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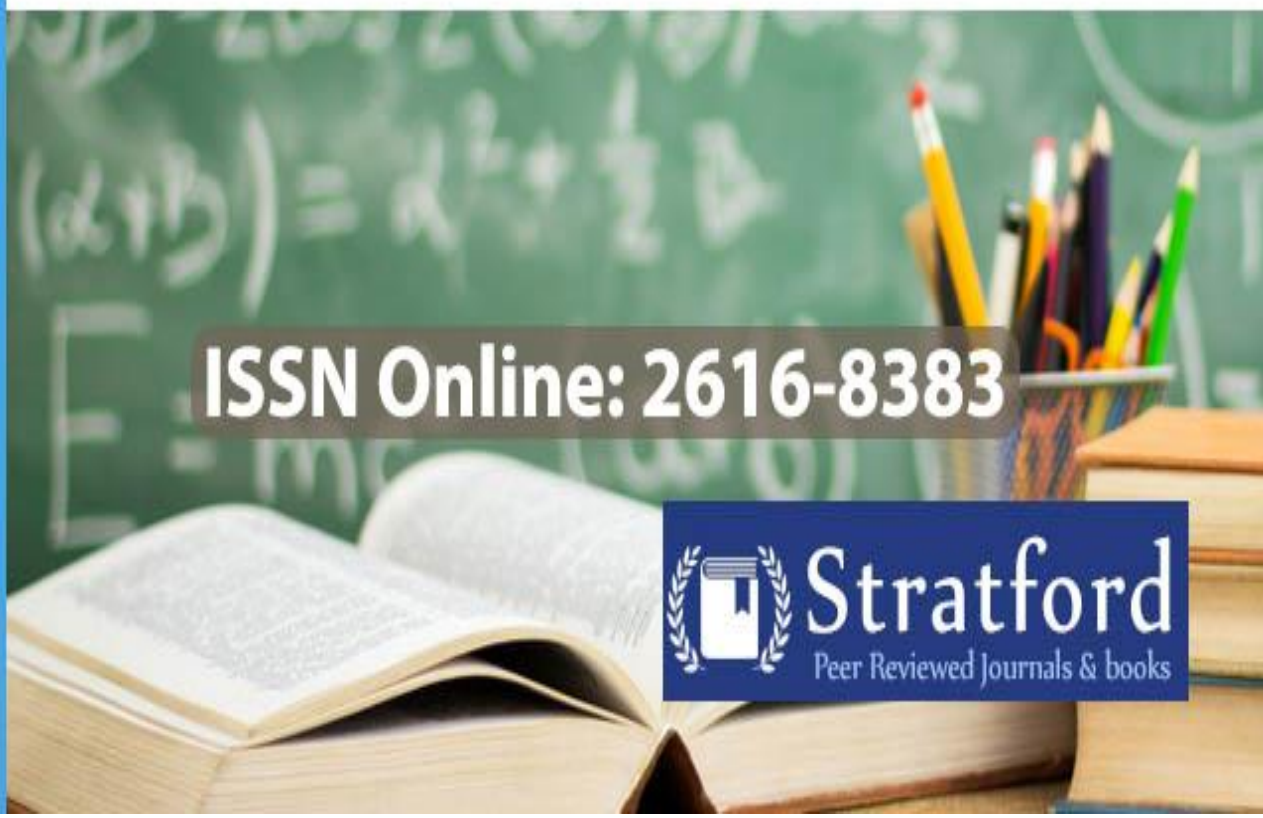

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Influence of Teachers 'Training on Students' Academic Performance in Science Subjects in Secondary Schools of Musanze Districts

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Abstract

The general objective of the current study was to assess the influence of training teachers on students' academic performance in science subjects with the case of selected secondary schools of Musanze district, Rwanda. The specific objectives were to assess the influence of teachers' training about preparation of practical sessions on students' academic performance in sciences subjects in selected schools of Musanze district, to examine the influence of teachers' training on equipment manipulation on students' academic performance in sciences subjects in selected schools of Musanze district and to find out the influence of teachers 'training on laboratory safety and equipment maintenance on students' academic performance in sciences subjects in selected schools of Musanze district. The study adopted a descriptive and correlational design which included descriptive survey and correlation analysis and a mixed approach of qualitative and quantitative approaches. The target population is made of science teachers, students and authorities. Pilot study was done using 10 respondents. Reliability was measured using Cronbach's Alpha. Validity of the instruments was measured using a team of experts in the field of education who are in charge of the area of study. Data was analyzed using qualitative and quantitative methods by SPSS version 20. The R value of 0.834 indicates a strong relationship between the predictors and the students' academic performance in sciences subjects in selected schools of Musanze district. The R Square value of 0.696 indicates that approximately 69.6% of the variability in the outcome variable can be explained by the predictors in the model. Overall, this model summary indicates a significant relationship between the planning factors and the outcome variable students' academic performance in sciences subjects in selected schools of Musanze district, with a good fit to the data. Specifically, Training about preparation of practical sessions has a coefficient of (β= 0.217, t=3.042, p value=0.003), Training in equipment manipulation and maintenance has a coefficient of (β= 0.259, t=4.422, p value=0.000), and Training on laboratory safety has a coefficient of (β= 0.480, t=6.336, p value=0.000). All these coefficients are statistically significant on students' academic performance in sciences subjects in selected schools of Musanze district, as indicated by their associated Sig. values below 0.05.

