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ASSESSMENT OF AVAILABILITY AND UTILIZATION OF BIOLOGY LABORATORY FACILITIES IN PUBLIC SECONDARY SCHOOLS IN EBONYI STATE

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Abstract

The study assessed the availability and utilization of Biology laboratory facilities in public secondary schools in Ebonyi State, Nigeria. A descriptive survey research design was adopted for the study. The population comprised 672 Biology teachers in public secondary schools across Ebonyi State. A sample was selected from the 13 Local Government Areas (LGAs) using a stratified sampling technique. The instrument for data collection was a structured questionnaire titled "Availability and Utilization of Biology Laboratory Facilities Questionnaire" (AUBLFQ). The questionnaire was designed using a modified four-point rating scale: Very High Extent (VHE = 4), High Extent (HE = 3), Low Extent (LE = 2), and Very Low Extent (VLE = 1). The instrument was subjected to face and content validation by a Senior Lecturer in Measurement and Evaluation at Niger Delta University, Bayelsa State, Nigeria. Its reliability was established through a pilot study involving 20 Biology teachers from public secondary schools outside the study area but with similar characteristics. The data obtained were analyzed using Cronbach's Alpha, which yielded a reliability coefficient of 0.981, exceeding the acceptable benchmark of 0.71 and indicating high internal consistency. Of the 663 copies of the questionnaire distributed, 600 were duly completed and returned for analysis. The research questions were answered using mean and standard deviation, with a criterion mean of 2.50, while the null hypotheses were tested using the t-test at a 0.05 level of significance. The findings revealed that the availability and utilization of Biology laboratory facilities in public secondary schools in Ebonyi State were generally low. The study concluded that inadequate availability and utilization of laboratory facilities hinder the effective implementation of Biology as a subject in public secondary schools in the state. It therefore recommended, among other measures, that the Ebonyi State Government should ensure the provision of adequately equipped Biology laboratories in public secondary schools to enhance effective teaching and learning.

***Keywords**: Biology, Education, Teachers, Utilization, Availability, Utilization, Science.*

Introduction

Biology education has been viewed as a critical driver of scientific advancement, technological innovation, and sustainable national development. It equips learners with the knowledge, skills, and competencies required to solve societal problems and contribute meaningfully to economic development. As one of the core science subjects taught at the secondary school level, Biology occupies a strategic position in the Nigerian educational system because it provides students with fundamental knowledge of living organisms and their interactions with the environment. It also serves as a prerequisite for careers in medicine, nursing, pharmacy, agriculture, biotechnology, environmental science, and other life science disciplines (Federal Republic of Nigeria [FRN], 2013).

Biology is both theoretical and practical in nature. Consequently, its effective teaching and learning require adequate practical experiences that enable students to

observe, experiment, investigate, and verify biological concepts through laboratory activities. Practical instruction not only enhances students' understanding of abstract concepts but also develops scientific inquiry, critical thinking, problem-solving, and manipulative skills necessary for scientific and technological development (Hofstein & Lunetta, 2004). In recognition of this, the National Policy on Education emphasizes the provision and effective utilization of science laboratories to facilitate the implementation of the science curriculum in secondary schools (FRN, 2013).

Biology laboratory facilities consist of laboratory buildings, microscopes, hand lenses, prepared slides, glassware, models, specimens, chemicals, reagents, laboratory furniture, charts, safety equipment, water supply, electricity, and other instructional materials required for practical instruction. The availability and effective utilization of these facilities are indispensable for achieving the objectives of the Biology curriculum. When laboratory facilities are adequate and properly utilized, Biology teachers are able to provide meaningful practical experiences that improve students' scientific process skills, academic achievement, and interest in the subject (West African Examinations Council [WAEC], 2024). the present study seeks to assess the availability and utilization of Biology laboratory facilities in public secondary schools in Ebonyi State. Specifically, the study will determine the availability of Biology laboratory facilities, examine the extent to which they are utilized by Biology teachers, identify the challenges affecting their effective utilization, and propose strategies for improving laboratory-based Biology teaching and learning in public secondary schools in Ebonyi State.

