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EFFECT OF TEACHING BASED ON DOMINANT LEARNING STYLE ON TEST SCORE OF UNDERGRADUATE NURSING STUDENTS: A QUASI-EXPERIMENTAL PRE-POST STUDY

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Abstract

Objective: *To determine the effect of teaching based on dominant learning style on test score of undergraduate nursing students*

Study Design: *A quasi-experimental pre-post study design was employed.*

Place and Duration of the Study: The study was executed at Ziauddin University Faculty of Nursing and Midwifery, Karachi, Pakistan. The study was conducted in two months (i.e., April 2023 to May 2023).

Methodology: *150 students of BSN-I were selected by convenience sampling technique, divided into two groups; 75 participants in control group and 75 participants in interventional group. 140 qualified participants altogether (control group n=70 and intervention group n=70) were included in the study. Kolb learning style inventory was used to assess learning style of students and a valid self-developed questionnaire was used to collect pre and post-test score.*

Results: *Majority of participants were females (n=75 out of 140) and mean age was 19.86±1.579. The study shows that most dominant learning style of undergraduate nursing students is diverging (n=74) while least dominant is convergent (n=8). Students in the interventional group gave better performance in the post-test {17.0 (4)} (p-value <0.001) as compared to control group {12.50 (5)} which proves that teaching based on dominant learning style has significant effect on test score of undergraduate nursing students.*

Conclusion: *This study proves that teaching based on dominant learning style improves learning score of students, therefore students' learning style should be taken into account while developing lesson plans, so that students learn more effectively and give better academic performance.*

Introduction

The process of learning is greatly influenced by learning styles. If teaching is aligned with the preferred learning style of students then students feel engaged and motivated in their studies and give a better academics performance.[(1)] The concept of different learning styles became popular in 1970.[(2)] Learning styles of individuals can be found out by learning style inventory. Kolb learning style inventory (KLSI), Visual, aural, read/write, kinesthetic (VARK) questionnaire, and the Honey-Alonso questionnaire are widely used tools to assess learning styles of healthcare students.[(3)]

According to Kolb, learners are distributed into four types according to their preferred learning methods which are; convergers, divergers, assimilators and accommodators. People who are divergers prefer group work, receive personal feedback and listen with an open mind. People with convergent learning style prefer technical tasks and find solutions to issues and address queries. People who have assimilating learning style prefer lecture, reading and writing. And people with learning style of accommodating favor hands on experience and new challenges.[4]
The rank of Pakistan is 125th out of 130 based on how well it performs in the domain of education based on the report of World Economic Forum's Global Human Capital, 2017.[5] and ranks 164 out of 195 in terms of its investment in education and healthcare.[6]
Hence, measures should be taken to enhance quality of education in Pakistan. This study will help to improve quality of education after testing effectiveness of teaching formulated on dominant style of learning. The dissemination of findings will enable the nursing educators and nursing institutions to reflect on the significance of students' learning styles and mould their pedagogical approaches accordingly.
The aims of this study are:

- To find out the dominant learning style of undergraduate nursing students
- To determine the effect of teaching based on dominant style of learning on the test score of undergraduate nursing students