Key words: *Training, Teacher, Student, Performance.*

1. Introduction

Effective teaching is a crucial component of schools, a driver of positive outcomes, and a byproduct of good teaching, as teachers are the foundation of school performance (Bakkum, 2013). Additionally, Sammons *et al.* (2013) argue that a teacher's competence is crucial for the development of students' character and for classroom procedures that improve student outcomes. Furthermore, according to Bright (2008), teachers need training to be able to care about knowledge and skills, comprehend the curriculum, deal with technological change in the classroom, understand the developmental stages of children, and use learner motivation to enhance performance. There are different programs of teacher trainings like PGDE and SMASSE among others for improving teaching methodology, training on English, computers and technology among others, but still students 'performance in science subjects is still low.

Although the study of sciences subjects is found to be of high importance and the candidates at the area of applied sciences are increasing considerably even at higher learning level, the background of the students in this area is still worrying; for example, a comparable study was conducted in Nigeria (Jerry, 2009), where secondary school science performance was extremely low. This poor performance was a result of a number of reasons, including the lack of suitable learning facilities in the secondary schools that lack science laboratories and equipment, qualified teachers who are dedicated to their jobs, students who struggle to perform well in practices, and teachers that use ineffective teaching strategies (Akinola, 2006). Most of them have studied the sciences theoretically, others choose to study sciences due to the wish of parents or other sponsors without their own commitment and interest, and it seems that fear is due to the weak background from the secondary schools 'level. According to Ajaja (2009) the inability of sciences teachers to apply guided discovery inquiry approaches in their teaching is mainly due to the lack of laboratory equipment among others. On the other hand, according to Fakoya (2002) under-funding had adverse effects on the quality educational resources in secondary schools. Their enrollment in sciences subjects has been persistently low because they find learning of sciences not stimulating, not interesting and joyful nor motivating (Rotich, 2013).

However, there are secondary schools with sufficient and adequate practical equipment, reagents and consumables and the later are being disposed regularly while the students are also suffering from the lack of practical skills due to tutor approach of teaching sciences without practices. Among the main reasons, there is a problem of teacher's poor knowledge of managing science practical works and this affect negatively the performance of students in science subjects. According to the study conducted by Kizito Ndihokubwayo, Laboratory activities are not fully done because of insufficiency of laboratories. Only 5 out of 13 TTCs had science laboratories and teachers encounter many problems including time limitation, scarcity of some materials and lack of skills. (Ndihokubwayo, 2020).

After examining the issue of insufficient knowledge and lack of competence and skills on the side of teachers, some secondary schools' leaders in the northern province took the imitative of training teachers about practical skills in their schools in Musanze districts in 2021-2022 with the purpose of strengthening skills of teachers in practice management and then upgrade the students' academic performance in science subjects. Trainings took place in some secondary schools in above mentioned district where teachers were trained by university lecturers in the disciplines of chemistry, physics and biology.

Nevertheless, since these activities were implemented, during academic year 2021-2022, no specific study was conducted to investigate their influence on the performance of students. This study aims at investigating the influence of the performed trainings for science teachers on the performance of the students in science subjects in those selected secondary schools to fill that gap of knowledge.

In case a such study is not conducted, none one interested in training teachers on practical skills and the ones who have already taken this initiative took it as a waste of time and money. However, by conducting this study and show how fruitful it is, it encouraged both parties; the ones who have trained their teachers had time to appreciate the work done and reinforce it on one hand, and on the other hand those who did not yet train their teachers realized the loss and then start to adopt this good and fruitful initiative.

1.1 Objectives of the study

The general objective of this study was to assess the influence of teachers' training on the performance of students in sciences subjects in secondary schools.

