Assessing Laboratory Skills Performance in Undergraduate Biology Students

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Abstract

The purpose of this study was to evaluate the laboratory skills performance of undergraduate biology students in Ethiopian universities based on skill performance rubric. Individual laboratory practical skill performance test was implemented with 55 randomly selected third year biology students from three universities in a laboratory setting under supervision of the raters. Five level scale questionnaires were administered to 208 third year biology students, 26 biology instructors and 2 laboratory assistants. The results showed that the laboratory skill performance test score was below the midpoint with significantly different between the old and the middle as well as the new university. Correlation and multiple regression analyses showed that teachers' experience had significant positive regression weight. From the results of the analysis, it is recommended that in biology laboratory, performance-based assessment needs to be undertaken in placement to written exam and instructors need much more assistance and professional development of biology laboratory performance skills as well as pedagogies of how to assess the laboratory performance skills of their students.

Keywords: Assessment, biology laboratory, skills performance, undergraduate

1.   Introduction

There is a need to have graduates who have the appropriate practical skills, attitudes and experiences to create work for their own and the communities as well; fit to be employed in different biological disciplines. Improving the standard and quality of biology education is essential in improving the quality of life in a society and to ensure their competitiveness in the globalized world (Turiman, et al., 2011). To overcome the challenges of the twenty first century in science and technology, students need to be equipped with 21st century skills in general and university students in particular should be prepared to have sufficient knowledge, skills and attitudes for better developments of the society.

Biology as scientific field of study should be learnt partly through experimental method. Majority of the course in biology cannot be considered as complete without including some practical work in it (Yadav and Mishra, 2013). Therefore, practical classes form an essential part of the learning experience for biology students, cultivating both their subject-specific and generic skills that will be of value throughout their university lives and future careers. Biology laboratory is the primary place to develop these skills and competences

Several studies have been conducted about the role of laboratory work in science (Hofstein, 2004; Hofstein and Lunetta, 2007).   Laboratory practical work uses as primary means of instruction in science **(**Blosser,1990)**;** gives opportunities for students to manipulate equipment and materials (Tobin, 1990); helps students to build confidence in their problem-solving abilities (Sundberg and Moncada, 1994; Tarhana and Sesen, 2010); maximizes their conceptual development (Domin, 2007); and develops their academic performance (Aladejama and Aderibigbe, 2007). Moreover, laboratory practical activity in science values learning new skills and using new equipment, gives opportunity for students' social interaction, illustrates materials given in lectures and develops high interest; and stimulate students to greater efforts of achievement (Collis et al., 2008; Hunt et al., 2012). However, Trapani and Clarke (2012) stated that the laboratory activities largely focus on illustrating concept and the delivery of information because of several factors. Among the factors are equipment and other resource constraints, large groups size, lack of sustained and repeated exposure to given practical skills and experimental techniques, poor organizational and time management, and variations in instructors' skills in teaching the laboratory teaching and learning.

To equip students with practical skills important in their future careers, laboratories should be efficiently used by teachers and students, and teachers themselves should possess these skills. Hence, consideration in the process of developing and evaluating a laboratory work task is important, such as the teachers, objectives and the task designed are influenced by teachers' views about science and learning, and by practical and institutional factors, such as the resources available, the requirement of the curriculum, its mode of assessment, and so on (Psillos and Niedderer, 2002).

Therefore, this study investigates whether the intended objectives have been attained or not, the major factors that affect the biology laboratory skill performance of undergraduate biology students and whether there is a relationship between availability of laboratory equipments and students' skill performance in biology laboratory work.

