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The Role of Crossover Learning Strategy in Developing Nursing Students' Academic Achievement and Reflective Thinking

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Abstract

This research investigates the effectiveness of the crossover learning strategy on nursing students' academic achievement and reflective thinking in the nursing department of a private institution in Rwanduz. The population of the study consists of first-stage students at the private institution in Rwanduz during the academic year 2023–2024. The sample of the study consists of first-stage students in the nursing department, who were selected purposively. The researchers employed a quasi-experimental design, and the sample was divided into two groups: 21 students in the control group and 21 students in the experimental group. The traditional method was implemented in the control group, while the crossover learning strategy was applied in the experimental group. Two scales were used as research tools. The first scale measured academic achievement and consisted of 40 multiple-choice items. The second scale measured reflective thinking, consisted of 35 items, and was adopted from another researcher. The validity and reliability of the research tools were assessed. Furthermore, pre- and post-tests of both groups' reflective thinking were conducted using a two-sample t-test, and an independent-samples t-test was conducted to analyze academic achievement. The results of the study revealed significant differences in academic achievement and reflective thinking between the experimental and control groups. The experimental group achieved higher scores using the crossover learning strategy than the control group, and their reflective thinking improved

more than that of the control group. Therefore, the crossover learning strategy was effective in improving students' academic achievement.

Keywords: Crossover learning, academic achievement, reflective thinking, nursing students, teaching and learning.

ڕۆڵی ستراتیژی فێربونی یەکتربڕ لە پەرەپێدانی دەسکەوتی ئەکادیمی خوێندکارانی پەرستاری و بیرکردنەوەی قوڵ

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پوختە

ئامانج لەم توێژینەوەیە لێکۆڵینەوەیە لەسەر کاریگەری ستراتیژیەتی فێربونی یەکتربڕ لەسەر دەسکەوتی ئەکادیمی وفێربونی قوڵ لە قوتابیانی بەشی پەرستاری لە پەیمانگەی تەکنیکی تایبەتی ڕواندز،کۆمەڵگەی توێژینەوەکە خوێندکاری قۆناغی یەکەمن لە پەیمانگای تەکنیکی ناحکومی ڕواندز لە ساڵی خوێندنی (٢٠٢٣-٢٠٢٤)، نمونەی توێژینەوەکەش خوێندکارانی قۆناغی یەکەمن لە بەشی پەرستاری، کە بە ویستەکی (مەبەست) هەڵبژێردراون، توێژەران پشتیان بەستوە بە نەخشەسازی ئەزمونی وە نمونەکە بەسەر دو گروپدا دابەشکراون: (٢١) خوێندکار لە گروپی کۆنترۆڵ و (٢١) خوێندکار لە گروپی ئەزمونی. شێوازی ئاسایی (تەقلیدی) لە گروپی کۆنترۆڵدا جێبەجێکرا، لەکاتێکدا ستراتیژی فێربونی یەکتربڕ لە گروپی ئەزمونی دا جێبەجێکرا. دو پێوەر وەک ئامرازی توێژینەوە بەکارهێنراون؛ پێوەری یەکەم دەستکەوتی ئەکادیمی بو، کە پێکهاتبو لە (٤٠) پرسیاری جۆری فرە هەڵبژاردن؛ پێوەرەکەی دوەم بیرکردنەوەی قوڵ بو، کە لە (٣٥) برگە پێکهاتوە، توێژەران وەریان گرتوە لە توێژینەوەیەکی تر. جێگیری وڕاستگۆیی بۆ ئامرازەکانی توێژینەوە ئەنجامدرا. سەرەڕای ئەوە، تاقیکردنەوەکانی پێش وەختەو دوا وەختە بۆ بیرکردنەوەی ڕەنگدانەوەیی هەردو گروپەکە بە بەکارهێنانی تێستیT دو نمونەیی (Two-sample t-test) ئەنجامدرا، وە نمونەی سەربەخۆ (Independent-samples) ئەنجامدرا بۆ شیکردنەوەی دەستکەوتی ئەکادیمییان. ئەنجامی توێژینەوەکە جیاوازییەکی بەرچاوی لە نێوان دەستکەوتی ئەکادیمی و بیرکردنەوەی قوڵ لە گروپی ئەزمونی و گروپی کۆنترۆڵدا دەرخست، گروپی ئەزمونی نمرەی بەرزتریان بەدەستهێناوە بە ستراتیژی فێربونی یەکتربڕ لە چاو گروپی کۆنترۆڵ، و بیرکردنەوەی قوڵ لەگروپی ئەزمونی زۆر باشتر بوە لە گروپی کۆنترۆڵ. کەواتە بەکارهێنانی ستراتیژی فێربونی یەکتربڕ دەستکەوتی ئەکادیمی خوێندکارانی بەرەو پێش بردوە.