Specific Objectives:

1. To assess the influence of teachers' training about preparation of practical sessions on students' academic performance in sciences subjects in selected schools of Musanze district.
2. To examine the influence of teachers' training in equipment manipulation and maintenance on students' academic performance in sciences subjects in selected schools of Musanze district.
3. To find out the influence of teachers 'training on laboratory safety on students' academic performance in sciences subjects in selected schools of Musanze and district.

1.2 Hypotheses

H_0: There is no significant influence of teachers' training on the performance of students in sciences subjects in secondary schools

H_{0a}. There is no significant influence of teachers' training about preparation of practical sessions on students' academic performance in sciences subjects in secondary schools

H_{0b}. There is no significant influence of teachers' training on equipment manipulation and maintenance on students' academic performance in sciences subjects in secondary schools

H_{0c}. There is no significant influence of teachers' training on laboratory safety on students' academic performance in sciences subjects in secondary schools

2. Literature review

2.1. Theoretical review

The theoretical review focuses on what other researchers, academics, and educators have stated about the usefulness and efficiency of laboratory resources, mechanisms for determining these factors, and other related topics.

2.1.1. Connectivism theory

Through network connections, according to Siemens' (2008) theory, people exchange their interests, knowledge, perspectives, expertise, and opinions in online or virtual learning settings.

George Siemens initially discussed connectivism in 2004 on a blog post, which was then turned into a paper and published in 2005.The central angle of connectivism is the representation of a organize with hubs and connections. In this representation, a hub is anything that can be associated to another hub such as an organization, data, information, sentiments, and pictures. Connectivism recognizes three hub sorts: neural, conceptual and external. Connectivism sees learning as the method of making associations and growing or expanding arrange complexity.

This theory of connectivism, applied during preparation of laboratory sessions when laboratory classes are vital for students to develop competencies such as critical observation, collaboration, critical thinking, technical, and problem-solving skills. Moreover, students who take virtual classes develop a sense of curiosity that motivates them to pay close attention in a lab setting in order to obtain precise results. Thus, we can make sure that students' curiosity and enthusiasm in science subjects rise as laboratory sessions are prepared.

2.1.2. Constructivism theory

Jean Piaget is often identified as the founder of constructivism. His work focused on children's cognitive development and suggested that kids play an active role in constructing their knowledge of the world.

According to the educational theory known as constructivism, people or students do not acquire knowledge and understanding by passively taking it in during a direct process of knowledge transmission. Instead, they create new understandings and knowledge through experience and social interaction, fusing new information with what they already know (called prior knowledge). Knowledge is actively generated by the cognizing subject (learner), not passively acquired from the environment, according to the fundamental principle of constructivism in contemporary publications (Matthews, 2003).

Constructivism is a way of looking at learning that starts with the learner's viewpoint rather than the teachers. The student does not get material in a one-way transaction. According to the constructivist viewpoint, understanding is created by the learner rather than imposed onto them.

According to Matthews (1992), knowledge is "personally and socially constructed". The learner uses his own experiences to build his understanding.

Constructivism is a perspective on learning that is initiated from the learner's perspective rather than by that of the teacher “understanding is constructed by the learner rather than placed upon the learner.” Practical reasoning can maximize the potential for constructivism to support teacher development.

The interaction between what preservice teachers is taught and what they bring to the learning environment occurs throughout the teacher education program; practical reasoning offers a mechanism via which each preservice teacher might build a constructivist knowledge. each educator. In context of the current work the theory of constructivism applied where students gain new knowledge by manipulating equipment and using laboratory materials and reagents to discover new phenomenon.

2.1.3. Humanism Theory

Humanistic Learning revolves around the learner being the source of authority. This means the student determines the learning method and materials. (Abraham Maslow, Carl Rogers, and James Bugental, 1990).

