 2013), the nurses showed improvements in terms of VTE prophylaxis practices after education sessions.The improvement of VTE prophylaxis is not reflecting only for improves nurses’ knowledge, also improves patient’s outcome, minimize morbidity and mortality of VTE, and care costs (Lee et al., 2014).

9.1.4 Comparison of the knowledge levels with descriptive data

First stage results showed thatin the post-test of the experimental group, there were statistically significant in terms of gender and nursing level toward overall VTE knowledge domains. In the control group, the results showed that there were statistically significant in terms of the last CGPA toward overall VTE knowledge domains. The study findings were congruent with USA study which showed statistically significant difference with descriptive characteristics of the students’ (Holman et al., 2016).

In second stage, the results showed there was a statistically significant difference between the flipped classroom with respect to nursing class groups and the last CGPA groups. The study findings were not congruent with Iranian study which showed no statistically significant difference with descriptive characteristics of the students’ (Dehghanzadeh and Jafaraghaie 2018). This could be a indicating of nursing students endeavoring advancement in their academic performance up to a point.

9.2 Discussion Regarding Qualitative Findings

9.2.1 Advantages of the flipped classroom method

In the both study stages, students were requested to effectively participate in aimed classroom activities through online discussions such as discussion of VTE case studies. As a follow-up to the online discussions, our students emerged effectively engaged among their lecturer as well as participated as a team-based group. The benefits of online discussions were reported in several studies. The Iranian nursing students demonstrated effective and purposeful group discussions and communicated with their classmates to share information (Dehghanzadeh and Jafaraghaie, 2018). In another study, students felt satisfied during an online discussion, contrary to the independent discussion, also it allowed them to ask more questions (Holman et al., 2016). Learning through online discussion with the flipped classroom method can improve cognitive skills before, during, and after discussion.

In the first stage, students mentioned that the flipped classroom method has advantages such as deep motive and improved self-confidence, which can force one to get out of their comfort zone and make learning more student-centered. Moreover, it causes them to be self-directed learners, and be active, as well as improve their cognitive skills with the efficient processing of information acquired.Iranian nursing students also noted that the flipped classroom translates to better teach (Dehghanzadeh et al., 2018). In another study, students noted that the flipped classroom's focus is student-centered; thus, they have the chance to view/listen to the sessions at a time that is convenient for them (Holman et al., 2016). Burden et al. conducted a qualitative study that describes nursing student's perceptions and implications after using a flipped classroom method for learning, the students showed improved engagement and communication as well as greater self-confidence (Burden et al., 2015). An interesting flipped

classroom advantage was cost-effectiveness, despite the fact that this advantage does not appear predominantly in the studies. However, Hardin et al, reported that the flipped classroom is a cost-effective model (Hardin et al., 2016)

In the second stage students' expressed strengths points of the flipped classroom training method included four classifications such as widens and deepens knowledge, technology support, team-based learning, and satisfaction. These strengths point allowed the students to shift from teacher-centered to student-centered. Also, it enabled the students to control and distinguish in their learning. Deep learning is a learning approach, which includes student's core aspects of meaningful and suitable engagement with context and organizing their thoughts regarding what they have taught (Takase et al., 2019). Students' felt that deep learning enhanced their professional knowledge, particularly, during analyzing the case study, when they found that the subjects important for their career. Our finding was consistent with Catharine et al's study (2013), which found that the students tended to deep learning after used flipped classrooms because instilling to them the real enthusiasm to study (Catharine et al 2013). In technology support, the students expressed that they can study whenever they want from any place connected with internet access at any time. The technical support was also mentioned in Holman and Hanson, 2016 study, which was held to compared teaching models in nursing courses, the students stated that technology allowed them to seen/listen to the lessons frequently. Team-based learning is an effective strategy used to ameliorate student's engagements and shifting them from individual learning to group learning (Siah et al.2019). Our students stated that team-based learning conferred them to earn and preserved abundant knowledge and also apply the acquired knowledge to solve problems in clinical practices. In the pre-test and post-test study, the nursing students reported enhanced their learning after team-based learning and satisfied to learn as a

team (Siah et al.2019). In terms of satisfaction with the flipped classroom, numerous studies have been shown students' satisfaction after using flipped classroom, (Dehghanzadeh and Jafaraghaie 2018; Tan et al 2017), which was confirmed with our results.

9.2.2 Disadvantages of the flipped classroom method

The time-consuming were the major common weakness point of flipped classroom reported by some of the students. This weakness point was noted by several studies (Dehghanzadeh and Jafaraghaie 2018; Holman and Hanson, 2016). Another weak point was the lengthiness of the videos. In the current study the length of videos was ranged between 30 to 40 minutes, which lead to boring, tiring and poor concentration among students. In this regard, Smith and McDonald recommend that videos which are presented in the flipped classroom should not be the long, with a suitable range of 10–20 minutes (Smith, McDonald, 2013). Similarly, in a recent study, students stated that it was time-consuming to prepare pre-class activities (Dehghanzadeh et al., 2018). Students in a previous study reported that watching the video lecture took twice as long as listening to a lecturer (Jerri et al., 2015). Another disadvantage of the flipped classroom was a shortage of time to interact with the teacher, which may be attributed to that students were accustomed to traditional lectures. In this regard, Medical-Surgical nursing students stated that discussions and listening to other students' questions in a traditional lecture improved learning and sparked questions they had (Jerri et al., 2015). The last disadvantage of flipped classroom was technological requirements. Students stated that they had internet connection problems, which sometimes made watching videos difficult.

