

## Effectiveness of Structured Teaching Program on Knowledge Regarding Arterial Blood Gas Analysis among Nursing Students

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### Abstract

**Background and Objectives:** Arterial blood gas (ABG) analysis is an essential investigation for assessing clinical oxygenation and acid-base status in critically ill patients. Since the nurses and student nurses in critical care units are more involved in ABG interpretation as well as caring patients on ventilation, they have more knowledge. The purpose of the study was to assess the effectiveness of structured teaching program on knowledge regarding arterial blood gas analysis among nursing students.

**Methods and Materials:** A Quasi-experimental study design was conducted among Nursing Students of LMCTH (Lumbini Medical College and Teaching Hospital). A total of 65 respondents were participated using Census enumeration method. Data was collected through structured pre-tested ( $r=0.7$ ) questionnaire. Data was first entered, coded and analyzed by using SPSS V20. Descriptive and inferential statistics were used.

**Results:** Findings of this study revealed that during pre-test, majority of the respondents (70.8%) had average knowledge, only 15.3% of respondents had adequate knowledge and 13.9% had inadequate knowledge whereas during post-test majority of the respondents (63.1%) had adequate knowledge, 35.4% had average knowledge and only 1.5% had inadequate knowledge regarding Arterial Blood Gas analysis. Structured teaching program was highly significant at  $p$  value  $<0.001$ . There was significant association between age, educational level, exposure to critical areas and level of knowledge score on pre and post-test.

**Conclusion:** The study concluded that the mean post-test knowledge score (28.38) was higher as compared with the pre-test score (23.46). Thus, structured teaching program was effective in improving the level of knowledge of nursing students.

**Keywords:** Arterial blood gas analysis; Nursing students; Structured teaching program

### Introduction

Arterial Blood Gas (ABG) analysis is an essential laboratory investigation used for assessing clinical oxygenation, acid-base status in critically ill patients and the degree of compensation that has occurred [1]. Arterial blood gas studies are concerned with the exchange of gases between the lungs and blood and between blood and tissues. An ABG can be safely and easily obtained and furnishes rapid and accurate information on how the lungs and kidneys are working. It is the single most useful laboratory test in patients with the respiratory and metabolic disorders [2].

The status of acid-base homeostasis may be monitored clinically through the serial measurement of arterial blood gases (ABGs) among the parameters reported are pH (7.35-7.45),  $\text{PaO}_2$  (80-100 mmHg),  $\text{PaCO}_2$  (35-45 mmHg) and  $\text{HCO}_3^-$  (22-26 mEq/L). These values may be used to determine the presence of type of acid base imbalances and evaluate the level of compensation. These disorders are not clinical diagnosis or diseases in themselves rather; they are clinically syndromes, associated with a wide variety of diseases [3-6].

Nurses play an important role in early detection of high-risk clients with acid-base imbalance in critical care units. The nurse collaborates in the administration of drug therapy, oxygen therapy and mechanical ventilation when indicated. In extreme circumstances in which therapeutic compensation is required, the nurse should be knowledgeable about potential risks of this therapy and able to carefully monitor administration rates and therapeutic responses. Correct interpretation of arterial blood gas is very essential, as misinterpretation can lead to serious complications like electrolyte imbalance, muscle weakness, narcosis, respiratory failure, organ failure, seizures, chronic kidney disease, arrhythmias, coma, shock and death [4,7].

Pre-experimental, two-group pre-test, post-test design in Bombay Hospital College of Nursing, Indore among 40 B.Sc. Nursing students revealed that during the pre-test, in the experimental group, majority (90%) had average knowledge and 10% had poor knowledge. From this, it is concluded that future nurses have no good knowledge regarding ABG-analysis which will leads to compromised quality care to the patient. Then structured teaching program was conducted in the experimental group and post-test was taken. Many of nursing students i.e., (80%) had good knowledge and 20% had average knowledge [2].

Similarly, a pre experimental one group pre-test post-test design conducted among 60 ICU nurses at selected hospitals, Jalandhar showed that there was improved knowledge on ABG-analysis after Structured Teaching Program from 11.7% to 66.7% [8].

In many countries, nurses are expected to be safe and fully competent practitioners upon completing their undergraduate nursing program. However, literature suggests that opportunities to practice in critical care usually scarce during undergraduate programs. This reality could have a negative impact on the development of competence of future newly qualified healthcare professionals, increasing the occurrence of mistakes and compromising patients' safety [9,10].

In many faculties around the country and around the world, budgets for innovation in teaching and learning are limited. This does not only apply to the acquisition of new equipment, but also to the amount of human resources dedicated to educate nursing students. Therefore, nursing educators should take into consideration that successful educational strategies must focus on the equal development of the cognitive, psychomotor and attitudinal domains of competence [10].