Statement of the Problem

The Biology curriculum in Nigerian secondary schools is designed to develop students' scientific knowledge, practical skills, and scientific inquiry competencies through effective laboratory-based instruction. To achieve these objectives, public secondary schools are expected to provide adequate Biology laboratory facilities and ensure that such facilities are effectively utilized during teaching and learning. Practical laboratory experiences are essential for helping students understand biological concepts, develop manipulative skills, and prepare for science-related careers as well as further education (Federal Republic of Nigeria [FRN], 2013). Several empirical studies have examined the availability and utilization of Biology laboratory facilities in different parts of Nigeria. For instance, Nwagbo (2017) reported that many secondary schools in Enugu State lacked adequate Biology laboratory facilities and that available facilities were not regularly utilized for practical instruction. Similarly, Okoli (2018) found low utilization of science laboratory facilities in Anambra State due to inadequate funding, overcrowded classrooms, and shortage of laboratory personnel. Ajayi and Yusuf (2020) further observed that schools with adequately equipped and effectively utilized Biology laboratories recorded better practical instruction and higher levels of students' participation than schools with inadequate laboratory facilities. These findings demonstrate that laboratory facilities are indispensable for effective Biology teaching and learning. Despite these findings, concerns remain regarding the situation in public secondary schools in Ebonyi State.

Aim of the Study

The study aimed to assess availability and utilization of Biology laboratory facilities in public secondary schools in Ebonyi State, with the following specific objectives:

1. Determine the availability of Biology laboratory facilities in public secondary schools in Ebonyi State;

2. Examine the extent to which Biology laboratory facilities are utilized by Biology teachers in public secondary schools in Ebonyi State;

Research Questions

The following research questions guided the study:

1. what is the level of availability of Biology laboratory facilities in public secondary schools in Ebonyi State?

2. What is the utilization level of Biology laboratories in public secondary schools in Ebonyi State?

Research Hypotheses

The following null hypotheses will be tested at the 0.05 level of significance:

H_{01}: There is no significant difference in the mean ratings of Biology teachers in urban and rural public secondary schools on the availability of Biology laboratory facilities in Ebonyi State.

H_{02}: There is no significant difference in the mean ratings of male and female Biology teachers on the extent of utilization of Biology laboratory facilities in public secondary schools in Ebonyi State.

Literature Review

Theoretical Review

The theory of utilitarianism which was first propounded by Jeremy Bentham (1748) as cited by Nwele (2022) was used to anchor this research. The main tenets of this theory are to advocate for actions and ideas that benefit the greatest number of people in the best way possible. Utilitarianism, in this sense, holds that utility should be maximized and this

is interpreted as being synonymous with well-being, benefits, or positive results. The founder of utilitarianism, Jeremy Bentham, defined utility as the ability of an action or object to have a positive effect and to aid functioning. The theory is relevant for the present study as it is about the importance of facilities to be available and effectively used in Biology laboratories, which is the central argument of the study. In this regard, the provision and proper utilization of laboratory facilities should bring welfare for both teachers and students by improving the level of teaching effectiveness, encouraging students to be active in practical activities and improving students' learning outcomes.

Utilization of Biology Laboratories

Nwagbo (2017) studied the use of Biology laboratory facilities and students' academic performance in secondary schools in Enugu state. A descriptive survey research design was used in the study. A multistage sampling technique was used to select a representative sample from the population, which consisted of Biology teachers and Senior Secondary School students from public secondary schools in Enugu State. A structured questionnaire and an observation checklist were used to gather data and appropriate descriptive statistical methods applied to analyse the data. The results showed that there were some laboratory facilities available in the schools, but a large number of schools did not have sufficient laboratory equipment and teaching aids. The study also revealed that the laboratory facilities available were not used regularly as a result of the lack of teacher preparation, limited time available for laboratory work, and poor maintenance of laboratory equipment.

Likewise, Okoli (2018) studied the utilisation of laboratory equipment for effective science teaching in public secondary schools in Anambra State. This study used a descriptive survey research design. The population was science teachers in public secondary schools in Anambra State, while a representative sample was selected using a suitable sampling techniques. A validated questionnaire was used for data collection and mean and standard deviation were used for data analysis. The results have shown that the use of the laboratory facilities was generally low, although a few essential laboratory facilities were available. The study revealed that the low level of funding, overcrowding of classrooms, lack of laboratory assistants and inadequate supervision are critical constraints on the effective use of laboratory facilities.