10. Conclusions

The results of this study demonstrated that applying flipped classroom enhances students' knowledge related VTE prevention. In the viewing of the importance of involving students in learning and establish a suitable platform for positive learning, it is proposed that flipped classroom teaching method can be used in nursing courses. This study has several limitations. First, the student's findings were evaluated on the last day of the course and we did not re-evaluate them at a subsequent time. Thus, we are not assured about the prolonged benefits of the intervention given. Further studies are required for creating credible results. Finally, this study was limited to one faculty in North Cyprus and cannot be generalized.

11. Findings and Recommendations

11.1 Findings in first stage

1. The mean age of students was 20.2 ± 6.8 years in the traditional lecture group and 19.9±7.6 years in the flipped classroom group.The majority of the students were in their first semester, and almost all of the students had not received any previous VTE education in both study group (Table 1).
2. The results showed a statistically significant improvement in the flipped classroom group after the intervention (Pre-test: 22.4±2.4, Post-test: 33.9±3.4) ($P < 0.05$); however, there was no statistically significant improvement in overall scores of the traditional lecture group ($P > 0.05$).The flipped classroom group showed statistically significant development in terms of all domains in the post intervention evaluation ($P < 0.05$), whereas in the traditional lecture group, the mean between pre-test and post-test results showed no statistically significant difference ($P > 0.05$) (Table 2).

3. In study group there were statistically significant improvements in knowledge levels of the students regarding VTE/DVT basic knowledge in posttest items; “Deep vein thrombosis (DVT) is a clinical manifestation of venous thromboembolism (VTE)”, “Decreased blood flow velocity is 1 of the 3 main causes of VTE formation”, “A high blood coagulation state is 1 of the 3 main causes of VTE formation”, “Limb redness, swelling, heat, and pain are clinical manifestations of acute DVT”, and “Syncope is a major clinical manifestation of acute large area PE”. Table 3
4. In study group there were statistically significant improvements in VTE/DVT risk assessment levels of the students regarding items; “Age is a risk factor for VTE”, “Chemotherapy is a risk factor for VTE”, “Acute myocardial infarction is a risk factor for VTE”, and “Severe lung disease, including pneumonia (<1 month) is a risk factor for VTE”. Table 4
5. In study group there were statistically significant improvements in VTE/DVT prophylaxis levels of the students regarding items; “Regularly moving bedridden patients is helpful for preventing VTE”, “Helping hospitalized patients to perform out-of-bed activity as soon as their condition allows does not prevent VTE”, “If GCS are too long, they can be folded down at the top of the thigh”, “With wearing GCS, the pressure injury can be ignored because of low incidence”, “accurate measurement should be made when choosing the size of GCS”, and “Hemorrhage is the most common complication after anticoagulant therapy”. Table 5
6. In the post-test of the experimental group, the results showed that there were statistically significant in terms of gender and nursing level toward overall VTE knowledge domains (P= 0.01). Female and fourth nursing level of participant’s revealed higher mean than

others.In the control group, the results showed that there were statistically significant in terms of the last CGPA toward overall VTE knowledge domains (P= 0.00). The participants who had the last CGPA ≥ 3 achieved a higher mean than others. Table 6

7. Four categories were composed from student responses regarding the advantages of flipped classroom, including “Deep motive,” “Engagement,” “Cost-effectiveness,” and “Self-confidence.”The disadvantages of flipped classroom were categorized into four categories, as follows: “Time demands,” “Technological requirements,” “Interaction challenges,” and “Enthusiasm challenges.”

11.2 Findings of Second Stage

1. Female constituted mostly of the participants (73.1%). The predominantly students were in their fourth semester (55.4%), and almost all of the students had not attended any external VTE education (89.2%). Table 1
2. The overall VTE knowledge domains showed a higher mean at post-test than at pre-test followed by statistically significant improvement after the educational intervention (pre-test: 23.3±2.5, post-test: 30.9±3.2) (P < 0.00).Table 2
3. There were statistically significant improvements in knowledge levels of the students regardingVTE/DVT basic knowledge in post-test in items of “decreased blood flow velocity is 1 of the 3 main causes of VTE formation”, “Hyperlipidemia is 1 of the 3 main causes of VTE formation”, and “Chest pain is not a clinical manifestation of acute DVT”. Table 3
4. There were statistically significant improvements in knowledge levels of the students regarding VTE/DVT risk assessment in post-test in items “History of malignancy is a risk

factor for VTE", "Leg swelling is a risk factor for VTE", "Acute myocardial infarction is a risk factor for VTE", and "Existing tumor is a risk factor for VTE". Table 4

5. There were statistically significant improvements in knowledge levels of the students regarding VTE/DVT prophylaxis in post-test in items "Controlling blood glucose and blood lipids can help prevent VTE", "Graduated compression stockings (GCS) can be removed at night to relax muscles", "with no effect on VTE prevention, GCS should not be worn folded", and "it is not important to be alert for complications during use of GCS or intermittent pneumatic compression devices". Table 5
6. There were no statistically significant differences between the overall VTE knowledge domain and gender, external VTE education, and age of students ($P > 0.05$). On the other hand, nursing class groups, and last CGPA groups, revealed significant variations toward overall VTE knowledge domains ($P< 0.001$). Table 6.
7. Students classified the strength points with four themes; deep motivelearning, technology support, team-based learning, and satisfaction. On the other hand, themes of the weakness points were including "Lengthiness of the videos, time-consuming".

12. Recommendations

Based on the results of the study following recommendations were made;

1. It is proposed that flipped classroom teaching methods can be used in nursing education as acredible and effective teaching method than traditional lectures.
2. Further studies including more extensive sample and evaluating long term effects of the flipped classroom method can be recommended.