Nepal, as a developing country, is facing these above problems. There are very few researches carried out on knowledge on ABG analysis among nurses and student nurses in Nepal. So, considering such problems, researchers interested to conduct this study to assess the effectiveness of structured teaching Program in improving the knowledge on ABG analysis among nursing students. The findings of this study would be helpful for the concerned authority to plan the educational program such as teaching/learning session, workshop for nursing students as well as nurses which can better to add in their knowledge.

## Materials and Methods

A Quasi-experimental study design was conducted to assess the effectiveness of structured teaching program on knowledge regarding Arterial Blood Gas analysis among Nursing Students of PCL and B.Sc. Nursing 3rd year students of Lumbini Medical College and Teaching Hospital (LMCTH), Palpa, Nepal. Total of 65 respondents were participated using Census enumeration method.

The self-structured questionnaire was developed by studying and reviewing the related literature. The content and face validity of the instrument was tested by panel of expertise. On the basis of feedback given, required modification of tool was done. Prior to the commencement of the study, ethical permission was obtained from ethical and research committee of college. After gaining approval, permission was taken from the college authority before the collection of data.

Structured questionnaire was pre-tested in 10% of the total sample size (i.e., 7) which is conducted in Devdaha College of Science and Technology, Butwal, Nepal. Reliability of the tool was measured by Cronbach's Alfa and it was found to be 0.9. Then, written permission was obtained from the LMCTH and the verbal informed consent was taken from each respondent, Pre-testing was performed by distributing semi-structured questionnaire to the respondents to assess the effectiveness of structured teaching program on knowledge regarding arterial blood gas analysis. The subject was assured for the confidentiality of the information and the respondent was allowed for refusing to participate in the study at any time if they wish. Then, structured teaching program was conducted. Appreciation was given

to all the respondents for their cooperativeness. After 7 days, the respondents were requested to come to same venue and time for post-test where questionnaire was distributed to the respondents. Data was collected from 26th January to 8th February 2019. At first, the collected data were edited for the completeness, consistency and accuracy. Then data were first entered, coded and analyzed by using SPSS V20. Descriptive and inferential statistics were used.

## Results

The study results were presented in socio-demographic variables of the respondents, Level of knowledge on pre-test and post-test, effectiveness of structured teaching program on knowledge regarding arterial blood gas analysis, comparison between Mean and Standard deviation of knowledge on different aspects of arterial blood gas analysis, association between Level of knowledge on pre-test and post-test score and selected independent variables. Analyzed data were presented through tables.

Variables		Frequency	Percentage
Age in years	≤20	27	41.5
	>20	58	58.5
(Mean ± SD=19.99 ± 4.33)	Total	65	100
Educational level	PCL Nursing	40	61.5
	B.Sc. Nursing	25	38.5
	Total	65	100
Observed ABG analysis procedure	Yes	58	89.2
	No	7	10.8
	Total	65	100
Performed ABG analysis procedure	Yes	7	10.8
	No	58	89.2
	Total	65	100
Attended ABG analysis classes/ presentations	Yes	45	69.2
	No	20	30.8
	Total	65	100
Exposure to Critical Areas	Yes	57	87.70%
	No	8	12.30%
	Total	65	100%
			n=65

**Table 1:** Socio-demographic variables of respondents.

Table 1 shows that more than half of the respondents (58.5%) fall under the age range of ≤ 20 and followed by 41.5% of the respondents fall under the age range of above 20. Likewise, more than half of the respondents (61.5%) were PCL nursing whereas only 38.5% of the respondents were B.Sc. nursing students. Regarding ABG analysis procedure, most of the respondents (89.2%) had observed ABG analysis procedure during posting whereas minimum of the respondents (10.8%) had not observed ABG analysis procedure.

Likewise, most of the respondents (89.2%) had not performed ABG analysis procedure during posting whereas only (10.8%) of the respondents had performed ABG analysis during posting. More than 2/3 of the respondents (69.2%) had attended ABG analysis related class/presentation whereas about only 1/3 of the respondents (30.8%) had not attended ABG analysis related classes/presentations. Similarly, most of the respondents (87.7%) had clinical exposure to the critical areas and only (12.3%) of the respondents had no clinical exposure to the critical areas.