Availability of Biology Laboratories

The availability of science laboratory facilities and its effect on the effectiveness of teaching biology in public secondary schools in Kwara state was studied by Ajayi and Yusuf (2020). The researchers used descriptive survey research design. The population consisted of Biology teachers and school principals in the public secondary schools of Kwara State which were sampled using stratified sampling technique. Structured questionnaire was used to collect data and descriptive statistical methods were used to analyze the collected data. The study showed that schools that are well equipped with Biology laboratories are able to give better practical teaching and have better participation by students than schools with poorly equipped laboratory. The study suggested that the government could provide more funding for the laboratory facilities and provide regular professional training for Biology teachers on how to manage the laboratory.

Eze and Nwafor (2021) conducted a study on the level of availability and utilization of Biology laboratory facilities in public secondary schools in South-East Nigeria. A descriptive survey research design was used in this study. The study targeted all Biology teachers in public secondary schools in selected states of South-East Nigeria where a representative sample was selected by multistage sampling technique. Structured questionnaires were used to gather data and the mean scores were used for the analysis. The results revealed that some schools had basic laboratory facilities, but many schools did not have sufficient modern laboratory equipment and/or laboratory teaching materials, and some of the laboratory teaching materials were outdated. Further, the study found that the poor maintenance practices, lack of adequate funding and irregular supply of electricity caused poor utilization of the available lab facilities.

Adebayo and Ibrahim (2022) conducted a study on teachers' utilization of Laboratory facilities and students' performance in Biology in public secondary schools in Oyo state. The study used correlational research design. The population consisted of Biology teachers and Senior secondary School students of public secondary schools in Oyo State from which samples were taken by simple random sampling technique. The methods used to collect and analyze data were questionnaire and students' academic achievement records analysis by Pearson Product-Moment Correlation Coefficient. The results showed that there was a significant positive correlation between teachers' use of laboratory facilities and students' achievement in Biology. The researchers found that often involvement in practical activities contributed to the understanding of biological concepts by students and suggested that continuous professional development programme should be undertaken by teachers in Biology.

Methods

This study adopted a descriptive survey research design. The population of the study was 672 which comprised of all Biology teachers in public secondary schools in Ebonyi

State (source: https://napid.net/view_student_research?ndn=NDN-PRJ-259726473177566182 1 and Ebonyi State Secondary Education Board (SEB). A sample of 51 Biology teachers were selected from each of the 13 LGAs in Ebonyi State, using stratified sampling technique to arrive at 663 respondents. The instrument for data collection was a structured questionnaire titled "Availability and Utilization of Biology Laboratory Facilities Questionnaire (AUBLFQ)." as detailed in Appendix I. The questionnaire was structured on a modified four-point Likert scale of Very High Extent (VHE = 4), Agree (High Extent = 3), Low Extent (LE = 2), and Very Low Extent (VLE = 1). The questionnaire was subjected to face and content validation by Measurement and Evaluation Senior Lecturer at the Niger Delta University, Bayelsa State, Nigeria.

The reliability of the instrument was determined through a pilot study involving 20 Biology teachers from public secondary schools outside the study area but with similar characteristics. The data obtained was analyzed using Cronbach's Alpha and obtained thus: .981>.71 indicating that the instrument was reliable.

Reliability Statistics

Cronbach's Alpha	N of Items
.981	16

Out of 663 copies of questionnaire distributed, 600 representing 84% were duly completed and returned and the study used the returned copies for its analysis. The research questions were answered using Mean and Standard Deviation at 2.5 mean benchmark, while the null hypotheses were tested using t-test at .05 significance level.

Results

Demographic Representation of Respondents

Table 1: gender of respondents

Gender	Frequency	Percent
Male	264	44.0
Female	336	56.0
Total	600	100.0

Table one above showed there were 264 male respondents representing 44%. Female respondents were 336 or 56%. There were more of Female respondents.