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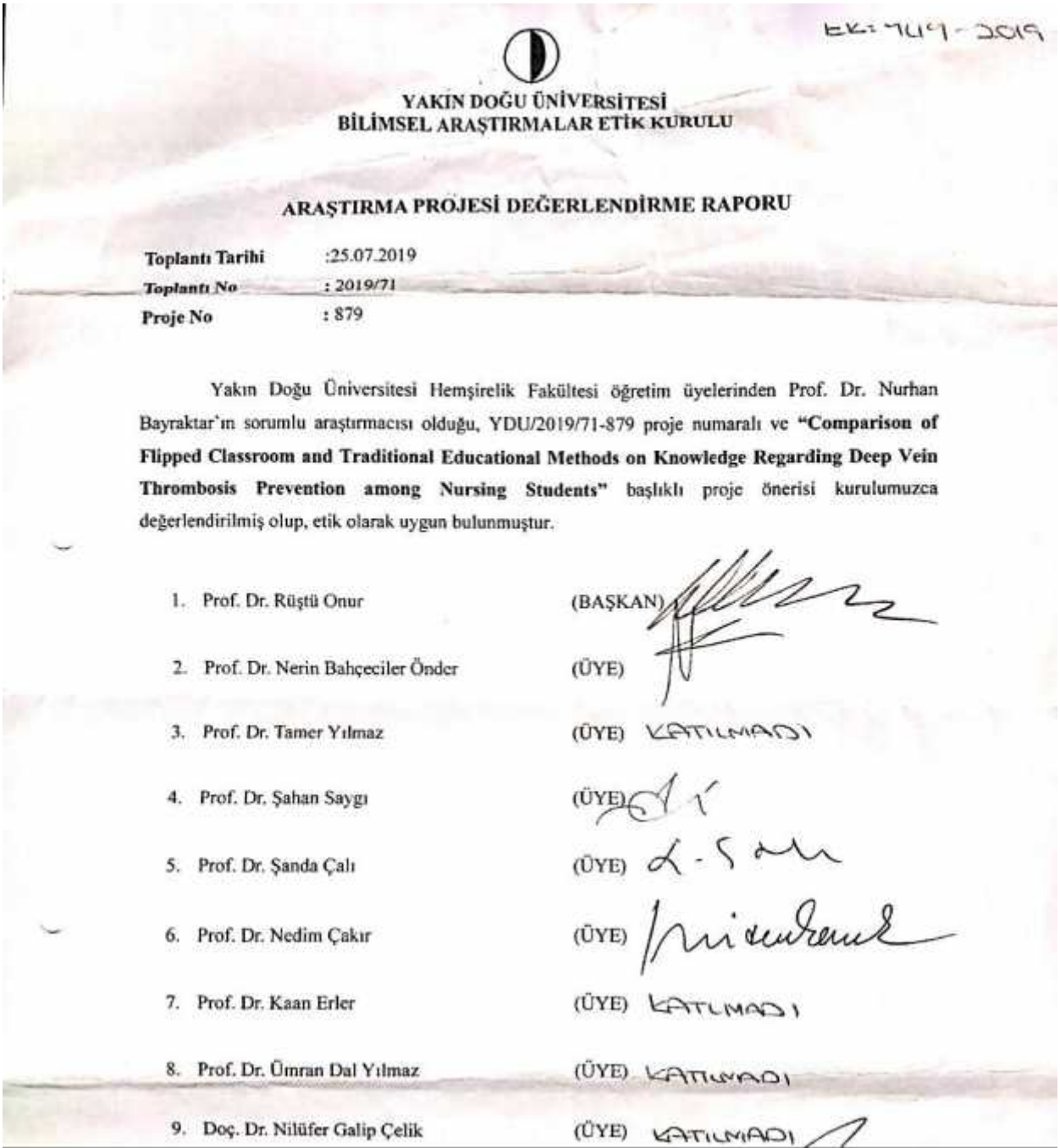
Appendix 1Ethical Approval Near East Institutional Reviews Board (IRB)First stage



EK: 7419 - 2019

YAKIN DOĞU ÜNİVERSİTESİ
BİLİMSEL ARAŞTIRMALAR ETİK KURULU

ARAŞTIRMA PROJESİ DEĞERLENDİRME RAPORU

Toplantı Tarihi :25.07.2019
Toplantı No : 2019/71
Proje No : 879

Yakın Doğu Üniversitesi Hemşirelik Fakültesi öğretim üyelerinden Prof. Dr. Nurhan Bayraktar'ın sorumlu araştırmacısı olduğu, YDU/2019/71-879 proje numaralı ve **"Comparison of Flipped Classroom and Traditional Educational Methods on Knowledge Regarding Deep Vein Thrombosis Prevention among Nursing Students"** başlıklı proje önerisi kurulumuzca değerlendirilmiş olup, etik olarak uygun bulunmuştur.

1. Prof. Dr. Rüştü Onur (BAŞKAN)
2. Prof. Dr. Nerin Bahçeciler Önder (ÜYE)
3. Prof. Dr. Tamer Yılmaz (ÜYE) KATILMADI
4. Prof. Dr. Şahan Saygı (ÜYE)
5. Prof. Dr. Şanda Çalı (ÜYE)
6. Prof. Dr. Nedim Çakır (ÜYE)
7. Prof. Dr. Kaan Erler (ÜYE) KATILMADI
8. Prof. Dr. Ümran Dal Yılmaz (ÜYE) KATILMADI
9. Doç. Dr. Nilüfer Galip Çelik (ÜYE) KATILMADI

Appendix 2 Ethical Approval near East Institutional Reviews Board (IRB)second stage

YAKIN DOĞU ÜNİVERSİTESİ
BİLİMSEL ARAŞTIRMALAR ETİK KURULU

ARAŞTIRMA PROJESİ DEĞERLENDİRME RAPORU

Toplantı Tarihi :20.11.2019
Toplantı No :2019/77
Proje No :669

Yakın Doğu Üniversitesi Hemşirelik Fakültesi öğretim üyelerinden Prof. Dr. Nurhan Bayraktar'ın sorumlu araştırmacısı olduğu, YDU/2019/77-669 proje Proje numaralı ve **"Effectiveness of flipped classroom among nursing students on venous thromboembolism"** başlıklı proje önerisi kurulumuzca değerlendirilmiş olup, etik olarak uygun bulunmuştur.