کلیلەوشەکان: فێربونی یەکتربڕ، دەستکەوتی ئەکادیمی، بیرکردنەوەی قوڵ، خوێندکارانی پەرستاری، فێرکردن و فێربون.

1.1 Introduction

Education is essential for social advancement, and access to high-quality education ensures the progress and development of any society. It has experienced substantial growth over the years, shifting from traditional lecture-based methods to more engaging, student-

centered approaches (Iyamuremye et al., 2024). The primary objective of scientific education is to cultivate cognitive abilities in learners, including self-directed learning, problem-solving skills, critical thinking, and decision-making. This objective can only be achieved if students actively participate in the teaching and learning process using activity-based and functional instructional methods (Ameen and Ibrahim, 2022). Over the past decade, teaching and learning have evolved from a didactic approach to more diverse approaches, as higher education has shifted its focus to preparing for the Fourth Industrial Revolution. Engaging students in the learning process through various methods and technological tools is now a key focus. Moreover, traditional teaching approaches effectively convey basic knowledge; nevertheless, they may not consistently provide sufficient opportunities for students to engage in critical thinking and collaborative learning. In contrast, effective teaching allows students to exchange ideas, cultivate soft skills, foster personal development and inquiry, and resolve misconceptions beyond the limitations of traditional learning environments (Abyzbekova et al., 2023, De Freitas et al., 2015, Laurillard, 2013).

The objectives of the current study are:

1. To investigate whether the crossover learning strategy has any impact on first-stage nursing students' academic achievement.
2. To examine whether crossover learning affects the reflective thinking skills of first-stage nursing students.

The research problem is based on the researchers' experience in teaching and learning processes at schools, institutions, and universities over several years. It has been observed that most nursing students are not adequately prepared for practical study and off-campus learning. Several reasons may explain this. First, this may be due to a lack of awareness of the benefits and experiences of learning in different environments. Second, it relates to the challenges of teachers' lesson planning and the difficulty of organizing off-campus activities, such as taking students to hospitals to apply what they have learned in theory. Finally, many students in different fields pursue their studies to meet academic requirements and obtain a diploma or bachelor's degree for future employment. Furthermore, many nursing students face difficulties in understanding medical and nursing concepts due to their complexity and terminology. It has also been noted that the academic achievement of students taught through traditional methods is lower compared

to those taught using different methods and strategies, especially in subjects that require demonstration and practice.

Therefore, the research problem is stated as follows: “What is the role of the crossover learning strategy in developing first-stage nursing students’ academic achievement and reflective thinking in Fundamental Nursing?

The significance of the current research from the researchers’ perspective lies in the following: because of a shortage of focus on crossover learning in nursing teaching and an insufficient examination of students’ reflective thinking outcomes, the research’s findings will provide teachers, educators, and students with a clear vision of modern teaching methods and strategies. According to the researchers’ knowledge, reading, and searching, this research will also be the first in Iraq and the Kurdistan Region, because teachers and lecturers in different fields will be familiar with one of the most precious and effective strategies for teaching their students. This might motivate nursing students to study different ways and utilize various learning methods to comprehend science concepts and knowledge. On the other hand, it might make learning enjoyable, make students more active, and help them experience both formal and informal learning environments. Moreover, the institution’s administrator might be motivated to make the crossover strategy compulsory for nursing students. Finally, compared to previous studies (Ugwu, 2024, Nwuba et al., 2023, Mariana and Syam, 2023, Joseph et al., 2023, Azmi et al., 2018), the current research's key point is that it deals with nursing students in an academic institution and how this method affects their academic achievement and reflective thinking skills.