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Volume 7||Issue 1||Page 27-37 ||January||2024|
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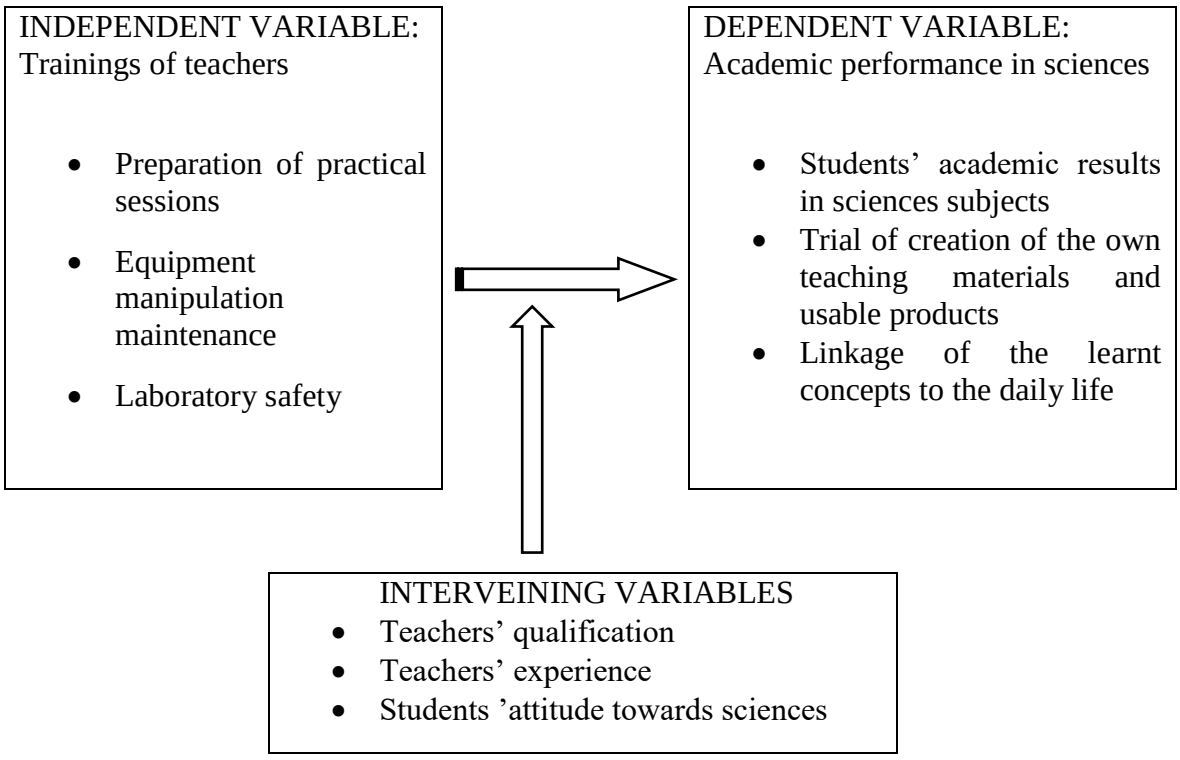
Maslow's humanistic theory of learning encourages innovation and creativity while purporting that everyone is responsible for his or her own learning as well as the learning of those around them. This theory encourages learners to be in supportive and safe environments so they are comfortable asking questions and exploring new.

The instructor acts as a coach and a facilitator. Humanist hypothesis plays a portion in approaches such as person-centered counseling, group-work approaches, student-centered learning, agreeable learning, and disclosure learning. Accentuation is on learner independence and self-motivation. Additionally, people have the capacity to judge truth and falsity for themselves using reason and empirical cognition. Learning is the process of acquiring new information through study, practice, and/or experience. It also includes the development of new habits, abilities, and beliefs. A "process by which behavior is changed, shaped, or controlled" is what it is (Knowles *et al*., 1998)

A key idea in this theory is the self-actualization need, which lies at the top of Maslow's hierarchy of needs. The humanism learning philosophy promotes students to be in nurturing and secure situations, to form relationships with the material and other people, and to take ownership of their own and others' education. In the context of the current study, the humanism theory was of great importance as to provide a safe environment by ensuring that safety measures are taken for laboratory sessions which allow students to develop new skills. Thus, to ensure the laboratory safety influence frequency of students' attendance in lab sessions due to favorable environment.

2.2 Conceptual framework



3. Research methodology

Different methodologies that employed in the study are presented in this chapiter.

3.1. Study Design

For this investigation, a descriptive survey design and correlational study design used. Both qualitative and quantitative data analysis used to find the relationship displayed by the variables. In brief descriptive and correlational design with mixed approach: qualitative and quantitative applied.

3.2. Study population

For the purpose of this work, the target population was the head teachers, heads of department of sciences where applicable, trained and untrained teachers, laboratory technicians where applicable and student from the 10 selected secondary schools in Musanze and Ngororero districts. The total number of study population is 176 people.

3.3. Sampling procedures/sample size determination and selection

The ever-increasing need for a representative statistical sample in empirical research has created the demand for an effective method of determining sample size. To address the existing gap, Krejcie & Morgan (1970) came up with a table for determining sample size for a given population for easy reference. The Table is constructed using the following formula for determining sample size.
Simple random sampling used in sampling for schools which do not yet train their teachers and snowball technique used to identify the schools which have trained their teachers since those are the simplest techniques with random sampling variants and also due to the anticipated structure of the population. Therefore, a total of 10 schools involved in the study.
The total number of respondents were 176 people composed by head teachers, science teachers, head of science departments, laboratory technicians and students.