Pre-test			Post-test	
Level of Knowledge	Frequency	Percentage	Frequency	Percentage
Inadequate knowledge	9	13.9	1	1.5
Average knowledge	46	70.8	23	35.4
Adequate knowledge	10	15.3	41	63.1

**Table 2:** Respondent’s level of knowledge on pre-test and post-test Score n=65.

Test	Mean	S.D.	Std Error Mean	Mean difference	Paired t-test	Df	p-value
Pre-test	23.46	4.139					
Post-test	28.38	3.652	0.642	4.923	7.644	64	0.00*

df= Degree of Freedom \*Level of Significance (p= 0.05)

**Table 3:** Effectiveness of structured teaching program on knowledge regarding ABG analysis.

Table 2 depicts that on pre-test, majority of respondents (70.8%) had moderately adequate knowledge whereas only 15.3% of

Variables		Mean	S.D.	t-value	df	p-value
Age	≤20	19.908	1.4331	7.524	64	0.00*
	>20	19.91	1.433	-	-	-
Educational level	PCL Nursing	21.78	4.022	-	-	-
	B.Sc. Nursing	26.16	2.656	4.826	63	0.00*
Observed ABG analysis procedure	Yes	28.07	3.68	-	-	-
	No	31	2.16	2.056	63	0.158
Performed ABG analysis procedure	Yes	27.29	2.812	-	-	-
	No	28.52	3.738	0.841	63	0.401
Attended ABG analysis related classes/presentations	Yes	27.8	3.865	-	-	-
	No	29.7	2.744	1.98	63	0.145
Exposure to the critical areas	Yes	28.61	3.272	-	-	-

respondents had adequate knowledge and minority of the respondents (13.9%) had inadequate knowledge regarding ABG analysis. Similarly, on post-test, majority of respondents (63.1%) had adequate knowledge whereas 1/3 of the respondents (35.4%) had moderately adequate knowledge and only 1.5% the respondents had inadequate knowledge regarding ABG analysis.

Table 3 reveals that pre-test mean was 23.46 and S.D. 4.139. Similarly, in post-test mean was 28.38 and S.D. 3.652. The enhancement mean was 4.923. Paired ‘t’ test value is 7.644. Effectiveness of structured teaching program on knowledge regarding arterial blood gas analysis was highly significant at p-value<0.001.

Aspects	Pre-test		Post-test		t value
	Mean score	S.D.	Mean score	S.D.	
Introduction of ABG analysis	4.45	0.613	4.58	0.659	1.35
Procedure of ABG analysis	10.63	1.957	13.34	1.822	9.111
Reference range and interpretation	8.38	2.865	10.46	2.244	4.693

S.D.=Standard Deviation, where n=65

**Table 4:** Comparison between mean and standard deviation of knowledge on different aspects of arterial blood gas analysis.

Table 4 indicates that on pre-test mean score on Introduction of ABG analysis was 4.45 with Standard deviation 0.613 whereas in post-test mean score was 4.58 with S.D. 0.659. The ‘t’ value for combined mean score was 1.350. Likewise, pre-test mean score on Procedure of ABG analysis was 10.63 with S.D. 1.957 and in post-test mean score was 13.34 with S.D. 1.822 and combined ‘t’ value was 9.111. Likewise, on Reference range and interpretation aspect pre-test mean score was 8.38 with S.D. 2.865 and post-test mean score was 10.46 with S.D. 2.244 and combined ‘t’ value is 4.693.

	No	26.75	5.726	1.361	63	0.023*
df= Degree of freedom *Level of significance (p= 0.05)						

**Table 5:** Association between level of knowledge on pre-test score and independent variables.

Table 5 shows that there was significant association between selected demographic variables; age (p=0.00), educational level (p=0.00) and level of knowledge score on pre-test. There was no any significant association between level of knowledge score on pre-test and observed ABG analysis procedure (p=0.158), performed ABG

analysis procedure (p=0.401) and attended ABG related class/presentation (p=0.145). But there was significant association between exposure to critical areas (p=0.023) and level of knowledge score on pre-test.

Variables		Mean	S.D.	t-value	Df	p-value
Age	≤ 20	19.91	1.433	-	-	-
	>20	28.38	3.652	18.865	64	0.00*
Educational level	PCL Nursing	27	3.755	-	-	-
	B.Sc. Nursing	30.6	2.082	4.964	62	0.00*
Observed ABG analysis procedure	Yes	28.07	3.694	-	-	-
	No	31	1.915	2.056	63	0.099
Performed ABG analysis procedure	Yes	29.71	2.36	-	-	-
	No	28.22	3.761	1.02	63	0.209
Exposure to Critical Areas	Yes	28.96	3.327	-	-	-
	No	24.25	3.327	3.753	63	0.00*
df= Degree of freedom *Level of Significance (p=0.05) where n=65						

**Table 6:** Association between level of knowledge on post-test score and independent variables.

Table 6 shows that there was significant association between selected socio-demographic variables: Age (p=0.00), educational level (p=0.00) and level of knowledge score on post-test. There was no any significant association between level of knowledge score on post-test and observed ABG analysis procedure (p=0.099), performed ABG analysis procedure (0.209). But there was significant association between exposure to critical areas (p=0.00) and level of knowledge score on post-test.

## Discussion

This study was conducted to assess the effectiveness of structured teaching program on knowledge regarding Arterial Blood Gas analysis among nursing students of LMCTH, Palpa. Total of 65 PCL and B.Sc. Nursing 3rd year students were taken for the purpose of the study.