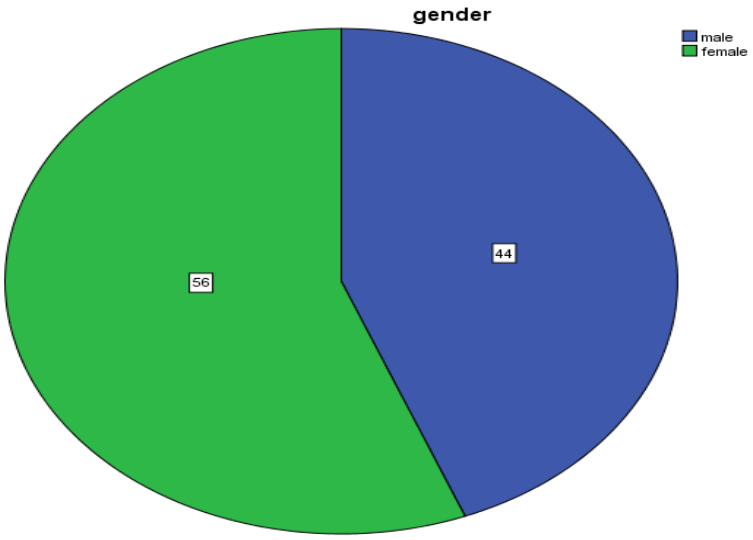
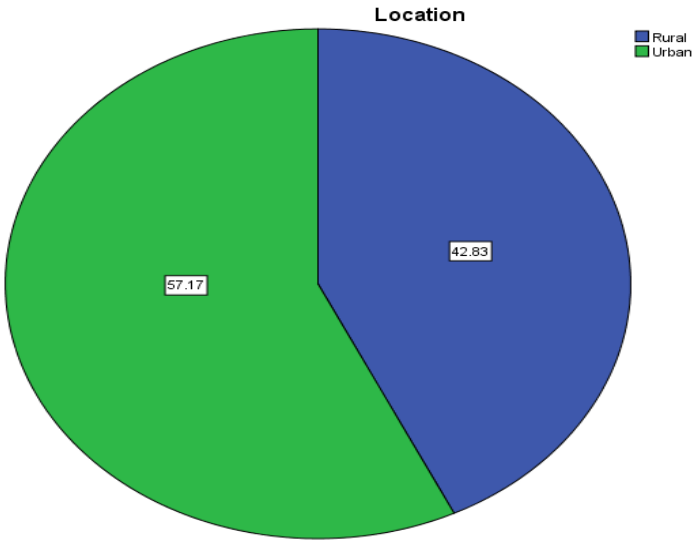


Table 2: Location of respondents

Location	Frequency	Percent
Rural	257	42.8
Urban	343	57.2
Total	600	100.0

Table 2 above showed there were 257 representing 42.8% respondents from rural areas of Ebonyi State, while 343 or 57.2% were respondents from the urban areas.



Answer to Research Questions

Research Question 1: what is the level of availability of Biology laboratory facilities in public secondary schools in Ebonyi State?

Table 3: Mean and Standard Deviation of the level of availability of Biology laboratory facilities in public secondary schools in Ebonyi State.

S/N	Items	N=600	Mean	Std. Deviation	Remark
1.	Biology laboratory is available in my school		2.78	1.68	High Extent
2.	Functional microscopes are available in the Biology laboratory		2.26	1.59	Low Extent
3.	Laboratory glassware (beakers, test tubes, measuring cylinders, etc.) is adequate		1.84	1.06	Very Low Extent
4.	Biology specimens and models are available for practical lessons		1.92	1.01	Very Low Extent
5.	Chemicals and reagents required for Biology practicals are available		2.16	1.48	Very Low Extent
6.	The Biology laboratory has adequate water and electricity supply		2.32	1.78	Low Extent
7.	Safety equipment (fire extinguisher, first aid box, gloves, etc.) is available.		2.32	1.19	Low Extent
8.	Laboratory furniture and storage facilities are adequate		2.36	1.57	Low Extent
Grand Mean			**2.24**	**1.42**	**Low Extent**