2. Definition of Laboratory work

Tamir et al. (1992) defined practical work as the study of natural phenomena by observations and experiments in the laboratory, as well as outdoor settings. A laboratory practical test can be described as a task which requires some manipulation of apparatus or some action on materials and which involves direct experiences of the examinee with the materials or events at hand. Further, Hofstein and Lunetta (2004) stated that the laboratory activities include laboratory demonstrations, hands-on activities, and experimental investigations. Laboratory work is an active learning process, which requires students to be involved in observing or manipulating real objects and materials. It plays a distinctive and central role for the development of students' understanding of scientific concepts, improvement of their cognitive skills as well as for the development of positive attitudes (Tobin, 1990).

3. Performance and the Role of Performance Assessment

Performance is defined as the accomplishment of a given task measured against preset known standards of accuracy, completeness and speed. The particular skills and competencies developed through practical learning in the biological sciences are as varied as the courses themselves and have also common skills (Harris, et al. 2007). Recently, science educators have shown increased interest in developing practical skills and competency- based approach, and assess specific core laboratory skills. According to Craw (2009), laboratory performance assessments provided teachers with valuable information to adjust instruction, inform curricular decisions, and as a basis for professional development. Implementing performance assessment as a teaching methodology is used to improve inquiry-based science education, promote the development of 21st century skills, involve students in the assessment process, provide teachers with valuable information to inform instruction, and as a tool for professional development. Performance tasks involve students demonstrating their understanding through actual manipulation of equipment and materials in the laboratory. However, several authors have indicated that the actual doing of the lab activities is rarely assessed (Tobin et al., 1990; Moni et al., 2007).The assessment of practical skills and competencies is of two broad types. Direct assessment, where either the demonstration of the skills themselves are the object of assessment; and indirect assessment, where a students' level of a practical skill has a bearing on a related, assessed activity (Harris, et al. 2007).

4. Theoretical Frame Work

Several studies have been conducted on how to assess the competencies. For example, Slater and Ryan (1993) have developed six performance task evaluations for an introductory physics laboratory. This evaluation has four discrete competency levels (i.e. no evidence, approaches goal, meets goal and exceeds goal). The authors stated that the instructor observes and evaluates students' competency levels with respect to the specific skills that the laboratory exercises was designed to teach.

Shavelson et al. (1991) developed alternative performance assessment instrument for fifth and sixth grade students assisted by computer simulation. Both researchers agreed that although the hands-on assessment is desirable, it is expensive and time consuming to administer. Moreover, Moni et al. (2007) have designed and implemented a strategy to assess individually 5 core laboratory skills of students in first-year laboratories for the course Human Biology. They designed a form for tutors to record the skill level of each student. Three levels of skill attainment were defined: not proficient, toward proficiency, and proficient. However, the levels used to evaluate the skills were more subjective like those used by Slater and Ryan (1993).

Craw (2009) studied the performance assessment practices of high school science teachers. The results revealed that teachers were less likely to use more open-ended, authentic forms of laboratory performance assessments. There

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was variability in teacher implementation of performance assessment possibly due to teacher's background, experience, or subject matter taught.

Hunt et al. (2012) have done an action research project to assess laboratory skills in a molecular biology course by replacing a single examination with direct observation of student participation and learning over a prolonged period of weekly laboratory sessions. They argued that practical laboratory skills should be assessed in the laboratory by observing what the student are actually performing rather than assessing written laboratory reports or answers to examination questions.

Bone and Reid (2011) reported that students who completed biology at the senior high school-level did perform better than those who had not. Moreover, there is also a debate that scientific process skills acquisition varies among sexes. Ochonogor (2011) stated that there is a difference in performance level between male and female undergraduate biology students in that the female students perform significantly better than the males. However, Jack (2013) stated that sex does not influence students' acquisition of science process skills. Moni et al., (2007) proposed that students would learn skills more effectively if they were individually assessed on core laboratory manipulative skills and that these skills should be assessed from their first-year of degree program.

Hence, it is important to examine if there is differences between male and female undergraduates biology students.

5. The Problem

Practical activities are part of biology education. Undergraduate biology students need to develop their biology skills that will equip them for life; enable them to solve problems, and think critically.