Methodology
The study design of quasi-experimental pre-test and post-test design was used to determine the effect of teaching based on dominant learning style on test score of undergraduate nursing students.
The study was conducted at Ziauddin University Faculty of Nursing and Midwifery (ZUFONAM). ZUFONAM is one of the leading nursing institutes of Karachi, Pakistan which was established in 1986 and recognized by Pakistan Nursing Council.
The study population was students of Bachelor of Science in Nursing (BSN) enrolled in year-I of the program, the total number of which was 150. Sample size has been calculated by Open Epi Software version 3.01. There is a previous study done in 2022; taken as reference "Impact of learning-style-based education on student performance and perception in preclinical endodontics".[7]
Where, Mean Difference = 0.5, SD1=1.01, SD2=1.06, confidence level (α) of 95%, absolute precision=5%, power=80%
The sample size is calculated to be n=136 divided into two groups. After adding 10% non-response rate of the total study participants, the final sample size for the study was found to be 150 (75 each arm; intervention and control).
A non-probability sampling technique i.e., Convenience sampling technique was used for selection of participants.
Step-1: 150 participants of BSN first year was selected for the study (the entire group of BSN-I).
Step-2: They were divided into two groups; 75 students were included in the control group and 75 students were included in interventional group. Naturally occurring groups of BSN-I section-A (n=75) and section-B (n=75) was taken as intervention group and control group respectively.
Step-3: Students in interventional group were further divided into four groups depending on their learning style which was assessed by KLSI.
Students of BSN who are in the first year, willing to participate in the study, sign the informed consent, and score less than 80% in the pre-test were included in the study.
Students greater than 35 year old, absent in one of the tests (pre or post-test), or unable to understand the study were excluded from the study.
No any student obtained score of greater than 80% in the pre-test. Five students from each group (five from control and five from interventional) were excluded from the study. Three students in control and two students in intervention group did not attempt the post-test, hence removed from the final analysis. And five students (two in control and three in intervention group) did not participate in the study. Final sample of 140 was obtained for the study (70 in interventional and 70 in control group).
The data collection procedure was started after approval from the graduate nursing research committee (GNRC), ethical review committee

(ERC), and board of advanced studies and research (BASR). In addition, permission was also granted from the management of the institute where the study was conducted. Participants were included in the study after completely explaining the nature and purpose of the study and signing the informed consent.

The study was conducted in two months (i.e., April 2023 to May 2023).

Data collection procedure was divided into four phases.

On day one, the first phase took place in which 150 participants were selected (entire group of BSN-I) after taking time from their class coordinator. After selection of participants, they were divided into two groups; 75 participants in control group and 75 participants in interventional group (naturally occurring groups of BSN-I, 75 students in Section-A and 75 students in Section-B). A pre-test was conducted on the topic of Infection Prevention and Control (IPC) which is Standard Precautions and Transmission-based Precautions after explaining the purpose and signing the informed consent which took 35 minutes to complete (25 minutes for MCQs and 10 minutes to explain the study and signing informed consent). The content validity index of the questionnaire was calculated to be 0.99 after reviewing the tool from eight experts. The filled questionnaires were later checked and scored by the primary investigator. The primary investigator (PI) was the facilitator in all the phases because of expertise in IPC. PI is working in IPC department as an infection control officer since 6 years and has expertise in teaching the related content.

Students scoring less than 80% marks in the pre-test were included in further phases and students securing more than 80% marks in the pre-test were excluded from the study. However, no any student obtained score of greater than 80% in the pre-test, hence all the students were included in the study according to the criteria.

The second phase took place on day two in which students' learning styles for both the groups was identified by using Kolb's LSI version 3.1. KLSI was given to students of first year (entire population). The students were given 30 minutes to fill out the KLSI and the result of the KLSI was analyzed later by the researcher, thus most dominant learning style of the students was identified. Students in interventional group were further divided into four groups depending on their learning style based on the results of KLSI. 39 students were divergers, 15 assimilators, 6 convergers, and 10 accommodators in the interventional group, according to the KLSI results (altogether 70).

On day three third phase took place in which teaching session was conducted on the topic of Infection Prevention and Control (Standard Precautions and Transmission-based Precautions). The teaching session was comprised of components that were based on the guidelines of Centers for Disease Control and Prevention, 2018. Similarity of content was ensured by teaching learning material with same objectives to all the groups. Conventional teaching strategy (Lecture Method) was used for control group (n=70) and teaching strategy of intervention group (n=70) was based on their dominant learning style. This phase took two hours to complete.

Students in diverging group were divided into seven groups consisting of five to six members in each group (total divergers in Intervention group=39). Written material was given to them regarding the topic. The groups were instructed to discuss the provided learning material in their groups and share ideas with each other. The groups then discuss their learning with the facilitator and group leader presented it to the whole class. The facilitator was there to facilitate the groups during this period.

The lecture was delivered through PowerPoint presentation to the participants in assimilator group regarding Standard Precautions and Transmission-based Precautions (total assimilators=15).