Table 3 above showed in item 1 that low extent with mean score of 2.78 and STD 1.68 high extent that there are Biology laboratory is available in my school. In item 2 mean score of 2.26 and 1.59 showed low extent that on functional microscopes are available in the Biology laboratory. Item 3 showed mean score of 1.84 and 1.06 implied low extent that Laboratory glassware (beakers, test tubes, measuring cylinders, etc. is adequate. Item 4 with mean score of 1.92 and 1.01 indicates low extent on the availability of Biology specimens and models are available for practical lessons. Item 5 with 2.16 and STD 1.46 equally showed extent on the availability chemicals and reagents required for Biology practicals are available. Item 6 showed mean score of 2.32 and STD 1.78 implied low extent on the availability Biology laboratory has adequate water and electricity supply. Item 7 showed in item 7 mean score of 2.32 and STD 1.19 on availability safety equipment (fire extinguisher, first aid box, gloves, etc. Item 8 showed low extent on the availability of laboratory furniture and storage facilities are adequate with the mean score of 2.36 and STD 1.57. Thus grand mean score of 2.24<2.5 implies low extent on the level of availability of availability of Biology laboratory facilities in public secondary schools in Ebonyi State.

Research Question 2: What is the utilization level of Biology laboratories in public secondary schools in Ebonyi State?

Table 4: Mean and Standard Deviation of the utilization level of Biology laboratories in public secondary schools in Ebonyi State.

Descriptive Statistics

S/N	Items	N=600	Mean	Std. Deviation	Remark
9.	regularly conduct Biology practical lessons		2.30	1.61	Low Extent
10.	Students frequently use laboratory equipment during practical lessons		1.36	.48	Very Low Extent
11.	Available laboratory facilities are adequately utilized during Biology instruction		1.92	1.27	Very Low Extent
12.	Biology practical activities are conducted according to the curriculum		1.16	.36	Very Low Extent
13.	Laboratory facilities enhance students' understanding of Biology concepts		2.70	1.36	High Extent
14.	I encourage students to participate actively in practical activities		2.41	1.54	Low Extent
15.	Laboratory equipment is properly maintained after use		1.80	1.05	Very Low Extent
16.	Biology practical lessons are conducted regularly throughout the academic session		1.88	1.03	Very Low Extent
	Grand Mean		**1.94**	**1.08**	**Very Low Extent**

Table 4 above showed in item 9 mean score of 2.30 and STD 1.61 indicating low extent on the regularity of conduct Biology practical lessons. Item 11 with mean score of 1.36 and STD .48 indicates very low extent that students frequently use laboratory equipment during practical lessons. Item 12 equally showed very low extent that available laboratory facilities are adequately utilized during Biology instruction with mean score of 1.16 and .36. Item 13 with mean score of 2.70 and 1.36 indicates high extent that Laboratory facilities enhance students' understanding of Biology concepts. Item 14 with mean score of 2.41 and STD 1.54 equally indicate low extent that respondents encourage students to participate actively in practical activities. In item 15 showed very extent that laboratory equipment is properly maintained after use with mean score of 1.80 and 1.05. Item 16 with mean score of 1.88 and STD 1.03 showed very low extent that Biology practical lessons are conducted regularly throughout the academic session.

Thus, grand mean score of 1.94<2.5 showed very low extent on the utilization of utilization level of Biology laboratories in public secondary schools in Ebonyi State

Test of Null Hypotheses

Ho_1: There is no significant difference in the mean ratings of Biology teachers in urban and rural public secondary schools on the availability of Biology laboratory facilities in Ebonyi

Table 5: T-test analysis of significant difference in the mean ratings of Biology teachers in urban and rural public secondary schools on the availability of Biology laboratory facilities

Variables	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Urban Biology teachers	34.591	599	.000	2.38000	2.2449	2.5151
Rural Biology Teachers	49.994	599	.000	3.26500	3.1367	3.3933

Table 5 above showed t- value of 34.591 for Urban Biology teachers and 49.994 for rural Biology teachers, degree of freedom value of 599, and mean difference of .88 and sig value of .000<.05 implies significant difference in the mean ratings of Biology teachers in urban and rural public secondary schools on the availability of Biology laboratory facilities. The null hypothesis is therefore rejected.

H0₂: There is no significant difference in the mean ratings of male and female Biology teachers on the extent of utilization of Biology laboratory facilities in public secondary schools in Ebonyi State.