The laboratories should be more efficient in accomplishing the objectives of teaching science than other models of instruction because laboratory work is both time consuming and expensive compared with other models (Sabri and Emuas, 1999). Studies have found that the less availability, misallocation and the deficiency in the use of science laboratory items lead to wastage of resources and lower academic achievement (Dahar and Faize, 2011). Most of the higher education biology laboratory equipments are very expensive to be purchased. If this biology laboratory equipment are not efficiently utilized, it would be economic loss to the country, especially for the developing countries, like Ethiopia. Thus, the biology laboratory work and the actual practices of laboratory work in universities require some examination so that biology laboratory activities could be better designed and implemented, and be able to fulfill their promises. Yet, there is little evidence to show how the extents of laboratory manipulation skills are acquired by biology undergraduate students. Moreover, no study has conducted about the implementation of the intended practical activities and whether those objectives have been attained or not. Moreover, this study also investigates whether there is relationship between the availability of laboratory materials and students' competency or not.

Science education researchers have become increasingly concerned with the performance assessment of laboratory work (Bekalo and Welford, 1999). The assessment of students' manipulation skills is important in that it provides students with an opportunity to demonstrate their manipulation skills, and understanding of processes and concepts through doing lab activities but it is often neglected by instructors in many universities because the instructors themselves do not have the necessary practical skills to organize, carry out and evaluate investigative science activities (Bekalo and Welford, 1999; Chabalengula, et al., 2009). Of the various techniques of assessing students' lab work, the most common laboratory evaluation techniques in universities are laboratory report and written examination (the act) during the lab, but not how well the students are capable of actually doing (performing) in biology laboratory based on their practical laboratory work (Slater and Ryan, 1993; Hunt et al.., 2012; Gobaw and Atagana, 2014). The existing evidence, however, is based largely on the assessment techniques but not on students' competency level.

Employers and instructors complain that the majority of biology undergraduate students do not have basic laboratory manipulative skills. Aladejama and Aderibigbe (2007) stated that the student's academic performance is positively correlated with the science laboratory environments. According to Doran et al. (1992), the educational context for practical work in science has four factors: philosophy of learning by doing, science curriculum, school facilities and science teachers. Therefore, this study addresses these issues and investigates the relationship of those variables with the undergraduate biology students' laboratory skill competency. Furthermore, the need is to identify the factors responsible for the present state of affairs on the acquisition of biology practical skills at undergraduate level.

The aim of this study is to evaluate the performance skill of biology undergraduate students in some Ethiopian universities based on skill performance rubric with a view to identify areas of deficiency and formulating intervention strategies, and then providing possible recommendations that could help to alleviate the existing problems.

This study therefore, would answer the following research questions:

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1. To what extent do biology students acquire the competencies and skills prescribed in the graduate profile?
2. What is the difference in students' competency level among universities with different resources?
3. How is the level of biology laboratory skill performance between male and female biology undergraduate students?

6. Methodology

6.1 Research Methods and Design

A correlational research design was used for this study. A correlational research design was appropriate because the study was a non-experimental research that did not control for any variables (Creswell, 2008). Data were collected from third year biology students and biology instructors in three universities to test the students' laboratory practical skill whether number of lab session, availability laboratory resource, teachers experience, teachers' qualification, teaches manipulative skills and efficient use of laboratory (independent variable) relate to the students' laboratory practical skill performance score (dependent variable). In this explanatory follow up, the plan was to evaluate the undergraduate biology instructions in some Ethiopian universities based on laboratory skill performance rubric developed by researcher with a view to identify areas of deficiency and formulating intervention strategies, and then advising higher education authorities on how to improve the teaching and learning of practical biology in the country.

6.2 Population and sampling

Among the governmental universities in the country, three universities were selected as case study. Three universities were chosen: University A, University B and University C. The universities have different age of teaching experience; however, there was no information on the availability of laboratory resources at these three universities and this need to be clarified. University "A" has over 20 years of teaching experience, university "B" has about 10 years of teaching experience and university "has 6 years of experience. All the third year students, biology instructors and laboratory assistants were selected as sample of the study.