Students of converging learning style were asked to study Standard Precautions and Transmission-based Precautions independently on the computer and give answers to the provided questions for which a paper was given to the students on which questions were written related to the topic. The facilitator was there for facilitation during this period (total convergers=6).

Written material was given to the students of accommodating learning style on the topic for self-study. Demonstration was used by facilitator

in teaching strategy and hands-on practice was done by the individual student (total accommodators=10).

The final (fourth) phase also occurred on day three in which the same test was used for the post-test as the pre-test (n=140). This phase took 25 minutes to complete the post-test. The filled post-test papers were checked and scored later by the researcher. The results of the post-test of both groups (control and interventional) was compared and test score of different learning styles in the interventional group was also compared. Thus, the effect of matched vs. mismatched teaching and learning style was identified.

Results

Demographic details of the participants include age and gender which is shown in Table-1 along with prior exposure to infection prevention and control (IPC) training and learning style of participants. Out of 140 participants 65 (46.4%) were males and 75 (53.6%) were females. 32 (22.9%) participants' age was 16-18, 86 (61.4%) participants' age was 19-21, and 22 (15.7%) participants were between the age of 22-24. Mean age was found to be 19.86±1.579. Moreover, 137 (97.9%) participants do not have prior exposure to IPC training while only 3 (2.1%) have prior exposure to IPC training. The students' dominant method of learning is diverging, the frequency of which is 74 (52.9%). The second and third most common learning styles are accommodating and assimilating, the frequency of which are 30 (21.4%) and 28 (20%) respectively. The least common learning style is converging with frequency of 8 (5.7%) (See Table 1).

Table-1: Demographic Characteristics of Participants (n=140)

S#	Categorical Variables	Frequency N (n=140)	Percentage %
1	**Gender**		
	Male	65	46.4
	Female	75	53.6
2	**Age (Years)** Mean±SD	19.86±1.579	
	16-18	32	22.9
	19-21	86	61.4
	22-24	22	15.7
3	**Prior IPC Training Exposure**		
	Yes	3	2.1
	No	137	97.9
4	**Learning Style of Participants**		
	Diverging	74	52.9
	Accommodating	30	21.4
	Assimilating	28	20
	Converging	8	5.7

The Shapiro-Wilk test was used to determine the data's normality and revealed that the data is non-parametric. The difference between scores of two groups (Intervention and Control) was compared by Mann-Whitney U Test and pre-post comparison was discovered by Wilcoxon signed-rank test. By analyzing the results of the study it is found that the median and interquartile range (IQR) of participants in control group were 6.0 (4) and 12.50 (5) in pre-test and post-test respectively. On the other hand, the median and interquartile range (IQR) of participants in intervention group were 6 (3) and 17 (4) in pre-test and post-test respectively which is shown in Table-2. The result shows significant difference in pre-post comparison of both the groups.

Moreover, pre-test scores for the two groups (control and intervention) do not significantly differ from one another, while there is significant difference of scores in post-test score between the groups. Intervention group performed better in the post-test as compared to control group. Significance was defined as a p-value of less than 0.05 (See Table-2).

Table-2: Median Difference of Control and Intervention's Pre-test and Post-test

	Control	Intervention	P-value
Pre-test, Median (IQR)	6.0 (4)	6.0 (3)	0.585
Post-test, Median (IQR)	12.50 (5)	17.0 (4)	<0.001
p-value	<0.001	<0.001	

Pre-post test scores was compared by Wilcoxon signed-rank test and control vs. intervention scores was compared by Mann-Whitney U test. P-value of less than 0.05 was considered as significant.

Pre and post-test scores are compared of different variables including age, gender and learning style which is shown in Table-3. The difference in pre-posttest was compared by Wilcoxon signed-rank test.

The study discovered a substantial difference between pre-test and post test scores of both the groups (control and intervention) in all categories (age, gender and learning style). Both the groups performed better in the post test in all categories except convergers. Pre-post analysis of convergers in the control group revealed no statistically significant difference in scores (See Table-3).