Table 6: T-test analysis of significant difference in the mean ratings of male and female Biology teachers on the extent of utilization of Biology laboratory facilities in public secondary schools in Ebonyi State.

Variables	Test Value = 0					
	T	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Female Biology Teachers	34.843	599	.000	2.30000	2.1704	2.4296
Male Biology Teachers	69.344	599	.000	1.36000	1.3215	1.3985

Table 6 above showed t- value of 34.843 for female Biology teachers and 69.344 for male Biology teachers, degree of freedom value of 599, and mean difference of 34.50 and sig value of .000<.05 implies significant difference in the mean ratings of male and female Biology teachers on the extent of utilization of Biology laboratory facilities in public secondary schools in Ebonyi State. The null hypothesis is therefore rejected

Summary of Findings

The summary of the study is hereunder summarized:

1. There is low level of availability of Biology laboratory facilities in public secondary schools in Ebonyi State?

2. There is very low-level utilization level of Biology laboratories in public secondary schools in Ebonyi State?

3. There is a significant difference in the mean ratings of Biology teachers in urban and rural public secondary schools on the availability of Biology laboratory facilities in Ebonyi State.

4. There is a significant difference in the mean ratings of male and female Biology teachers on the extent of utilization of Biology laboratory facilities in public secondary schools in Ebonyi State.

Discussion of Findings

Level of availability of Biology laboratory facilities

The findings of the study are hereunder discussed based on the objectives of the study:

The study aimed to find out the status of the availability of Biology laboratory facilities in public secondary schools in Ebonyi State. The results showed that the overall level of Biology laboratory facilities in these schools was generally not high. In addition, the test on Hypothesis One yielded significant difference in the mean ratings of the Biology teachers on urban and rural public secondary schools on the availability of Biology laboratory facilities in Ebonyi State. This shows that there was variation in the teachers' perceptions of level of facility availability depending on school location, but the level of availability was still low overall. The result of the present study is in tandem with Nwagbo (2017) who studied the utilization of Biology laboratory facilities and students' academic achievement in secondary schools in the neighbouring state of Ebonyi, Enugu State. The study identified that some Biology laboratory facilities were available in the schools, but many schools did not have sufficient laboratory set-ups and the teaching materials. It also confirmed that the facilities available were not used regularly because of the lack of preparation of teachers, the lack of time for laboratory activities, and the poor condition of the laboratory equipment. The results of the present study, however, were slightly different from the study conducted by Okoli (2018) which indicated that availability of laboratory facilities is closely related to their utilization. This means that the provision of laboratory facilities is not enough to have the desired educational impact without effective and frequent use of the facilities.

Level utilization level of Biology laboratories

The study focused on the level of utilization of the Biology laboratory facilities in public secondary schools of Ebonyi State. The second hypothesis was tested to find out if there is any significance difference between the mean rating of the male and female Biology teachers in the extent of utilization of Biology laboratory facilities in public secondary schools in the State. The results indicated that there was very low utilization of Biology laboratory facilities among both male and female Biology teachers, but no significant difference in the mean ratings made by both. This implies that the level of utilization was also low for teachers regardless of their gender and type of schools, rural or urban areas. The conclusions of this study are similar to that of Adebayo and Ibrahim (2022) which investigated teachers utilization of the lab facilities and students' academic achievement in Biology in public secondary schools in Oyo state. Their study found that there was a significant and positive correlation between the use of laboratory facilities by teachers and the students' performance in Biology. The researchers have found that regular involvement in practical activities improves the

students' understanding of biological concepts and so on-going professional development programmes were recommended for Biology teachers.

Conclusion

The study investigated assessment of availability and utilization of Biology laboratory facilities in public secondary schools in Ebonyi State. The findings of the study showed that low level of availability and utilization of Biology laboratories in Ebonyi State, Nigeria. This study therefore concludes that with the low availability of and utilization of Biology laboratories, there is poor implementation of Biology as a subject in public secondary schools in Ebonyi State, Nigeria.

Recommendations

Based on the findings and conclusion of the study, the following recommendations have been made:

1. Ebonyi State Government should ensure provision of Biology laboratories to public secondary schools in Ebonyi State.
2. School management of public secondary schools in Ebonyi State should ensure effective use of available Biology laboratories in Ebonyi State, Nigeria.

