Assessment of the Adequacy and Quality of Laboratory Facilities: It's Impact on Students' Academic Achievement

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ABSTRACT

Assessing the quality and adequacy of laboratory facilities is key to adapting specific interventions to improve the overall impact of students' academic achievement. This paper examined the quality and adequacy of laboratory facilities regarding physical structure, equipment, supplies, and maintenance that impact students' academic achievements. A survey was conducted to assess these factors among the students enrolled in the first semester of the school year 2018-2019 in the 12 various colleges and programs of a university that have laboratory facilities utilized by the students. Results show that the student's overall academic achievement was good and that students rated the laboratory facilities, physical structure, equipment, and supplies as "adequate". There is a significant relationship between academic achievement and sex, program, and adequacy and quality of laboratory facilities. The results further reveal that the academic program significantly predicted the students' academic achievement. Furthermore, the findings show that the quality and adequacy of laboratory facilities have a negative relationship with academic achievement, implying that students have less expectation of dependence on the laboratory facilities to get higher grades.

Keywords: Adequacy, laboratories facilities, academic achievement

INTRODUCTION

Education is a two-way process, as we all perceive; a two-way process in the sense that we have to learn the theories first, then the skills or application will come in second. A theory is a system of ideas intended to explain something, especially one based on general principles independent of the thing to be explained. While a laboratory is where students work to enhance skills or a class period during which students perform experiments or work in a laboratory, principles and applications should still be discussed. Whatever is done in the laboratory is for obtaining or acquiring skills that would help advance scientific knowledge, subsequently leading to the development of the ideal graduates. The laboratory course of every program is not limited to the different sciences area but includes all programs offered in the various schools and institutions.

This is so the laboratory experience should significantly attain, that is, a participation in the series of experimental, observational, and demonstration activities that provide an opportunity for students to develop an understanding of practical and theoretical concepts through solutions to problems, concluding that adequate laboratory facilities aid in achieving the necessary competencies of the students. Furthermore, without adequate facilities and resources, it is extremely difficult to meet the learning needs of the students (Akami, 2015).

The laboratory for the educational environment has been described as a room or a building specially built for teaching by demonstration of theoretical phenomena in practical terms. The laboratory is the workplace of the science teacher. According to Neji, Ukwetang Nja, and Cecilia (2014), the adequacy of laboratory facilities, students' academic achievement, the teaching and learning experience, and the teachers' effectiveness in using laboratory facilities that aim to facilitate and provide meaningful learning experiences in the learners.

Hager (1974) stressed, based on the instructional theory of learning interaction, hypothesized that the laboratory had a direct effect on both students' attitudes and academic achievement. It is generally believed that constant practice leads to proficiency in what the learner learns during classroom instructions; hence, the important idea or role is 'practice makes perfect.' It has increased the expectation that it should adequately provide laboratory facilities to secondary schools for effective teaching and learning.

FRAMEWORK

The current study was anchored on Jerome Bruner's constructivism theoretical arguments that learning is an active process in which learners construct new ideas or concepts based on their current or past knowledge (Bruner, 1996). He also argues that humans generate knowledge and meaning through interaction between their experiences and ideas. The theory is associated with pedagogic approaches promoting active learning and discovery. Hands-on experiences are, therefore, necessary for effective learning as the learner must do something in the learning process. The teacher should try to encourage students to discover principles by themselves. Laboratory teachers can achieve this by giving practical tasks in the laboratory. The various laboratory experiences expose the learners to hands-on activities, thus actively participating in the learning process. Laboratory experiences can develop scientific thinking and practical abilities if well-planned in a properly set laboratory.

OBJECTIVES OF THE STUDY

The study assessed the adequacy and quality of the laboratory facilities of the University. Likewise, evaluate the implication on students' academic achievement, and identify the variable that best influences academic achievements. It also tried to determine differentiating factors in their academic achievement when grouped according to demographic profile.