The following null hypotheses are stated:

1. There is no significant difference in students’ academic achievement between the experimental and control groups at the 0.05 significance level (two-tailed).
2. At the significance level (0.05), there is no significant difference in the students’ reflective thinking between the experimental and control groups.

2. Theoretical framework

There have been several previous studies on the use of crossover learning strategies. According to (Ugwu, 2024), the academic achievement of the students taught using the crossover strategy was higher than those using cooperative strategies. Moreover, female students achieved higher scores than male students. Nwuba et al. (2023) found that

academic performance increased more using the crossover strategy than the traditional method, and there were no significant differences between male and female students.

A study by (Mariana and Syam, 2023) showed that teachers and students believe using the crossover learning strategy is enjoyable, makes students more active, and helps improve learning because students can experience and learn from formal and informal environments. Another research by (Joseph et al., 2023) found that the crossover strategy effectively increases students' environmental awareness. Finally, Azmi et al. (2018) stated that crossover learning positively impacts students' achievement and learning experiences.

2.1 Crossover learning

Learning is generally categorized into two coexisting types, which are formal and informal. Formal education is delivered by instructors and structured around a standardized set of specified outcomes; nevertheless, it is inflexible, passive, and limited beyond the classroom environment. On the other hand, informal learning is unstructured and adaptable, allowing students to establish personal objectives and control the pace of their learning. Thus, crossover learning, situated at the intersection of formal and informal education, is frequently recognized as an important educational advancement (Sharples et al., 2016). The 2015 Innovating Pedagogy study identifies crossover learning as one of ten innovations expected to significantly impact education. The fundamental concept of crossover learning involves an integrated understanding of learning that connects formal and informal educational contexts (Joseph et al., 2023). In this approach, students learn within formal environments aligned with their curriculum, where teachers provide topics or problems that encourage investigation during visits or field trips (Srinivasa et al., 2022).

Furthermore, an effective way to implement crossover learning is for teachers to pose stimulating questions within the formal classroom environment, while students seek answers in the informal settings they explore. Students are encouraged to take notes and collect photographs or other relevant data to enhance information gathering and obtain diverse perspectives. They then convey their insights to better understand and explain the issue (Panke, 2017).

2.2 Innovative pedagogy in nursing

Nursing is a profession in the healthcare field and a cornerstone of the healthcare system, playing a significant role in improving human life. Individuals who study this field are nursing students who will become future nurses (Emire et al., 2022). In recent decades, nursing educators worldwide have increasingly adopted innovative teaching strategies in

the classroom, moving away from traditional methods. These improvements are attributed to several advantages, including increased self-confidence and enhanced competency levels (Amtamwa, 2019). Nevertheless, the effectiveness of crossover learning in enabling students to develop the necessary skills for health professions remains underexplored. This issue requires further investigation, as training programs for health professionals differ from others in that they require students to attain specific, applicable outcomes, with learning environments encompassing diverse settings such as classrooms and hospitals. The application of complex theories to clinical problem-solving presents a significant challenge for students.

Various teaching methods have been examined with differing degrees of success, including team-based learning, role-playing, and interdisciplinary assignments within pharmacy education (Bleske et al., 2016, Adrian et al., 2015, Stewart et al., 2011). Moreover, a major challenge in nursing education is identifying and implementing innovative teaching strategies to enhance students' learning and critical thinking skills. Educational programs aimed at empowering nurses must carefully select relevant content as well as appropriate teaching strategies and methods (Jaafarpour et al., 2016).

2.3 The advantages and disadvantages of crossover learning

The advantages of crossover learning include promoting learner autonomy, supporting authentic learning, enhancing students' motivation, and providing opportunities for engaging learning experiences. Since most young learners want to take greater control over their education, they have more flexibility in choosing informal learning activities compared to the restrictions imposed by textbooks and classroom syllabuses. Students tend to select instructional content related to their daily lives, and they do not perceive this form of learning as merely a homework task; rather, they actively pursue knowledge about subjects that capture their interest. Additionally, crossover learning enables students to integrate academic knowledge with practical experience.