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Appendix I

SPSS OUTPUT

Frequencies

Notes

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Statistics

		gender	Location
N	Valid	600	600
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Frequency Table

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
PU1	600	1.00	5.00	2.3800	1.68533
PU2	600	1.00	5.00	2.2650	1.59970
PU3	600	1.00	4.00	1.8400	1.06597
PU4	600	1.00	4.00	1.9200	1.01751
PU5	600	1.00	5.00	2.1600	1.48933
PU6	600	1.00	5.00	2.3200	1.78407
PU7	600	1.00	4.00	2.3250	1.19656
PU8	600	1.00	5.00	2.3600	1.57306
Valid N (listwise)	600				

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
PO9	600	1.00	5.00	2.3000	1.61690
PO10	600	1.00	2.00	1.3600	.48040
PO11	600	1.00	4.00	1.9200	1.27919
PO12	600	1.00	2.00	1.1600	.36691
PO13	600	1.00	5.00	2.7050	1.36421
PO14	600	1.0	5.0	2.415	1.5482
PO15	600	1.00	4.00	1.8000	1.05918
Valid N (listwise)	600				

T-Test

Notes

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	Cases Used	Statistics for each analysis are based on the cases with no missing or out-of-range data for any variable in the analysis.
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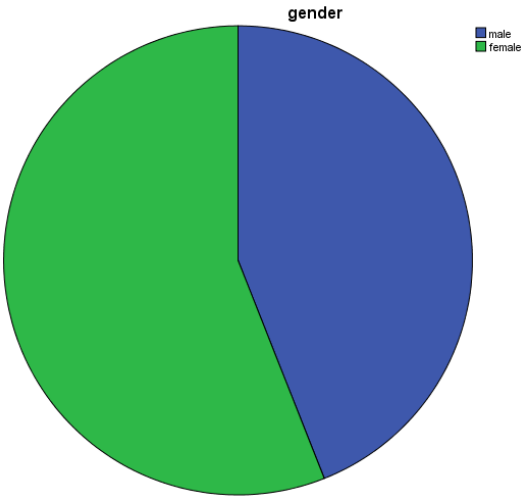
One-Sample Statistics

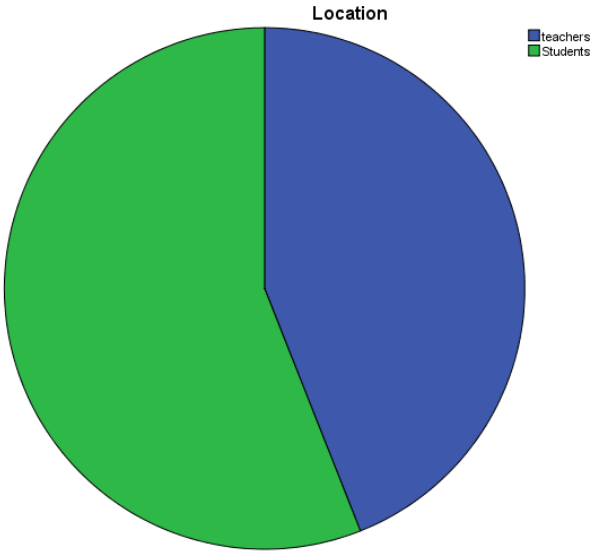
	N	Mean	Std. Deviation	Std. Error Mean
PU1	600	2.3800	1.68533	.06880
PU2	600	3.2650	1.59970	.06531

One-Sample Test

	Test Value = 0					
	t	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
PU1	34.591	599	.000	2.38000	2.2449	2.5151
PU2	49.994	599	.000	3.26500	3.1367	3.3933

Pie Chart





Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
PU1	600	1.00	5.00	2.3800	1.68533
PU2	600	1.00	5.00	3.2650	1.59970
PU3	600	1.00	4.00	1.8400	1.06597
PU4	600	1.00	4.00	1.9200	1.01751
PU5	600	1.00	5.00	2.1600	1.48933
PU6	600	1.00	5.00	2.3200	1.78407
PU7	600	1.00	4.00	2.3250	1.19656
PU8	600	1.00	5.00	2.3600	1.57306
Valid N (listwise)	600				