1. Prof. Dr. Rüştü Onur (BAŞKAN)
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8. Prof. Dr. Ümran Dal Yılmaz (ÜYE) KATILMADI
9. Doç. Dr. Nilüfer Galip Çelik (ÜYE)

Appendix 3 Educational Materials

Venous thromboemolism

Venous thromboembolism (VTE)

- Thrombotic disorders are one of the leading causes of morbidity and mortality worldwide.
- The World Health Organization (WHO) 2015 reports a global increase in mortality from noncommunicable diseases.

Cont.

- (VTE) is a major health problem. It is a condition in which a blood clot (thrombus) forms in a vein and manifests clinically as deep vein thrombosis.
- Venous thromboemolism (deep vein thrombosis (DVT) + pulmonary embolism PE).

Cont.

- Deep venous thrombosis (DVT) and pulmonary embolism (PE) have considered source of morbidity and mortality in the last 20 years.
- Venous thromboembolism is a major global problem with approximately 10 million cases per year.
- The mean annual incidence of venous thromboembolism (VTE) is 23 269 / 100,000.

Incidence

- It is the third most common cardiovascular disease after myocardial infarction and stroke
- The overall VTE rates are 100 per 100,000 population per year, of which 70% are hospital acquired
- It is estimated that 25,000 people in the UK die from preventable hospital acquired VTE every year.

Cont.

- the annual incidence is estimated to be higher in cases that are clinically silent or lost without diagnosis.
- Even in developed countries, VTE remains one of the main causes of morbidity and mortality in hospitalized patients.

Cont.

- Deep vein thrombosis (DVT) venous thromboembolism (VTE) is a major problem in both outpatients and inpatients.
- Venous thromboembolism (VTE) alone in the US results in 600,000 hospitalizations and 60,000 deaths per year.
- The incidence of VTE for the first time in the United States is more than 100 in the 100,000 population.

Cont.

- it has been determined that 500,000 deep vein thrombosis and 300 000 pulmonary embolism occur in 6 European countries with a population of 300 million
- The 30-day mortality rate for patients diagnosed with DVT is around 6% and for those who develop PE, it is about 12%.
- The DVT / VTE causes approximately 25,000 deaths in the UK, accounting for about 10% of hospital deaths each year.

Cont.

- In 2008, the financial cost of VTE in Australia is estimated at $ 1.72 billion.
- The annual economic burden of venous thromboembolism in the US is estimated at US $ 7-10 billion.
- The average annual incidence of DVT increases exponentially with age, and venous thromboembolism occurs in one in a hundred people over 80 years of age.

Cont.

- From 45 years of age, the risk of developing venous thromboembolism is 8%.
- Compared to whites, incidence is higher in black people.
- The incidence of DVT is lower in Asians and the reason for this condition has not been elucidated yet.

Cont.

- The incidence of postoperative VTE is 1% and one-third of VTE patients develop pulmonary embolism.
- This significantly increases postoperative morbidity and mortality

Deep vein thrombosis

- **Superficial veins** such as greater saphenous, lesser saphenous, basilic, external jugular veins are **thick walled** muscular structures that lie under the skin
- **Deep vein** are **thin walled** and have less muscle in the media. Run parallel to arteries and carry same names.
- Deep and superficial vein **have valves** that keep blood in **one-way flow from superficial to the deep system.**

Cont.

- Deep vein thrombosis may also occur in the deep veins of the arms, splanchnic vessels and cerebral veins with frequent development of the legs.

Cont.

- DVT is usually asymptomatic and is commonly known as a «silent killer».
- PE occurs if the clot breaks off from the site in which it was created and lodges in the lung vessels, also considered severe complication of DVT.

Pathophysiology

- Exact cause is not known, yet 3 reasons are known called **(Virchow's triad)**: **blood stasis (venous stasis), vessel wall injury, & altered blood coagulation.**
- A thrombus becomes an embolus if it dislodges from its site of origin to enter the circulation, ultimately impacting in another vascular bed
- **Thrombophelibitis**: formation of **thrombus with inflammation** to the veins wall
- **Phlebothrombosis**: development of **thrombus** in the veins as a result of stasis or hypercoagulability but **without inflammation**.

Virchow triad

- DVT formation occurs by one or combination of these three factors.
- To date, these have been the cornerstones not only of etiology, but also of defining risks and preventing venous thromboembolism (VTE).

Cont.

- These physiological changes can occur as a result of pathology, therapy and treatments.
- Damage to the vessel wall may result from trauma, surgical or invasive treatments

- Vein Thrombosis (VT) Occurs in any veins but mainly in **lower extremities,** but also can occur in upper extremities
- **Upper extremities** VT occurs from IV catheter, disease cause hypercoagulability
- venous thrombi: aggregates of platelets attached to the vein wall, along with a tail-like appendage containing fibrin, WBC's, and RBC's