At the same time, everyday interactions can enhance school and college education, and the integration of classroom inquiry with real-world experiences can further promote informal learning (Johnsi Priya, 2022, Sunitha, 2018, Rao, 2019).

2.4 Academic achievement

Academic achievement is a result of an educational program. It refers to a quantitative measure of a student's academic performance within an academic curriculum. Moreover, it refers to the extent to which a student has gained the anticipated academic knowledge,

skills, and abilities following class instruction (NWUBA et al., 2022). Academic achievement is influenced by various factors, including personality traits (motivation, psychological wellness, quality of life, engagement in activities), school attributes (both human and physical resources, class size, quality of syllabus, extracurricular activities, technology, evaluation mechanisms, and facilities), support from families (home atmosphere, availability of supplies, family members' attitudes, education levels, family size), and social supports such as physical and leisure activities (Engin-Demir, 2009, Barbosa et al., 2020).

2.5 Reflective thinking

Reflective thinking is an intellectual, systematic, and disciplined process of understanding and evaluation of the importance of a situation in connection to one's prior experiences, current knowledge, deeply held beliefs, and expectations (Asselin, 2011, Rodgers, 2002). It also refers to students' learning outcomes and performances, that means the extent to which a student has achieved learning objectives. They emphasize assessments and activities in formal learning environment, such as universities, colleges, institutions, and schools (Steinmayr et al., 2014). Boosting reflective thinking enhances lifelong learning competencies, including critical thinking, problem-solving, clinical reasoning, decision-making, communication skills, self-directed learning, and professional growth. Consequently, improved reflective thinking abilities may better equip students for the obstacles encountered in their future clinical work (Croke, 2004, Hanya et al., 2014). Furthermore, increasing pharmacy students' metacognitive skills might facilitate applying theoretical knowledge to address challenges they may face in their future clinical practices. Consequently, integrating these essential abilities into the pharmacy curriculum may constitute an effective pedagogical approach (Hagemeier and Mason, 2011, Tsingos-Lucas et al., 2016).

3. Methodology and the Procedures of the Study

3.1 Experimental Design

This study employed an experimental design involving two equivalent groups. The first group was experimental (21 students) and was taught using a crossover strategy, while the second group was a control group (21 students) and was taught using a traditional method (i.e., teacher-centered and didactic, which is the most familiar and longest-established method of teaching). The research procedure consisted of a post-test for academic achievement, as well as a test and a retest for reflective thinking. The experimental design of the study is illustrated in Table 3.1.

Table (3.1): Research experimental design

Groups	Pre-test	Independent variables	Dependent variables (Re-test)
Experimental	Reflective thinking	Strategy of Crossover learning	Academic achievement
Control		Traditional method	Reflective thinking

3.2 The Research Population and Sample

The target population of this study comprises all first-stage students in the institutions of the Soran Independent Administration for the academic year 2023–2024. The study sample consisted of 42 first-stage nursing students who were purposively selected from the Nursing Department of the Rwandz Institution. Furthermore, the sample was divided into 21 students in the control group and 21 students in the experimental group, as shown in Table 3.2.

Table (3.2): The Sample of the Study.

Classes	The Groups	Teaching Methods	Number of students
A	Control	Traditional Method	21
B	Experimental	Crossover Learning Strategy	21
Total			**42**

3.3 Equivalence Procedure of the Research Groups

The equivalency of several variables between the two research groups was implemented because they affect the dependent variables. So, these variables are as follows:

3.3.1 Intelligence Degree Test

The study used the Raven-prepared IQ test, which consists of 60 illustrated items with scores ranging from 0 to 60. After collecting responses from the students in the two research groups, the results revealed that the mean IQ score of the experimental group was 30.10, whereas the mean score of the control group was 27. 76.. The researcher employed the independent samples T-test to determine the difference between them; the calculated T-value was (0.849), which is less than the scheduled T-value (1.684) at the significance level (0.05) at the degree of freedom (40), indicating that the difference is not statistically significant. This shows that the two groups were equivalent in terms of IQ, as presented in Table 3.3.