This study revealed that more than half of the respondents (58.5%) fall under the age range of ≤ 20 whereas less than half of the respondents (41.5%) fall under the age range of above 20. This finding was contradictory with the findings of study conducted in Indore where majority of the respondents (67.5%) were in the age group of above 20 years and 32.5% were in the age group of ≤ 20 years [2].

Likewise, in terms of educational level more than half of the respondents (61.5%) were PCL nursing whereas only 38.5% of the respondents were B.Sc. nursing students. Similarly, most of the

respondents (87.7%) had clinical exposure to the critical areas and minority of the respondents (12.3%) had no clinical exposure to the critical areas. The above result was supported by the study conducted in Bombay Hospital College of Nursing, Indore, India in which majority of the students (85%) had exposure to critical areas and only 15% had no exposure to critical areas [2].

This study represented that most of the respondents (89.2%) had observed ABG analysis procedure whereas only 10.8% of the respondents had not observed ABG analysis procedure. Likewise, most of the respondents (89.2%) had not performed ABG analysis procedure whereas only 10.8% of the respondents had performed ABG analysis during posting. Similarly, 2/3 of the respondents (69.2%) had attended ABG analysis related class/presentation whereas 1/3 of the respondents (30.8%) had not attended ABG analysis related class/presentation.

This study revealed that on pre-test, majority of respondents (70.8%) average knowledge whereas only (15.3%) of respondents had adequate knowledge and minority of the respondents (13.9%) had inadequate knowledge regarding ABG analysis which was inconsistent with the result obtained from the study conducted in Chennai where 90% of the staff nurses had inadequate knowledge and 10% had average knowledge during pre-test [11].

Similarly, on post-test, majority of respondents (63.1%) had adequate knowledge whereas less than half of the respondents (35.4%) had average knowledge and only 1.5% of the respondents had

inadequate knowledge regarding Arterial Blood Gas analysis which was consistent with the result obtained from the study conducted in Chennai where majority of the staff nurses (80%) had adequate knowledge and only 20% had average knowledge during post-test [11].

This study showed that pre-test mean was 23.46 and S.D. 4.139. Similarly, in post-test mean was 28.38 and S.D. 3.652. The enhancement mean was 4.923. Paired 't' test value is 7.644. Effectiveness of structured teaching program on knowledge regarding arterial blood gas analysis was highly significant at p value <0.001 which was supported by the study conducted in Bombay in which post-test mean was 24.10 which was higher as compared with the pre-test mean 14.7. The p-value of experimental group was less than 0.05. Therefore, there was a difference in the knowledge level of B.Sc. Nursing students after the administration of Structured Teaching Program. Hence, alternative hypothesis (H1) was accepted [2].

This study revealed that there was significant association between selected demographic variables: age ( $p=0.00$ ), educational level ( $p=0.00$ ) and level of knowledge score on pre-test. Also, there was significant association between exposure to critical areas ( $p=0.023$ ) and level of knowledge score on pre-test. This finding was contradictory with the findings of studies conducted in Punjab, Bombay and Chennai where the socio-demographic variables had no significant association with level of knowledge on pre-test score. But there was not any significant association between observed ABG analysis procedure ( $p=0.158$ ), performed ABG analysis procedure ( $p=0.401$ ), attended ABG analysis related class/presentation ( $p=0.145$ ) and level of knowledge score on pre-test. The above result was supported by studies conducted in Punjab, Bombay and Chennai where the socio-demographic variables had no significant association with level of knowledge on pre-test [2,8,11].

During post-test there was significant association between selected socio-demographic variables: age ( $p=0.00$ ), educational level ( $p=0.00$ ) and level of knowledge score on post-test. Also there was significant association between attended ABG analysis related class/presentation ( $p=0.00$ ) and level of knowledge score on post-test which was contradictory with the finding of studies conducted in Punjab, Bombay and Chennai where the socio-demographic variables had no any significant association with level of knowledge on post-test score. But there was no any significant association between observed ABG analysis procedure ( $p=0.099$ ), performed ABG analysis procedure ( $p=0.209$ ) and level of knowledge score on post-test. The above result was supported by the finding of studies conducted in Punjab, Bombay and Chennai where the socio-demographic variables had no significant association with level of knowledge on pre-test score [2,8,11].

## Conclusion

Based on the findings of the present study, it can be concluded that most of the nursing students have deficit in knowledge related to ABG analysis pre teaching program. The mean post-test knowledge scores were higher than the mean pre-test knowledge scores. Structured teaching program had significant effect on the level of knowledge of nursing students. Thus, nursing students should be exposed in critical areas and should perform ABG analysis procedure as much as possible for enhancing the knowledge related to ABG analysis.

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