- **Complication of VT**

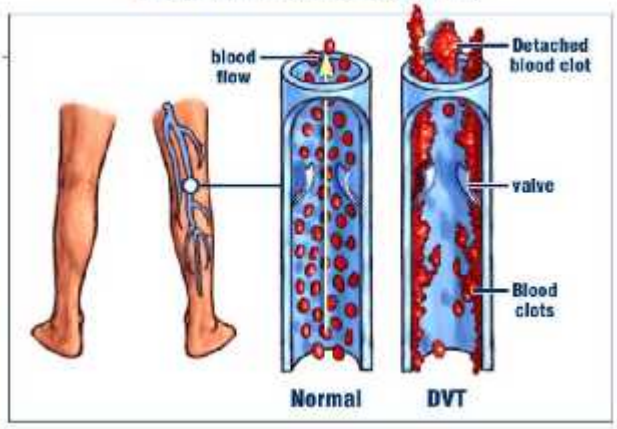
- Chronic venous occlusion
  - Pulmonary embolism
  - Vulvar destruction (Chronic Venous Insufficiency , ↑ venous pressure, varicosities, venous ulcer)
  - Venous obstruction (↑ distal pressure, fluid stasis, edema, venous gangrene)

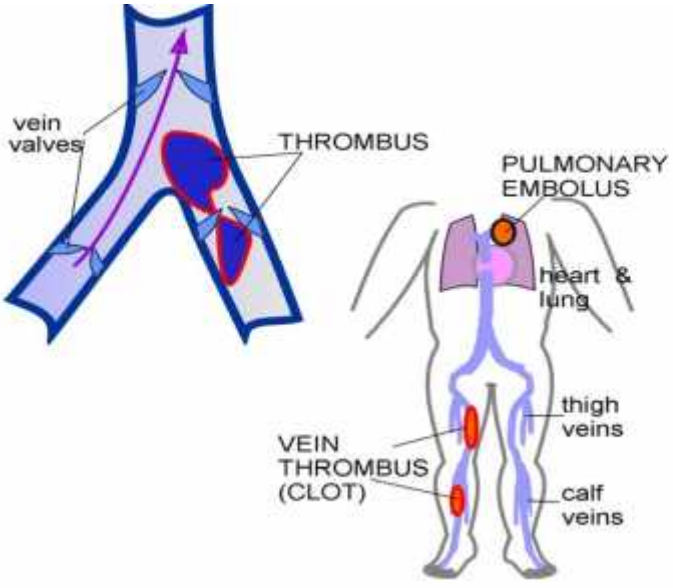
Cont.

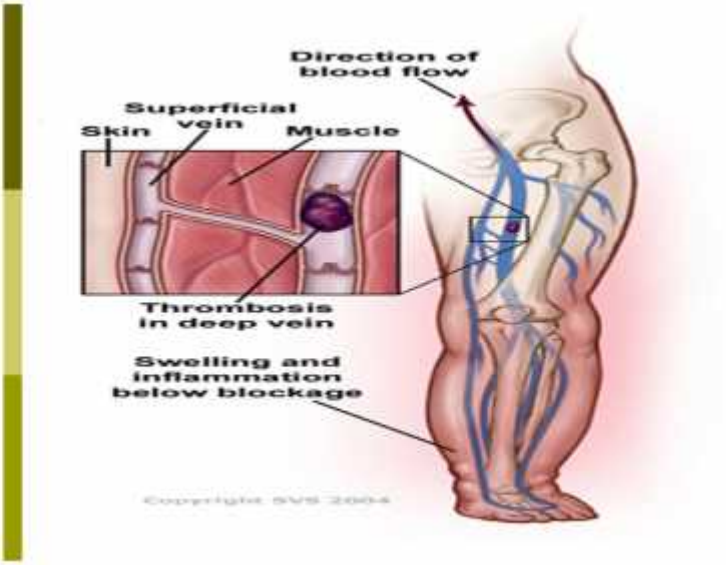
- Pulmonary embolism (PE) causes at least 200,000 deaths per year in the United States.
- Pulmonary embolism is the third most common cause of mortality in all age groups and is more common in adults

Cont.

- Post thrombotic syndrome reduces quality of life and has significant adverse economic effects.
- Post-thrombotic syndrome (PTS) develops in 20-50% of patients with deep vein thrombosis.







Clinical Manifestation

- Deep veins
  - Deep vein thrombosis signs and symptoms can include: Swelling in the affected leg. Rarely, there's swelling in both legs. pain in your leg, the pain often starts in your calf and can feel like cramping or soreness, red or discolored skin on the leg, a feeling of warmth in the affected leg.

Clinical Manifestation

- The warning signs and symptoms of a pulmonary embolism include:
- Sudden shortness of breath, Chest pain or discomfort, Dyspnea, Feeling lightheaded or dizzy, or fainting, rapid pulse coughing up blood, Syncope is a major clinical manifestation of PE

Risk Factors

Patients seen in medical wards differ from surgical patients with many having comorbidities including renal or hepatic impairment, and increased risk of bleeding.

An active cancer
Previous VTE & Family history
Reduced mobility
Already known thrombophilic condition
Recent (<1 month) trauma and/or surgery

Risk Factors

Age 70 years and above
Heart and/or respiratory failure
Acute myocardial infarction or ischemic stroke
Acute infection and/or rheumatologic disorder
Obesity BMI >30kg/m2
Ongoing hormonal therapy
Oral contraceptive use
Polycythemia
Septicemia

Strong risk factors for venous thromboembolism:

- Surgical
- immobilization
- Cancer

Surgical

- Major surgical intervention is the major risk factor for venous thromboembolism.
- VTE develops in 40% of patients hospitalized in surgical wards and 20% of patients hospitalized in internal wards.

Immobilization

- It has been identified as an important risk factor for VTE, especially in elderly populations over 70 years of age.
- Even short-term (one week) immobilization increases the risk of VTE.
- It is well known that surgery increases the risk of embolism by causing immobilization.

Cancer

- VTE was found in 4-28% of cancer patients.
- Approximately 20% of all venous thromboembolism is cancer-related.
- Abdominal and thoracic cancers and brain tumors are at higher risk.
- The risk is further increased in patients receiving immunosuppressive or cytotoxic chemotherapy.