Table-3: Pre-test and Post-test Scores of Different Categorical Variables

Category	Group	Pre-score Median (IQR)	Post-score Median (IQR)	P-value
Gender				
Male	**Control**	6.0 (3)	10.0 (4)	<0.001
	Intervention	6.0 (4)	16.0 (2)	<0.001
	Control	7.0 (3)	14.0 (4)	<0.001
Female	**Intervention**	6.0 (4)	18.0 (5)	<0.001
Age				
16-18	**Control**	6.0 (3)	13.0 (7)	0.002
	Intervention	7.50 (5)	17.50 (4)	<0.001
	Control	6.0 (4)	12.0 (5)	<0.001
19-21	**Intervention**	6.0 (2)	16.50 (6)	<0.001
	Control	6.0 (2)	13.0 (5)	0.007
	Intervention	6.50 (3)	19.0 (5)	0.002
22-24				
Learning Style				
Diverging	**Control**	7.0 (3)	11.0 (6)	<0.001
	Intervention	6.0 (5)	17 (5)	<0.001
Accommodating	**Control**	5.50 (3)	13.0 (5)	<0.001
	Intervention	6.50 (2)	18.50 (5)	0.002
Assimilating	**Control**	6.0 (3)	14.0 (6)	0.001
	Intervention	6.0 (3)	17.0 (4)	0.001
Converging	**Control**	6.0 (.)	15.50 (.)	0.180
	Intervention	7.50 (3)	14.50 (5)	0.027

Pre-post comparison was checked by Wilcoxon signed-rank test among above variables. P-value of less than 0.05 was considered as significant.

Comparison of scores was found out among different categorical variables including age, gender and learning styles which is shown in Table-4. The difference was compared by Mann-

Whitney U test for gender and Kruskal-Wallis H test for age and learning styles.

The study concludes that there are no gender, age, or learning style-related differences in the pre-test results. Additionally, the research reveals no appreciable variation in post-test scores among age and learning styles while significant difference was seen in post-test scores between males and females. Females performed better in the post-test as compared to males (See Table-4).

Table-4: Scores among Different Categorical Variables

Variable	Pre-test	Post-test
Gender		
Control		
Male	6.0 (3)	10.0 (4)
Female	7.0 (3)	14.0 (4)
p-value	0.161	0.001
Intervention		
Male	6.0 (4)	16.0 (2)
Female	6.0 (4)	18.0 (5)
p-value	0.195	0.020
Age		
Control		
16-18	6.0 (3)	13.0 (7)
19-21	6.0 (4)	12.0 (5)
22-24	6.0 (2)	6.50 (3)
p-value	0.948	0.976
Intervention		
16-18	7.50 (5)	17.50 (4)
19-21	6.0 (2)	16.50 (6)
22-24	13.0 (5)	19.0 (5)
p-value	0.156	0.493
Learning Style		
Control		
Diverging	7.0 (3)	11.0 (6)
Converging	6.0 (.)	15.50 (.)
Assimilating	6.0 (3)	14.0 (6)
Accommodating	5.50 (3)	13.0 (5)
p-value	0.193	0.054
Intervention		
Diverging	6.0 (5)	17 (5)
Converging	7.50 (3)	14.50 (5)
Assimilating	6.0 (3)	17.0 (4)
Accommodating	6.50 (2)	18.50 (5)
p-value	0.693	0.125

Scores of gender was compared by Mann-Whitney U test and scores among different learning styles and age groups was compared by Kruskal-Wallis H test. P-value of less than 0.05 was considered as significant.

Comparison of scores was found out between control and intervention group with respect to different learning styles which is shown in Table-5. The difference was compared by Mann-Whitney U test. The study concludes that there are no differences between control and intervention's pre-test results of all the learning styles while significant difference was seen between post-test scores of intervention and control group among all the learning styles (p-value less than 0.05) except convergers. No difference between control and intervention's

post-test scores was seen in the convergers group with p-value of 0.613 (See Table-5).