METHODS

The study utilized the descriptive-correlational research design to investigate the quantitative data on assessing the adequacy of the laboratory facilities. It was conducted at a private university in Northern Mindanao. The study's respondents were the students from 12 programs of the University for the SY 2018-2019. A researcher-made questionnaire was utilized in the study and was validated by three experts. The questionnaire was based on the Philippine Association of Colleges and Universities Commission on Accreditation (PACUCOA) survey instrument and was subjected to a scale reliability test through pilot testing. Respondents were asked to indicate their agreement with each item (statement), using a four-point Likert scale type providing an interval level measurement of Strongly Agreed (SA), Agreed (A), Disagree (D), and Strongly Disagree (SD) were used. Nominal values of 4, 3, 2, and 1 were attached.

An interview guide was also provided and used as a tool for the focus group discussion, composed of open-ended questions to gather data on the students' actual experiences with the use of laboratory facilities. These questions were also utilized as a follow-up to certain questionnaire responses or to investigate their responses further to support the quantitative results.

The respondents were given informed consent and assured the gathered data maintained strict confidentiality and that their identities would not be divulged. Descriptive statistical comparisons and analyses were used to provide the relationship of variables. Means and standard deviations variables were measured on a continuous scale of measurement. Furthermore, the Pearson Product Moment Correlation was also used to test the relationship between the adequacies of laboratory facilities on students' academic achievements.

RESULTS AND DISCUSSION

A total of 457 fourth-year students enrolled in the first SY 2018-2019 from 12 university programs rated the adequacy and quality of laboratory facilities. The frequency distribution of the students according to demographics is shown in Table 1. The table shows that dominantly or more than 16% of the participants were from the HRIM-BSTIM program. The respondents from the BS Biology program have the least number, with only four or less than 1%. Moreover, 67% of respondents were female and generally from Psychology and BS Biology programs 100%, and only 33% were male, and most are from BS Criminology more than 92%. The data revealed that more females than males were enrolling as 4th year in the 12 programs offered by the university.

Table 1

Level of Academic Performance of the Students

Program	QPA	Qualitative Description
	M	
BS in Radiologic Technology	2.10	Good
BS in Criminology	2.04	Very Good
BS in HRIM-BSTIM	1.83	Very Good
BS in Information Technology	2.20	Good
BS in Biology	1.54	Excellent
BS in Psychology	2.29	Good
BS in Physical Therapy	2.59	Fair
BS in Medical Laboratory	2.43	Good
BS in Nursing	2.41	Good
BS in C Teacher Education	1.70	Very Good
BS in Pharmacy	2.25	Good
BS in Engineering	1.96	Very Good
Overall Mean	**2.11**	**Good**

Table 1 shows the level of academic achievement of the students by program. Program which got the highest academic achievement attained by the students is excellent which achieved to the Bachelor of Science in Biology. The findings show that highest academic achievements were gained from BS in Teacher Education (QPA 1.70), BS in HRIM-BSTIM (QPA1.83), BS in Engineering (QPA 1.96) and BS in Criminology (QPA 2.04), were achieved a "very good" by the students. Six programs out of 12 achieved a rating of "good" only with QPA from 2.10-2.43. The BS in Physical Therapy got the lowest QPA of 2.59 with a qualitative description of "fair". This implies that the general population of the students in the university belongs to the average level of academic achievement. Empirically, it implies that the university is not employing the selective program admissions where the different programs are supposed to implement a competitive selection process and require additional admission steps. The university is open to admit

all student applicants. Thereby, the general academic achievement of the students is not expected to be very high.