Table (3.1): The IQ test for the two groups

Group	Number of students	Mean	Standard deviation	T value		Significance level (0.05)
				Calculated	Schedule	
Experimental	21	30.10	9.679	0.849	1.684	Not significance statistically
Control	21	27.76	8.062			

3.3.2 Previous Knowledge of the Subject:

For the equivalence of prior knowledge between the two research groups, the researcher prepared a multiple-choice achievement test consisting of 25 items. Before conducting the test, it was reviewed by specialists in nursing and teaching methods. After conducting the test, the arithmetic mean was calculated using a t-test. The results showed that there was a significant difference between the prior knowledge of the two groups because the calculated T value (3.433) is more than the table value (1.684) at the significance level (0.05), at the degree of freedom (40). The mean of the experimental group (16.309) is more than the mean of the control group (12.92). These results show that the two groups were not equivalent in their prior knowledge of the subject matter before the experiment, as presented in Table 3.4. The researchers consider this outcome normal, as the study was conducted in a private institution where some students already hold another degree and have prior academic experience. Therefore, differences in prior knowledge between the two groups are possible.

Table (3.2): The previous knowledge test for the two groups

Group	Number of students	Mean	Standard deviation	T value		Significance (0.05)level
				Calculated	Schedule	
Experimental	21	16.309	3.348	3.433	1.684	Statistically Significant
Control	21	12.92	3.026			

3.3.3 Chronological Age:

The calculation of students' age in months is referred to as chronological age. The researcher obtained data for this variable from the students' academic records as well as from the students themselves. The chronological age of students in both research groups was calculated in months up to 25/8/2024. To verify the equivalence between the two groups, an independent-samples t-test was conducted to determine the significance of the

difference between the two means. The results indicated a statistically significant difference, as the calculated t-value (1.783) exceeded the tabulated value (1.684) at the 0.05 significance level with 40 degrees of freedom. This suggests a difference in the ages of the two groups, with the experimental group having a higher mean age (22.498) than the control group (10.32). Accordingly, the two groups are not equivalent in terms of chronological age, as shown in Table 3.5.

As mentioned earlier, Rwandz Institution is a private institution; therefore, the students' ages range from 18 to 50 years. Consequently, the presence of older students (e.g., around 50 years old) may have contributed to this difference. However, the difference is relatively small when considering the group means.

Table (3.5): Shows the arithmetic mean, and standard deviation, the calculated and tabular value (T) for the two groups of research in the chronological age variable

Group	Number of students	Mean	Standard deviation	T value		Significance level (0.05)
				Calculated	Schedule	
Experimental	21	22.498	103.09	1.783	1.684	Statistically Significant
Control	21	10.32	47.32			

3.3.4 The Level of Parents' Education

3.3.4.1 For Mothers

However, assessing the parents' educational level is not quite necessary here, because of the students' age, the researchers performed statistical analyses by using Chi square ($\chi 2$) on the academic achievement data for the students' mothers from the two research groups. The findings indicated that the calculated value of the chi square was (4.20) exceeding the table value (3.891) at the level of significance (0.05) and a degree of freedom (1). Therefore, the two groups are not equivalent in mothers' educational level, as shown in (Table 3.6).

Table (3.6): The educational level of the mothers of the students of the two research groups and the calculated and tabular value of the chi-square

Group	Number of students	Mother's academic achievement level		χ2 value		Significance (0.05level (
		Illiterate	Primary and higher	Calculated	Schedule	

Experimental	21	18	3	4.20	3.891	Statistically Significant
Control	21	12	9			

3.3.4.2 For Fathers

The calculation of the parents' educational level is not necessary for fathers too, because of the students' age. The researchers conducted statistical analyses by applying Chi-square to the educational level data for the students' fathers of the two research groups. The results showed that there is no difference between fathers' educational level of the two groups, since the computed Chi square value was (3.864) which is less than its table value (5.991) at the level of significance (0.05) and degree of freedom (1). Consequently, the two groups are equivalent in fathers' educational level, as shown in (Table 3.7).