Cont.

- The risk is particularly high for patients undergoing major orthopedic surgery.
- Obesity increases the risk of VTE 2-3 times, and the higher the weight, the higher the probability of VTE.
- The risk is higher in poorer education, low income group, unmarried and some occupational groups.

Risk diseases:

- Diabetes mellitus
- Cushing's syndrome
- hyperthyroidism
- Microalbuminuria
- Multiple sclerosis
- Rheumatoid arthritis
- Ulcerative colitis
- hypoalbuminemia

Assessment and Diagnostic Findings

Detecting early signs and symptoms: feeling of heaviness, limb pain, functional impairment, ankle engorgement, edema, circumference differences, temp (hotness at calf and ankle), tenderness.

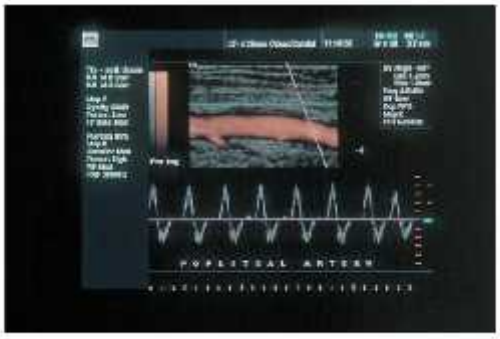
Homans' sign (pain in the calf as the foot is sharply dorsiflexed)

Diagnosis:

1. Venography: The radiologist **injects contrast material into a vein** on the top of the foot. The *blood clot appears* as a defect in contrast material on the **X-ray picture** of the veins.

2. Duplex ultrasound: noninvasive procedure reflects gray-scale imaging for vein or artery. Help in determination the **level and extent of venous disease** and **locate the disease stenosis or occlusion**

Color Flow Duplex Image



Prevention of DVT

- Prevention of VTE has been a goal of several organizations:
- National Institute of Health and Care Excellence - NICE)
- American College of Chest Physicians –ACCP

Prevention of DVT

- Determining which patients are at risk
- An appropriate prophylaxis method should be selected.

Preventing DVT / VTE

- Venous thrombosis events (VTE), are the most preventable cause of death in hospitalized patients.
- Before performing pharmacological prophylaxis, the risk of VTE should be weighed with both the patient and the procedure-related bleeding risk.
- NICE recommends that a patient's risk of bleeding and VTE be assessed within 24 hours of admission to hospital and when the clinical situation changes

Cont.

- The initial objectives for the VTE management it is prevent of clot extension, prevention of PE, reducing of later risk complications
- Prophylaxis for VTE includes early mobilization after surgery, intermittent pneumatic compression, graduated compression stockings, inferior vena cava filters and anticoagulants

Cont.

- Mechanical prophylaxis is also effective when used in combination with early ambulation but less efficacious than pharmacologic methods when used as a standalone modality
- Mechanical prophylaxis are applicable pre and intraoperative, and should be continued postoperatively until the patient is fully ambulating

Mechanical Prophylaxis:

- Graduated compression stockings (GCS)
- Intermittent Pneumatic Compression (IPC)

Graduated compression stockings - GCS

- It serves as the outer muscle layer.
- decreasing the pressure applied to the ankle to the thigh vein (8-18 mm Hg) and the right atrium facilitates venous return true
- until there is an independent mobilization should be used by all surgical patients unless contraindicated.

Instructions for (GCS)

- Compression stockings come in a variety of sizes, lengths.
- Select the proper size
- Your legs will be measured to see what size stockings you need, and your GP or nurse will check they fit properly.
- You may need to wear them on both legs, or just on 1.
- You should wear your compression stockings during the all day

Cont.

- You should be given at least 2 stockings, or 2 pairs if you're wearing them on both legs.
- If GCS are too long, don't folded down at the top of the thigh.
- GCS should not be worn folded
- The right way to put on GCS is to roll them from proximal limb to distal gradually
- Note the complications

Intermittent Pneumatic Compression- IPC

- Fulfill the function by preventing venous stasis in the legs.
- Intermittent pneumatic pressure (IPC) is applied to increase venous blood flow, elimination of venous stasis and the effects of the natural muscle pump.
- It is more effective when combined with pharmacological prophylaxis.
- Used for patients with a high risk of postoperative bleeding, stroke patients, and obese patients.

Instructions for (IPC)

- Used with elastic stocking to prevent DVT, increased blood velocity
- Positioning the body and encouraging exercise.
- Elevate feet and the lower leg above heart level when pt in bed rest
- Deep breathing exercise

Cont.

- Instruct pt to avoid sitting for more than 1hr-Perform active and passive leg exercise when pt cannot ambulate
- Walk for at least 10 min every 1-2 hr's
- Should be used 24 hours a day for bedridden patients

- Compression therapy:
  - Stocking:
    - Used for pt with venous insufficiency
    - Exert sustained evenly distributed pressure over the entire calves resulting in ↑ **flow in the deeper veins**
    - They may be knee high, thigh high, or panty hose
    - **When stocking are off inspect skin for irritation and tenderness in calves**
    - **Contraindicated in pt with severe pitting edema.**

Inferior vena cava Filters

- These are mechanical devices that are placed temporarily or permanently into the inferior vena cava under radiological follow-up.
- Formal structure holds large clots and prevent it from falling to the lower extremities of the pulmonary circulation.

Cont.

- This treatment has been shown to reduce the risk of life-threatening PE but has no effect on long-term morbidity associated with DVT.

Medical Management

- Objectives:
  - **Prevent** thrombus from **growing** and fragmenting
  - Prevent **recurrent** thromboemboli
- Achieved by pharmacologic therapy or surgical therapy.