Table 2

Descriptive Statistics of Level of Adequacy of Laboratory Facilities by Programs

PROGRAM	PS M	Interpretation	ES M	Interpretation	MT M	Interpretation	*Overall* M	Interpretation
BS Radiologic Technology	3.10	Adequate	3.13	Adequate	3.25	Adequate	3.16	Adequate
BS in Criminal Justice	3.13	Adequate	3.24	Adequate	3.24	Adequate	3.20	Adequate
BS in HRIM-BSTIM	3.07	Adequate	3.14	Adequate	3.10	Adequate	3.10	Adequate
BS in Information Technology	2.67	Adequate	2.58	Adequate	2.69	Adequate	2.65	Adequate
BS in Biology	2.84	Adequate	3.06	Adequate	3.19	Adequate	3.03	Adequate
BS in Psychology	3.21	Adequate	3.00	Adequate	3.07	Adequate	3.09	Adequate
BS in Physical Therapy	2.27	Moderately Adequate	2.73	Adequate	2.66	Adequate	2.55	Adequate
BS in Medical Laboratory	3.12	Adequate	3.35	Adequate	3.58	Highly Adequate	3.35	Adequate
BS in Nursing	3.18	Adequate	3.42	Adequate	3.28	Adequate	3.29	Adequate
BS in C Teacher Education	3.18	Adequate	3.30	Adequate	3.29	Adequate	3.26	Adequate
BS in Pharmacy	2.79	Adequate	3.04	Adequate	3.00	Adequate	2.94	Adequate
BS in Engineering	2.88	Adequate	2.89	Adequate	2.88	Adequate	2.88	Adequate
Overall	**2.95**		**3.07**		**3.10**		**3.04**	

Notes: PS=Physical Structures, ES=Equipment and Supplies, and MT=Maintenance.

Table 2 shows the level of adequacy of laboratory facilities in terms of physical structure, equipment and supplies, and maintenance. As reflected on the table in terms of physical structure, the laboratory facilities with the highest mean of 3.21, verbally described as adequate, is the BS in Psychology laboratory facilities. It implies that among the laboratory facilities of the twelve (12) programs, the BS Psychology laboratory facilities are the most sufficient. On the other hand, the BS in Physical Therapy laboratory facilities got the lowest mean of 2.27, verbally described as moderately adequate. It reveals that among the laboratory facilities of the twelve (12) programs, the BS Physical Therapy laboratory facilities are the least sufficient in terms of physical structure which contradicted the claims of the students during the focus group discussion. They mentioned that the laboratory facilities, in terms of the physical structure, are not sufficient, emphasizing the immediate need for improvement.

Regarding equipment and supplies, the highest mean of 3.42 is verbally described as adequate, and the lowest is 2.58, which is also verbally described as adequate. The data show that the laboratory facilities, in terms of equipment and supplies, are sufficient and available for the students. These findings confirm the students' claims during the focus group discussion to triangulate the data. They said that the equipment and supplies of the laboratories are enough to provide

the students with the necessary tools and apparatuses for practice.

In terms of maintenance, the highest mean of 3.58 was verbally described as highly adequate. It implies that proper maintenance of the laboratory facilities is very much observed. This result confirms/contradicts the students' claims during the focus group discussion, although the lowest mean of 2.66 is still verbally described as adequate. It reveals that the laboratory facilities in terms of its maintenance are still sufficient. They verbalized that the maintenance of the laboratory facilities is adequately observed though it is mentioned that these facilities are already obsolete.

Generally, the laboratory facilities of the university in terms of physical structure, equipment and supplies, and maintenance got a mean of 2.95, 3.07, 3.10, and 3.04, respectively which are verbally described as adequate. It means that the laboratory facilities of the private university are sufficient to supplement the academic needs of the students.

Table 3

Summary of statistics, correlations between academic achievements (QPA), gender, program, adequacy and quality of laboratory facilities (QALF) n=457

Variable	1	2	3	4	5	6	M	SD
1. Academic Performance							2.17	.461
2. Sex	.103*						1.67	.470
3. Program	.150**	.212**					6.30	3.51
4. Adequacy and Quality	.116*	.027	.010				3.05	.442
5. Physical Structure	.198**	-.013	.078	.922**			2.94	.490
6. Equipment and Supply	-.051	.045	-.044	.896**	.706**		3.09	.491
7. Maintenance	-.069	.043	-.006	.938**	.833**	.758**	3.12	.462

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Table 3 shows the correlational analyses used to examine the relationship between academic achievements, sex, program and perceived adequacy and quality of laboratory facilities of university students. As reflected on the table, shows the correlations results indicated a significant inverse relationship between the academic achievement (QPA) and the program ($r = .150$, $p < .01$), the quality and adequacy of laboratory facilities of the university ($r = .116$, $p < .05$). The results revealed that the relationship between of the program, adequacy and quality of laboratory facilities was associated with reduced positive affect on academic achievements. One reason may be that academic achievements was associated with experiencing less important of the

sophisticated equipment and facilities of the laboratory to perform experiments and activities related to the course.