Table-5: Scores of Different Learning Styles in Control and Intervention

Learning Style	Control	Intervention	p-value
Diverging	n=35	n=39	
Pre-test	7.0 (3)	6.0 (5)	0.534
Post-test	11.0 (6)	17 (5)	<0.001
Converging	n=2	n=6	
Pre-test	6.0 (.)	7.50 (3)	0.495
Post-test	15.50 (.)	14.50 (5)	0.613
Assimilating	n=15	n=15	
Pre-test	6.0 (3)	6.0 (3)	0.457
Post-test	14.0 (6)	17.0 (4)	0.008
Accommodating	n=18	n=10	
Pre-test	5.50 (3)	6.50 (2)	0.244
Post-test	13.0 (5)	18.50 (5)	<0.001

Difference of scores among different learning styles was compared by Mann-Whitney U test. P-value of less than 0.05 was considered as significant.

Association among learning style, age and gender was assessed by chi-square test. The study finds no significant association of gender with learning style (p-value=0.717). The research also reveals no evidence of a substantial association between learning style and age (p-value=0.122).

Discussion

Participants in this research belong to generation Z with an age range of 17 to 24 years. Generation Z is the generation born between 1997-2012 with an age range of 11 to 26 years.[8] Similar finding has been reported by Simpson,[9] which shows that most of the undergraduate nursing students belong to the generation Z. Another study[10] has same finding which show that the age range of undergraduate nursing students is 15-24 years.

According to this study, divergent is the most popular learning method among undergraduate nursing students. The findings of other studies[1,3,11,12,13,14,15] are consistent with this result. This demonstrates that the divergent is the most prevalent learning style among undergraduate nursing students. This similarity may be as a result of having the same educational background.

In contrast to findings of other studies[12,16] which shows that convergent is the most prevalent learning style among undergraduate nursing students, this study found that convergent is the least common learning style among undergraduate nursing students with frequency of 8 (5.7%) only. The possible reason for this difference could be due to cultural difference which is one of the factors affecting learning styles. Similar results to this study have been reported[3,11,12] which demonstrates that convergent is the least popular learning style among undergraduate nursing students.

The present study indicates that students in the intervention group who were taught with matched learning style performed better in the post-test which is congruent with the results of other studies.[1,7,17] This proves that students who are taught with teaching method matched with their learning style give better test score as compared to students who are taught with mismatched teaching style.

Moreover, pre-test scores for the two groups (control and intervention) do not significantly differ from one another which is consistent with the findings of another study[1] which shows no significant difference of pre-test scores in intervention and control groups. Because these groups did not study the content prior to the pre-test, the outcomes were similar.

According to the findings of this study, participants' test scores and learning preferences do not differ significantly, which is consistent with the findings of Vizeshfar and Torabizadeh[1] who observed no significant difference between

academic performance and learning preferences. Since, there is no learning style that is superior to another, research that discovered no correlation between learning style and test score have also found comparable results.

The findings of this study show no association between test score and learning methods of the students. Research by Shirazi and Heidari[12] shows different findings from this study, which demonstrates significant relationship between learning preferences and academic performance of students. This discrepancy could be the result of a confounding factor in the aforementioned study.

In addition, this study found no difference between post-test score and age which is similar to the results of Vizeshfar and Torabizadeh[1] who found no difference between post-test score and age. Students in these studies belong to same generation (Z) because of which no difference was observed between age and post-test score.

Moreover, this study found significant difference of post-test score between males and females. Females performed better in the post-test as compared to males. P-value is 0.001 in the control group and 0.020 in the intervention group which is significant (p-value less than 0.05 was considered as significant). This result is contradictory to the findings of other studies[1,7] which shows no significant difference of post-test scores between males and females. The reason for this contradiction is unclear.

Furthermore, this study shows that convergers post-test scores did not differ significantly between intervention and control group with p-value of 0.613 which is contradictory to the findings of Shirazi and Heidari[12] which shows that academic achievement among accommodators is highest. This difference could be due to the number of participants in the group which is two in control and six in interventional. Both the groups might learnt more effectively due to the fewest number of students in convergent learning style.

Conclusion

This study found that dominant learning style of undergraduate nursing students is diverging and teaching based on dominant learning style improves learning score of students; therefore students' learning style should be taken into account while developing lesson plans, so that students learn more effectively and give better academic performance.

Declarations

Authors declared no conflict of interest.

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