6.3 Instruments of Data Collection

Two instruments were employed in this study. The first was evaluating the performance skill of 55 randomly selected third-year biology students (19 students from university A, 20 students from University B and 16 students from university C) using skill performance rubric developed by the researchers (see method supplement). There are a variety of laboratory tasks, but in this study three core manipulative skills are considered. The three core manipulative laboratory tasks were identifying the basic biology laboratory equipment, accurate and precise use of light microscope and measuring weights and volumes. The reason for selecting these laboratory skills is they are the basic and minimum laboratory practices for undergraduate biology students and found in all courses of biology work. Individual student's laboratory practical skill performance was assessed by the rubric and every student was evaluated by two raters. The inter- rater agreement was computed by the Spearman correlation coefficient which is rho=0.86 which is significant (p=0.000) at the 0.01 level and the intra-class correlation coefficient between raters was 0.94.

The second instrument was questionnaires distributed currently enrolled third year biology students in the three universities. A total of 252 questionnaires were distributed and 208(83.2%) completed questionnaires were returned from three universities. The students' questionnaire includes questions of evaluation of their skills based on the graduate profile set in the curriculum. The closed ended questionnaires were designed with Likert scale (1–5 scale). Closed ended questionnaires and open ended questionnaires were also filled by 26 instructors and 2 laboratory assistants. The completed questionnaires were analyzed by descriptive and inferential statistics using SPSS version 20.

6.4 Instrument Validation

Prior to administration, the laboratory practical skill performance test was submitted to a group of four biology professors for the assessment of its content validation. The purpose of the content validation was to get the draft item moderated so as to be reliable. The reliability of the instrument was determined using pilot study. The reliability of the instruments has Cronbach's alpha value of 0.91which indicates that a high internal consistency (Tan, 2009).

6.5   Data Analysis

The data obtained in the study were analyzed by using the SPSS statistical program. The following methods were used in the analyses:

Pearson correlation was used to determine whether there was a significant relationship between the independent variables and students' lab practical skill performance test results. Multiple Regression analysis with linear function was used to find out the differential impact (causal-relationship) and T-test to compare the achievement levels of the students who performed basic biology laboratory skill performance test.

6.6   Ethics

Permission from all individuals and universities participating in the study were obtained prior to collecting personal information. The confidentiality of all individuals was respected and name of the individuals and institutes involved in the questionnaires and interviews remained anonymous.

6.7   Results

Ten Likert scale questions on a scale of 1 (strongly disagree) to 5 (strongly agree) about the acquisition of competencies and skills were administered to 208 students in the sample universities. Students perceived that they have the ability to perform the competences and skills prescribed on the undergraduate biology curriculum. As shown in Table 1, more than 51% of the students agreed and 24 % strongly agreed that they have the ability to perform the competencies and skills prescribed on the biology curriculum. About 25%, of the students disagreed or not sure about their ability to perform the competencies and skills prescribed on the biology curriculum of the old, the middle and new universities respectively.

The questions were analyzed inferentially with the Kruskal-Wallis Analysis of Variance test with the age of the universities being the independent variable. The results indicate that there were no significant differences in participants' response on a scale of 1 (strongly disagree) to 5 (strongly agree).

Laboratory skill performance test was carried out for 55 students in the three universities. The score was evaluated out of 57 marks. As can be seen in Table 2, students performed better in identification of laboratory equipment (7.3±3.0) and function of laboratory equipment (7.6±2.6). The most challenging skills for the students were estimation of diameter of field of vision, focusing, setting of microscope, mounting, staining, drawing and measuring weight and liquid. None of the students could be able to estimate and determine of fields of vision of a microscope. The average score for the entire test obtained by students were 33.6, 21.4 and 22.6 in the old university, middle-aged university and new university respectively. The mean score for the entire test in the three universities was 25.4.