Sex is one of the factors also mentioned in some literatures to have considerable effects on students' academic achievements especially in science and laboratory subjects. Sex is the range of physical, biological, mental and behavioral characteristics pertaining to and differentiating between the feminine and masculine (female and male) population (Adigun, Onihunwa, Irunokhai, Sada, & Adesina, 2015). With the result on correlation between academic achievement and sex (r =0.103, p < .05) which gives a positive association to the achievement of the students. The mean academic achievements of male and female students across various programs in the university showed that the female (*M=2.20*, *SD=0.473*) students perform better compared to the male (*M=2.09*, *SD=0.429*) students. The study of Parajuli, Mankumari & Thapa, Ajay (2017), found a significant association between student's sex and their academic performance with a relatively greater percentage of female scores compared to their male counterparts, evidently it indicates that female students outperformed male students.

The importance of examining achievement in relation to sex is based primarily on the social orientation differences between male and female. Some of the learning colleges or department have been regarded as men's (engineering, arts and crafts, agriculture etc.) while others as women's (catering, office job related works, nursing etc.). Also, the female students have a higher deviation around the average compared to the male counterparts (Adigun, et al., 2015). We tend to **Reject** the hypotheses, statistically the results in spite of a weak correlation values there is a significant relationship between academic achievements when group according to sex, program and the quality and adequacy of laboratory facilities.

Table 4

Variables	Model 1			Model 2		
	B	*SE B*	*β*	*B*	*SE B*	*β*
Constant	2.522			2.408		
Sex	.076	.046	.078*	.062	.045	.063*
PROGRAM	-.017	.006	-.132**	-.013	.006	-.098*
Adequacy and Quality	-.122	.048	-.117*			
Physical Structure				-.414	.079	-.441***
Equipment and supply				.064	.066	.068
Maintenance				.243	.090	.243**
R²	.041			.088		
F	6.52***			8.73***		

*p < .05. **p < .01. ***p < .001.*

Notes: MT=Maintenance, PS=Physical Structures, ES=Equipment and Supplies. PROG= Program/course/department, AQLF= Adequacy and

Quality of laboratory facilities

Table 4 presents the regression analyses were to examine the relationship between college academic performance (QPA) and various potential predictors. As shown on the table, the multiple regression *model 1* with all two predictors produced R^2 = .041, $F(3, 456)$ = 6.52, $p < .001$. The Analytic and Quantitative Academic Performance (QPA) scales had significant positive regression weights on gender, indicating students with higher grades on these scales were expected to have higher QPA, for on the other variables in the model. It was found that PROGRAM significantly predicted (β = -.132, p <.01) the academic performance (QPA) of the students, indicating that the students in most of the PROGRAM are equally possesses remarkable intellect prior to enrolment. Furthermore, the quality and adequacy of laboratory facilities (β = -.177, p <.05) which give a negative regression to academic performance (QPA) indicating that student have a less expectation of the dependent of the laboratory facilities just to get a higher grade academically. The motivation of teachers and students to performed laboratory (QALF) tasks plays vital factors.

Regression equation:
QPA = 2.522 – (0.017) PROG + (0.076) Sex - (0.122) QALF

The multiple regression model 2 with all three predictors produced R^2 = .088, $F(5, 451)$ = 8.73, $p < .001$. As can be seen in Table 4, the Analytic and Quantitative Academic Performance (QPA) scales had significant negative regression weights on program (PROG), indicating students with higher grades on these scales were expected to have higher QPA, for on the other variables in the model.

Regression equation:
QPA = 2.408 - .013PROG + .062Sex -. 414PS + .064ES + .243MT

In summary, academically PROG (programs) was found to be a potent predictor of academic performance of university students. did not contribute to the multiple regressions in both models.