Table 3.7 The educational level of the fathers of the students of the two research groups and the calculated and tabular value of the chi square

Group	Number of students	Father's academic achievement level			χ2 value		Significance (0,05level (
		Illiterate	primary	Higher school	Calculated	Table	
Experimental	21	9	4	8	3.864	5.991	Not significance statistically
Control	21s	6	10	5			

3.4 Research tools

3.4.1 Academic Achievement Scale

Since one of the necessities of the present study is to create a test to measure the academic achievement of the nursing students in the experimental and control groups, researchers designed the test items of the multiple-choice type, which includes (40) questions related to what students have been taught during the course, and each question has four options. The researcher marked the answers of the students of the two groups, depending on the marking key that was prepared for this purpose. Score (1) was assigned to each correct answer and (zero) for the wrong or left answer.

3.4.1.1 The Scale items Validity and Reliability

The researchers designed a multiple-choice test with (40) items, and each item has four alternative answers. For validity, the researcher applied content validity for the scale and sent them to several experts in the field, who evaluated it; the degree of acceptance for all items was 80% for the scale items. Thus, all items were valid. Moreover, the researcher conducted a test with (43) students in the nursing department at Soran technical institute, the alpha Cronbach was calculated (0.879), which clarifies the reliability of the academic achievement scale was reliable.

3.4.2 Reflective Thinking Scale

The researcher applied reflective thinking test which was prepared by (Ahmed and Haji, 2020), for two independent samples which consisted of (35) items, with four response options: Always, Extremely, Sometimes, and Rarely. The response options were scored on a four-point scale, with values of 4, 3, 2, and 1 assigned respectively.

3.4.2.1 The Scale Items Validity and Reliability

To verify the reliability of the scale, the researcher relied on Cronbach's alpha, which is preferred for items on a graded scale. The researcher administrated the test to (43) students, who were an exploratory sample of the scale in the nursing department at Mergasor Technical Institute, it was confirmed that all items were reliable. Also, Alpha Cronbach was calculated (0.897), which clarifies the reliability of the reflective thinking scale test.

4. Data Analysis and Discussion

4.1 The First Hypothesis

“No significant difference exists between the students’ academic achievement in the experimental and control groups at the significance level (0.05). they have been taught according to the Crossover Learning Strategy and the average degrees of the control group students, which were taught according to the Traditional Method, in the Academic Achievement.” To analyze the data, the researcher applied two samples t-tests, which show that there is a significant difference between the academic achievement of the two groups because the calculated t-value (8.154) is much greater than the T table value (1.684) at the significance level (0.05) and the degree of freedom (40). While the mean of the experimental group is (68.329), which is more than the mean of the control group (53.929), thus, this indicates that the experimental group achieves higher results in the fundamentals of nursing subject of first stage students after the completion of the

experiment with the cross-over strategy than the control group with the traditional method. Consequently, this rejects the first null hypothesis and accepts the alternative hypothesis. (Table 4.1) indicates the result of the study's first objective.

Table 4.1: The result of the first hypothesis

Group	Number of students	Mean	Standard deviation	T value		Significance level ((0.05
				Calculated	Schedule	
Experimental	21	68.329	9.208	8.154	1.684	Statistically significant
Control	21	53.929	5.415			

According to the result of the first objectives, this result may be attributed to the Crossover learning strategies being more adaptable to individual learning styles. Nursing students come from diverse backgrounds and have different ways of processing information. Also, according to results, nursing students need to be prepared to handle complex and unpredictable situations in clinical environments. Crossover learning emphasizes real-world scenarios through case-based learning, clinical rotations, and interactive simulations. This prepares students for the dynamic nature of healthcare, helping them develop technical skills, empathy, cultural competence, and ethical decision-making. Traditional methods may lack these practical, immersive experiences. Moreover, nursing is a field where information must be quickly recalled and applied under pressure. Thus, an outcome in the experimental group shows that Crossover learning promotes active participation, which improves memory retention and understanding. Instead of passively receiving information from lectures, students engage with the material through activities, visiting hospitals, and showing real cases. At the same time, traditional methods, which may emphasize passive learning, are less likely to produce the same long-term knowledge retention.

To sum up, this study matches with the previous studies by (Wilson et al., 2016, Ugwu, 2024, Nwuba et al., 2023, Mariana and Syam, 2023, Joseph et al., 2023) and (Azmi et al., 2018), who revealed that the cross-over strategy is more effective than the traditional teaching method. Moreover, the cross-over strategy can improve students' achievement in the subject matter, make them more engaged with it, and make the knowledge more absorbed.