Pharmacologic therapy

- Indicating for pt with *Thrombophelibitis, recurrent embolus formation, persistent leg edema from HF, elderly with hip fracture*
- **Unfractionated heparin**: 5-7 days *to prevent formation* of new thrombi.
- **Low-molecular-weight heparin**: more effective than heparin, *longer half life*
- **Thrombolytic therapy**: (Streptokinas&Urokinase)
  - cause the thrombus to **dissolve in 50% of pts**
  - Given in the **1st 3 day of acute thrombosis**

** Advantage: less-long-term damage to the venous valves and reduced incidence of postthrombotic syndrome and chronic venous insufficiency

** Disadvantage: The incidence of bleeding is greater than heparin

- **Factor Xa inhibitor:**
  - Fondaparinux (Arixtra): inhibit factor Xa
  - Given S\c in a daily fixed dose
  - **Has no effect on PTT or PT**
  - Used as *prophylactic in major orthopedic surgery*
- **Oral anticoagulant**: (warfarin)
  Is *a vit K antagonist*
- **Surgical management**:
  - Is necessary when anticoagulant and thrombolytic therapy is Contraindicated.
  - **Thrombectomy** is done to prevent the risk of pulmonary emboli.
  - Balloon **angiography with stent** used for iliac vein

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Nursing Management

- If patient is taking anticoagulant medication: the nurse should **monitor PT and PTT, Hb and HCT** values, **platelets count, fibrinogen level**. **Control bleeding** (bruises, nose bleeding, gum bleeding).
- The nurse should monitor for potential **complication** as (bleeding, thrombocytopenia)
- Providing comfort: **bed rest (5-7days from diagnosis, elevation of the leg), elastic stocking (when pt start to ambulate), analgesic, bed exercise as repetitive Dorsiflexion of foot**
- **Walking** is better than standing or sitting for long period
- Warm compress over affected area to promote comfort

Patient's education: anticoagulant medication

- Take the medication at the same time each day
- Wear identification band So that others would know, and notify healthcare providers.
- Avoid alcohol and drug interact with anticoagulant medications
- The correct needle puncture angle for subcutaneous anticoagulant injection is 90 degrees.
- The most common injection site for anticoagulants is the umbilicus.
- Hemorrhage is the most common complication after anticoagulant therapy.

Items	Basic Knowledge	T/F
1.	Deep vein thrombosis (DVT) is a clinical manifestation of Venous thromboembolism (VTE).	T
2.	Pulmonary embolism (PE) is a clinical manifestation of VTE.	T
3.	PE is the most severe complication of DVT.	T
4.	Decreased blood flow velocity is 1 of the 3 main causes of VTE formation.	T
5.	Blood vessel injury is 1 of the 3 main causes of VTE formation.	T

6.	A high blood coagulation state is 1 of the 3 main causes of VTE formation.	T
7.	Hyperlipidemia is 1 of the 3 main causes of VTE formation.	F
8.	Limb redness, swelling, heat, and pain are clinical manifestations of acute DVT.	T
9.	Dyspnea is a clinical manifestation of acute DVT.	F
10.	Chest pain is not a clinical manifestation of acute DVT.	T
11.	Chest pain is a clinical manifestation of acute PE.	T
12.	Dyspnea is a clinical manifestation of acute PE.	T
13.	Syncope is a major clinical manifestation of acute large area PE.	T

Items	**Risk assessment**	**T/F**
1.	Age is a risk factor for VTE.	T
2.	History of malignancy is a risk factor for VTE.	T
3.	Inflammatory bowel disease is a risk factor for VTE.	T
4.	Leg swelling is a risk factor for VTE.	T
5.	Chemotherapy is a risk factor for VTE.	T
6.	Acute myocardial infarction is a risk factor for VTE	T