CONCLUSIONS

Laboratory classes play an important aspect in honing and developing the psychomotor learning and skills of the student's side-by-side of the theories that underscores on their cognitive type of learning. One important factor that creates

a big impact on the quality of learning, especially in the laboratory classes, is the adequacy and quality of laboratory facilities. The process is both necessary for students received quality learning. The students assessed as the laboratory facilities "adequate" which implies that is to pose a challenge to the University, as always strives for excellence. This suggests that the used of the laboratory purposely to help the students develop scientific and problem-solving skills. These are creative thinking, reflective thinking, and critical thinking. It helps individual learners to develop both in critical thinking, creative thinking and reflective thinking that enables the students to change their impression about the environment and the world at large. Using laboratory is the most widely acclaimed strategy for laboratory inquiry instruction. It helps to develop students' ability to organize and classify information, give self-satisfaction and reward to students especially on successful execution of a project or investigation. It holds facts more permanently, especially when such facts and information collected by the students themselves through investigation. The study provides a complete direction to the university in maintaining and improving the adequacy and quality of laboratory, not just to settle the "adequate" response from the students but to extend to highly adequate even though the results reveal a weak relationship on academic achievement.

RECOMMENDATIONS

From the findings of the study, the following are recommended:

1. The administration will continue to provide needed budget to support acquiring new equipment and updated apparatuses for efficient teaching and learning in every laboratory class, and should create a committee to oversee the proper maintenance, the adequacy and quality of all laboratory facilities;

2. A similar study may be conducted in determine significant relationship among other factors on adequacy and quality of laboratory facilities;

3. A study may be conducted a wider perspective may be conducted like involving the various year level students of all programs; and

4. For those who will further conduct this research study, may consider using different tool which is fitted to all program.

LITERATURE CITED

Adigun, J., Onihunwa, J., Irunokhai, E., Sada, Y., & Adesina, O. (2015). Effect of Gender on Students' Academic Performance in Computer Studies in Secondary Schools in New Bussa, Borgu Local Government of Niger State. *Journal of Education and practice, 6*(33), 1-7.

Akami, O., (2015). Laboratory Teaching: Implication on Students 'Achievement in Chemistry in Secondary School in Ebonyi State of Nigeria. *Journal of Education and Practice*. Department of Science Education, Faculty of Education, Ebonyi State University, Abakaliki, ISSN 2222-1735 (Paper) ISSN 2222-288X (Online) Vol.6, No.30,

Bruner, J. (1997). The culture of education. *In The Culture of Education*. Harvard university press.

Durbin, J, et al. (1989). *Management and organization*. Ohio: Southern Western Publication Company.

O'Neill, D. J. (2000). *The impact of school facilities on student achievement, behavior, attendance, and teacher turnover rate at selected Texas middle schools in Region XIII ESC* (Doctoral dissertation, Texas A&M University).

Uyoata, U. E. (2006). Availability, Science and Utilization of Instructional Resources for Teaching Primary Science in Uyo Local Government Education Authority Akwa Ibom Stat. In *Proceeding of the 47th Annual Conference of Science Teachers Association of Nigeria (STAN). Nzewi (Ed).*

Umeh, M. O. (2006). Availability and use of human and material resources in teaching of ecology and genetics in Biology Education in Senior Secondary schools in Anambra State. In *Proceedings of Annual STAN Conference* (pp. 128-13).

Lewin, K. M. (2000). Mapping Science Education Policy in Developing Countries. Secondary Education Series.

Lyons, J. (2012). Do schools facilities really impact a child's education. Retrieved from http://schoolfacilities.com/pdf/School%20Facilities%20Impact% 2012-27-01.pdf Dated: August 16, 2017

Momoh, O. A., Onjewu M. (2006). Optimal Maintenance of School Facilities for Enhanced Learning. *Journal of Educational Management and Planning, 1*(1) April.

Parajuli, Mankumari & Thapa, Ajay. (2017). Gender Differences in the Academic Performance of Students. *Journal of Development and Social Engineering. 3*(39-47).10.3126/jdse.v3i1.27958. Available from: https://www.researchgate. net/publication/339922091_Gender_Differences_in_the_Academic_ Performance_of_Students [accessed Nov 28 2022].

ACKNOWLEDGMENTS