The results of the analysis regarding the differences between universities in laboratory skill performance were examined by student's t-test (see Table 3). There is a high significant difference among the three universities. However, there is no significant difference between the middle-aged and the new universities.

The finding of this study also revealed that there is no significant difference in performance level between biology undergraduate male and female students.

Correlation and multiple regression analyses were conducted to examine the relationship between third year biology under graduate students' laboratory performance skill and various potential predictors, such as higher education entrance exam score, high school background, number of laboratory sessions they conducted, availability of laboratory resources, instructors' experience, instructors' qualification, instructors' manipulative skills and efficient use of laboratory resources.

Table 1: Students response on the acquisition of competencies and skills prescribed on the harmonized biology curriculum

Competencies	Strongly Disagree			Disagree			Not Sure			Agree			Strongly Agree		
1 I am able to relate things learned in the class to daily life, transform them into practice and solve problems	1	0	0	2	3	0	7	6	2	53	38	56	13	16	9
	1.3%	0%	0%	2.6%	4.6%	0%	9.2%	9.2%	3.%	69.7%	58.5%	83.6%	17.1%	24.6%	13.4%
2 I am able to do experiments, and to use laboratory equipment	2	0	0	3	0	0	11	4	5	39	40	46	21	19	16
	2.6%	0%	0%	3.9%	0%	0%	14.5%	6.2%	7.5%	51.3%	61.5%	68.7%	27.6%	29.2%	23.9%
3 I can design a scientific procedure to answer question	1	0	0	6	4	2	10	18	24	39	34	31	20	7	10
	1.3%	0%	0%	7.9%	6.2%	3%	13.2%	27.7%	35.8%	51.3%	52.3%	46.3%	26.3%	10.8%	14.9%

Item															
4 I am able to conduct researches in various biological disciplines	0 0%	1 1.5%	0 0%	5 6.6%	3 4.6%	2 3%	11 14.5%	10 15.4%	17 25.4%	41 53.9%	38 58.5%	36 53.7%	19 25.0%	11 16.9%	11 16.4%
5 I am able to collect data systematically, catalogue and preserve field biological materials and museum specimens of plants, animals and microbes	4 5.3%	1 1.5%	1 1.5%	2 2.6%	3 4.6%	6 9%	19 25%	6 9.2%	12 17.9%	38 50%	35 53.8%	36 53.7%	13 17.1%	18 27.7%	12 17.9%
6 I am able to apply the techniques of culture media, and carry out culturing, isolation and identification of micro-organisms and report	2 2.6%	1 1.5%	1 1.5%	5 6.6%	2 3.1%	3 4.5%	13 17.1%	5 7.7%	5 7.5%	35 46.1%	26 40.0%	35 52.2%	21 27.6%	28 43.1%	23 34.3%
7 I am able to analyze and interpret biological data and write and present scientific reports	1 1.3%	2 3.1%	1 1.5%	3 3.9%	2 3.1%	5 7.5%	14 18.4%	8 12.3%	7 10.4%	37 48.7%	31 47.7%	37 55.2%	21 27.6%	20 30.8%	16 23.9%
8 I am able to operate basic biological equipment	2 2.6%	0 0%	1 1.5%	5 6.6%	3 4.6%	3 4.5%	13 17.1%	10 15.4%	17 25.4%	38 50%	38 58.5%	28 41.8%	18 23.7%	11 16.9%	18 26.9%
9 I am able to solve environmental and conservation problems of the Country.	3 3.9%	0 0%	0 0%	1 1.3%	3 4.6%	4 6%	13 17.1%	7 10.8%	8 11.9%	33 43.4%	38 58.5%	32 47.8%	26 34.2%	15 23.1%	22 32.8%
10 I can design ways to prevent infectious diseases	1 1.3%	0 0%	2 3%	2 2.6%	3 4.6%	2 3%	8 10.5%	4 6.2%	3 4.5%	38 50%	34 52.3%	32 47.8%	27 35.5%	21 32.3%	28 41.8%
Total	17 2.2%	5 0.8%	6 0.9%	34 4.5%	26 4.1%	27 4.0%	119 15.7%	78 12.4%	100 15.0%	391 51.4%	352 56.1%	369 55.3%	199 26.2%	166 26.5%	165 24.7%