4.2 The Second Hypothesis

"There is no statistically significant difference at the significance level (0.05) between the students' degrees of the experimental group who have been taught according to the Crossover Learning Strategy and the students' degrees of the control group who have been taught according to the Traditional Method in developing Reflective Thinking". To achieve the study's second objective, the two research groups' reflective thinking was tested using a pre- and post-test using a paired t-test. The results revealed a significant difference between the average growth variations in Reflective Thinking among the students of both research groups because the calculated in both groups was more than the scheduled t-test; in the experimental group, the calculated t-value was (2.425), while the calculated t-test value of the control group was (1.818), and the scheduled t-value was (1.727) in each group at the significance level (0.05) and the degree of freedom (20). Thus, there is a statistically significant difference between the two groups' pre and post-test for students in reflective thinking. Nevertheless, students' reflective thinking in the experimental group progresses more after the crossover learning than in the control group when the mean of the experimental group (110.667) is greater than the mean of the control group (102.333), as shown in (Table 4.2). Subsequently, the second null hypothesis is rejected and the alternative hypothesis is accepted.

Table (4.2): The result of the second hypothesis

Group	Number of students	Mean	Standard deviation	T value		Significance level (0.05)
				Calculated	Scheduled	
Experimental	21	110.667	9.124	2.425	1.725	Statistically significant
Control	21	102.333	13.08	1.816	1.725	

According to the findings of the first objectives, the researcher credited the experimental group students' mastery over the control group students to the effect of the independent variable, utilized with the experimental group. This variable involved many activities, such as visiting hospitals, that in turn helped to develop the students' Reflective Thinking. These activities were part of the students' reflective thinking developments. It was provided by the strategy used by the experimental group. On the other hand, the control group's reflective thinking improved. This might be because of the formal environment of the Rwandz private institution, which makes students more engaged with the class and learn new things. Besides, lecturers might play a significant role in improving their students'

reflective thinking by having lots of activities on campus and sharing their experiences and knowledge with them. Thus, the abovementioned reason can make students' reflective thinking progress.

Conclusions, Recommendations and Suggestions

5.1 Conclusions

According to the study results, the following conclusions were reached:

1. The cross-over learning strategy can improve students' academic achievement in nursing and other fields, as it adapts real-world practice, engages students in everyday problem-solving, and helps them to solve them.
2. In addition, a cross-over learning strategy can improve students' reflective thinking. Teachers and lecturers can support the development of reflective thinking by providing an appropriate learning environment.
3. The cross-over learning strategy can change students' perceptions about the difficulty of learning the fundamentals of nursing subjects and make the subject more enjoyable and interesting. Furthermore, the students exposed to cross-over learning were more enthusiastic and passionate about learning.
4. The cross-over learning strategy can create a learner-centered approach, which is crucial to teachers and students as well. It encourages students to engage in self-directed learning and develop new nursing skills so that they can easily get jobs in the future.

1.2 Recommendations

The recommendations of the study are the following: -

1. Make the cross-over learning strategy compulsory in the nursing departments to allow students to engage in real-world practice.
2. Conduct workshops, training courses, and seminars for teachers to familiarize them with the cross-over learning strategy.
3. Integrating innovative pedagogical methods and strategies with the teaching and learning process to improve students' academic achievement in nursing and other fields in general.
4. Teachers and lecturers should be familiarized with the fastest ways to improve their students' reflective thinking to master their personality and thinking.

1.3 Suggestions

Further studies are recommended in this field incorporating other variables. The following suggestions are proposed:

1. A comparative study of the effects of cross-over and cooperative learning strategies on nursing students' critical thinking.
2. A comparative study of the effectiveness of hands-on learning and the cross-over learning strategy on the nursing students' attitudes toward biology concepts.
3. The effectiveness of the cross-over strategy on the nursing students' critical thinking.
4. The effectiveness of integrating cross-over strategy with learning by doing theory on the nursing students' achievement, reflective thinking, and critical thinking.

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