Appendix 4 Data Collection Tools

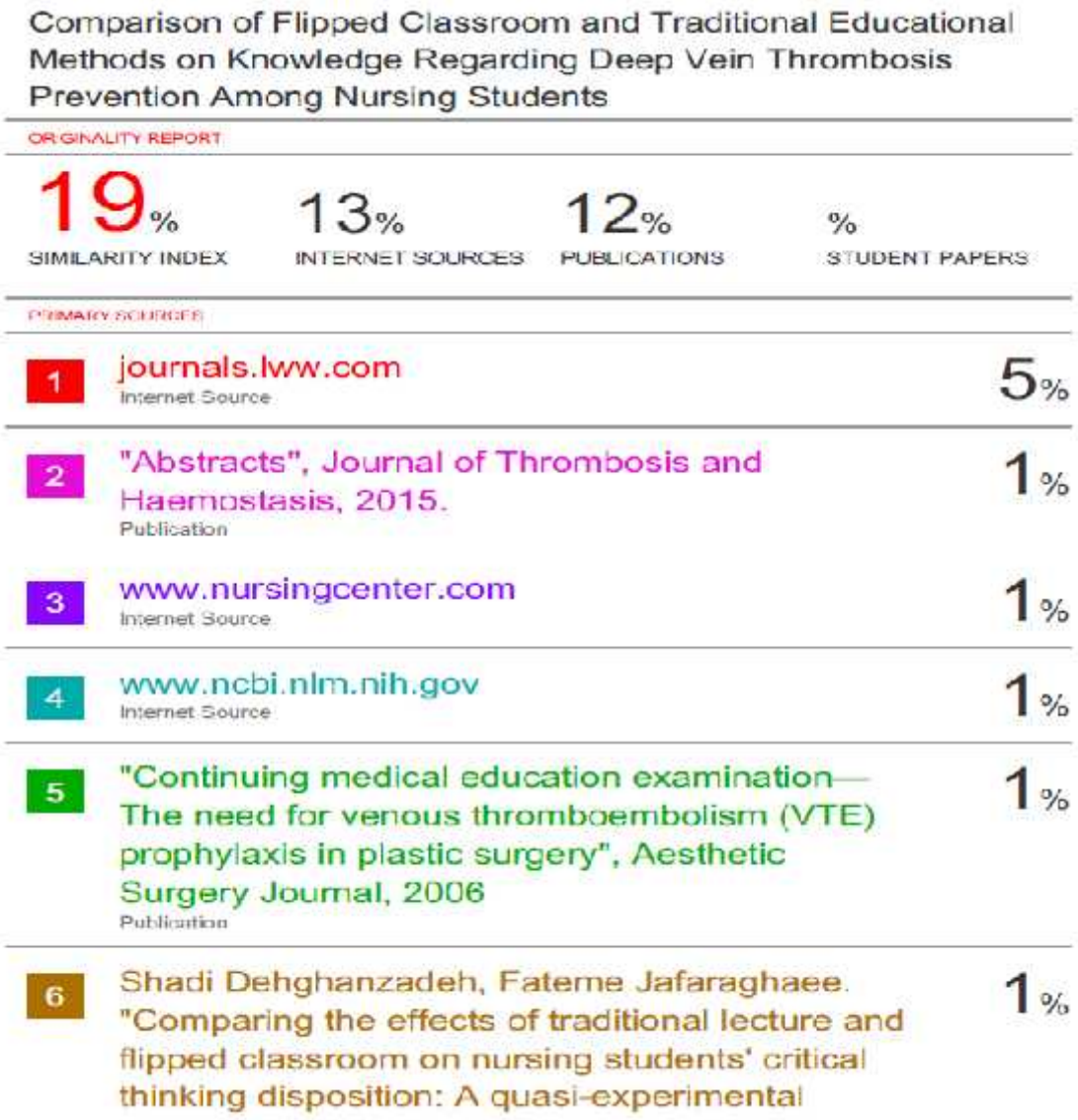
7.	Congestive heart failure is a risk factor for VTE.	T
8.	Leg plaster or splint fixation is a risk factor for VTE.	T
9.	Pregnancy or<1 month postpartum is a risk factor for VTE.	T
10.	Septicemia (<1 month) is a risk factor for VTE.	T
11.	Severe lung disease, including pneumonia (<1 month) is a risk factor for VTE	T
12.	Pulmonary dysfunction (e.g., COPD) is a risk factor for VTE.	T
13.	Existing tumor is a risk factor for VTE	T

Items	**VTE Prophylaxis**	**T/F**
1.	It is helpful to instruct bedridden patients in lower limb exercises to prevent VTE.	T
2.	Regularly moving bedridden patients is helpful for preventing VTE	T
3.	Adequate hydration can prevent the occurrence of VTE.	T
4.	Giving up smoking and drinking has no effect on preventing VTE.	F
5.	Controlling blood glucose and blood lipids can help prevent VTE	T
6.	Helping hospitalized patients to perform out-of-bed activity as soon as their condition allows does not prevent VTE.	F
7.	Graduated compression stockings (GCS) can be removed at night to relax muscles, with no effect on VTE prevention.	F
8.	GCS require regular sun exposure for sterilization.	F

9.	Alkaline detergent should be used to clean GCS	F
10.	If GCS are too long, they can be folded down at the top of the thigh.	F
11.	The right way to put on GCS is to roll them from distal to proximal limb gradually	F
12.	GCS should not be worn folded	T
13.	The right side of the patient's GCS is wearing correctly	F
14.	With wearing GCS, the pressure injury can be ignored because of low incidence	F
15.	Accurate measurement should be made when choosing the size of GCS	T
16.	GCS cannot continue to be applied when a patient presents VTE.	F
17.	Intermittent pneumatic compression devices can be used after the occurrence of VTE.	T
18.	Intermittent pneumatic compression devices should be used 24 hours a day for bedridden patients.	T
19.	It is not important to be alert for complications during use of GCS or intermittent pneumatic compression devices.	F
20.	The correct needle puncture angle for subcutaneous anticoagulant injection is 90 degrees	T
21.	Before the injection of pre-filled anticoagulant drugs, the air in the needle tube should be exhausted	F
22.	The most common injection site for anticoagulants is the umbilicus.	T
23.	Hemorrhage is the most common complication after anticoagulant therapy	T
24.	Allergic reaction is the most common complication after anticoagulant therapy	F

TURNITIN REPOR

TURNITIN REPORT



Comparison of Flipped Classroom and Traditional Educational Methods on Knowledge Regarding Deep Vein Thrombosis Prevention Among Nursing Students

ORIGINALITY REPORT

19%	13%	12%	%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

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2	"Abstracts", Journal of Thrombosis and Haemostasis, 2015. Publication	1%
3	www.nursingcenter.com Internet Source	1%
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6	Shadi Dehghanzadeh, Fateme Jafaraghaee. "Comparing the effects of traditional lecture and flipped classroom on nursing students' critical thinking disposition: A quasi-experimental	1%

CURRICULUM VITAE

Name	Khalid Anwer	Surname	AL-Mugheed
Place of Birth	Jordan	Date of Birth	13\10\1986
Nationality	Jordanain	Tel	
E-mail	khaledjust@yahoo.com		

Educational Level

	Name of the Institution	Graduation year
Postgraduate/Specialization	Phd. Surgical Nursing\ Near East University	Fall 2021
Masters	Surgical Nursing\ Near East University	2017
Undergraduate	BS. Nursing\ Jordan University	2008

Job Experience

Duty	Institution	Duration (Year - Year)
research assistant	Near East University	2016-2020
Clinical instructor	Najran Hospitl	2012-2016