Table 2: Laboratory skill performance test results of universities

	Weight of score	University A (Old)			University B (Middle-aged)			University C (New)			Grand Total	
		N	Mean	Std. Deviation	N	Mean	Std. Deviation	N	Mean	Std. Deviation	Mean	StdDev
Identification of lab equipment	10	16	7.25	3.04	20	5.40	3.36	19	7.16	2.65	6.55	3.11
Function of laboratory equipments	10	16	7.63	2.63	20	4.90	3.09	19	5.16	2.81	5.78	3.06
Handling of microscope	4	16	3.47	0.72	20	1.68	0.98	19	1.92	0.87	2.3	1.2
Setting of microscope	4	16	3.53	0.81	20	2.25	0.79	19	2.21	0.56	2.6	0.9
Mounting of specimen	4	16	3.19	0.85	20	1.73	0.75	19	1.76	0.82	2.2	1.0
Staining of specimen	4	16	2.09	1.37	20	1.93	1.02	19	1.63	0.88	1.9	1.1
Focusing of a microscope from low to high power objectives	4	16	2.56	0.60	20	1.85	0.81	19	1.58	0.65	2.0	0.8
Estimation of diameter of field of vision	4	16	0.00	0.00	19	0.00	0.00	19	0.00	0.00	0	0
Drawing of specimen seen in the microscope	4	16	1.06	1.06	19	0.26	0.56	19	0.11	0.32	0.4	0.8
Measuring liquid in liter, ml and µl	4	16	1.47	1.06	20	0.50	0.58	19	0.61	0.91	0.8	0.9
Measuring weight in gm, mg and µg	5	16	1.34	0.85	20	0.90	0.60	19	0.42	0.75	0.9	0.8
Total	57		33.6			21.4			22.56		25.43	

Table 3: Skill Performance Test Result between- Universities t-test (p<0.05)

Universities	N	Mean	STDEV	Between universities	P
A(old)	16	33.60	6.46	Between A and B	0.00006
B(meddle)	20	21.38	9.55	Between A and C	0.00006
C(new)	19	22.56	7.70	Between B and C	0.67

As can be seen in the correlation in Table 4, students' laboratory performance skills are significantly positively correlated with their higher education entrance exam score, availability of laboratory resources and instructors' experience indicating that those with higher scores on these predictive variables tend to have higher students' laboratory performance skills. Instructors' experience had significant positive regression weights (Table 5).

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Table 4: Correlation between laboratory performance skills and other independent variables

Skill	Independent variables	Sig.(1-tailed)
	Higher education entrance exam score	0.003
	High school lab back ground	0.167
	Maximum number of lab session	0.233
	Availability Laboratory resource	0.003
	Teachers experience	0.000
	Teachers qualification	0.011
	Teaches manipulative skills	0.326
	Efficient use of lab	0.110

Table 5: Multiple regression model summary of the predictor variable

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
1 (Constant)	2.104	.267		7.878	.000		
High school lab back ground	-.064	.036	-.127	-1.754	.081	.980	1.021
Sex	-.231	.078	-.214	-2.945	.004	.969	1.032
Higher education entrance exam score	.003	.001	.291	4.041	.000	.981	1.020
Maximum number of lab session	.027	.018	.111	1.551	.123	.989	1.011

a. Dependent Variable: GPA

7. Discussion

The laboratory performance skill test scores used in the study were identification of lab equipment (67.1%), function of laboratory equipment (58.36%), setting a microscope (26.09%), handling of microscope (22.82%), mounting of specimen on slide (21.64%), staining specimen (18. 73%), focusing from low to high power (19. 64%), measuring weight in gm, mg and µg (8.64%), measuring liquid in liter, ml and µl (8.18%), drawing (4.44%) and estimation of the diameter of a microscope (0 %). Measuring is basic (lower order) science process skills but is low. The result of this study is different from those of Moni et al. (2007). The results of Moni et al. (2007), showed that students demonstrating proficient core laboratory skills on their first attempt for correct use of a micropipette, for preparation of dilutions using a micropipette, for correct use of a light microscope, and for proficient use of digital data.

The result of this study is in agreement with the results shown by Saha (2001) and Cushing (2002). Saha (2001) showed that students demonstrated more skill in performing than planning and reasoning and the students' performances at the item level were very poor for some items. Cushing (2002) studied that the mean score of microscope assessment and task assessment were low.

Balanay and Roa (2013) showed that students differ in their accuracy and precision in the measurement but were moderately excellent in data collection and excellent in the setting up the equipment, following procedures, safety and precautions and clean up procedure. Microscopes are the most common source of technology, but were used almost exclusively for observations of teacher-determined objects, rather than as tools to increase the number of categories of science inquiry addressed (Basey, et al., 2000). There is a need, therefore, to use the available laboratory instruments more effectively and efficiently.

There was an assumption that students with better prior back ground in biology laboratory at secondary and preparatory schools would have higher biology laboratory performance test results than those without it but there was no significant correlation between high school lab back ground and laboratory skill performance test result. The result of this study supports that of Bone and Reid (2011).

Ochonogor(2011) stated that there is a significant difference in performance level among biology education undergraduates and between male and female biology education students in that the female students are more in biology education as a course and also perform significantly better than the males. However, in this study, there is no significant difference in laboratory practical performance level of male and female students. But the result of this study is in agreement with Jack (2013). A study conducted by Jack (2013), to find out the influence of selected variables, such as sex, on students' science process skills acquisition in Nigeria, revealed that sex, does not influence students' acquisition of science process skills.

Correlation and multiple regression analyses revealed that students' laboratory performance skills are significantly

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positively correlated with higher education entrance exam score, availability of laboratory resources and teachers 'experiences. Teachers' experience has significant positive regression weights in agreement with Friedrichsen et al. (2009) in that teaching experience appear to lead to more integration among pedagogical knowledge components for students' achievement.

The mode of assessment directly influences teachers' teaching methods, students' learning styles and attitudes towards practical activities (Bekalo and Welford, 1999), Akinbobola and Afolabi, 2010). Although, performance assessments require more time to administer than do other forms of assessment, it is appropriate to evaluate students' laboratory skill performance. The unique challenges of skill assessment are transferability of skills, use of time constrains and the increased risk for test anxiety (Silvestrone, 2005).

This study showed that practical methods of assessing students' performance need more attention. The result of this study will be great importance for the universities not only in Ethiopia, but in other countries, not only in biology undergraduate laboratories, but also in other sciences such as chemistry and physics. The finding of this study would also provide the universities with the opportunities to evaluate what was intended to teach in the laboratory and what students are actually able to do in the laboratory. In addition, implications of these findings highlight the importance in fostering the acquisition of biology laboratory practical skills there by students would productively contribute towards global excellence in practical skills.

8. Recommendation

From the results of the analysis and the conclusion, the following recommendations are drawn:

1. In biology laboratory, performance-based assessment needs to be undertaken in placement of laboratory report and laboratory written examination.
2. Departments should stabilize systems to check the mode of the assessments for the laboratory skills.
3. Instructors need much more assistance and professional development of biology laboratory performance skills as well as pedagogies how to assess the laboratory performance skills of their students.
4. Further studies should be conducted how to assess the laboratory performance skills of students in large class size.

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