3.4. Data collection methods

Considering the level of the literacy and age of the respondents participating in this study, the following data collection methods employed: questionnaire, interview guide, observation, FGD, and Documentary review.

3.5. Data analysis

In the current situation, data analyzed using both qualitative and quantitative analysis method. Gathered information analyzed through calculations and statistical presentation of the information made through pie-charts, frequency tables and graphs. Qualitatively, those issues describing the outcome of the research also analyzed.

4. Research findings

This study investigated the influence of training teachers on students' academic performance in science subjects. Out of a total of 176 questionnaires distributed, an impressive 172 were returned, resulting in a return rate of 97.7%. This high return rate is indicative of a strong and positive response from the surveyed individuals or groups. Only 4 questionnaires remained unreturned, representing a mere 2.3% of the total.

Stratford Peer Reviewed Journals and Book Publishing
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Volume 7||Issue 1||Page 27-37 ||January||2024|
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Table 1 Correlations

		Training about preparation of practical sessions	Training in equipment manipulation and maintenance	Training on laboratory safety	Students' academic performance
Training about preparation of practical sessions	Pearson Correlation	1	.607**	.757**	.711**
	Sig. (2-tailed)		.000	.000	.000
	N	172	172	172	172
Training in equipment manipulation and maintenance	Pearson Correlation	.607**	1	.692**	.705**
	Sig. (2-tailed)	.000		.000	.000
	N	172	172	172	172
Training on laboratory safety	Pearson Correlation	.757**	.692**	1	.796**
	Sig. (2-tailed)	.000	.000		.000
	N	172	172	172	172
Students' academic performance	Pearson Correlation	.711**	.705**	.796**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	172	172	172	172

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

In Table 1, strong positive correlations are evident between various planning factors and Project performance. Training about preparation of practical sessions exhibits a strong positive correlation of 0.711, highlighting that well-structured Training about preparation of practical sessions is closely linked to better Students' academic performance. Similarly, Training in equipment manipulation and maintenance shows a strong positive correlation of 0.705, indicating that effective Training in equipment manipulation and maintenance contributes significantly to improved Students' academic performance. Training on laboratory safety demonstrates a positive correlation of 0.796, emphasizing the importance of Training on laboratory safety in Students' academic performance. These correlations, all statistically significant at the 0.05 level, collectively indicates that enhancements in Training about preparation of practical sessions, Training in equipment manipulation and maintenance, and Training on laboratory safety are associated with improved overall students' academic performance in sciences subjects in selected schools of Musanze district.

The findings are in line with Heinrich's (2019) emphasis on the convergence of natural sciences and human sciences, where both follow similar rules and contribute to a deeper understanding of reality. Just as scientific research can challenge fundamental beliefs, the study's positive correlations between various training factors and students' academic performance in science subjects highlight the importance of structured training in enhancing educational outcomes, underscoring the interconnectedness of science and human understanding.

Table 2 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.834[a]	.696	.691	.36698

a. Predictors: (Constant), Training on laboratory safety, Training in equipment manipulation and maintenance, Training about preparation of practical sessions

Stratford Peer Reviewed Journals and Book Publishing
Journal of Education
Volume 7||Issue 1||Page 27-37 ||January||2024|
Email: info@stratfordjournals.org ISSN: 2616-8383

Table 2 presents the model summary for a regression analysis. The model includes predictors such as Training on laboratory safety, Training in equipment manipulation and maintenance, Training about preparation of practical sessions. The R value of 0.834 indicates a strong relationship between the predictors and the students' academic performance in sciences subjects in selected schools of Musanze district. The R Square value of 0.696 indicates that approximately 69.6% of the variability in the outcome variable can be explained by the predictors in the model. Overall, this model summary indicates a significant relationship between the planning factors and the outcome variable students' academic performance in sciences subjects in selected schools of Musanze district, with a good fit to the data.

The findings are consistent with Schuster, Murdick, and Klatt's (1985) emphasis on the role of training in increasing predictability of behavior and enhancing organizational efficiency. They underscore the notion that training aims to improve skills and behavior, aligning with the regression analysis that demonstrates the significant relationship between various training factors and students' academic performance in science subjects. This supports the idea that effective training can have a positive impact on educational outcomes.

Table 3 ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	51.881	3	17.294	128.411	.000[b]
	Residual	22.626	168	.135		
	Total	74.507	171			

a. Dependent Variable: Students' academic performance

b. Predictors: (Constant), Training on laboratory safety, Training in equipment manipulation and maintenance, Training about preparation of practical sessions

The F-statistic in Table 3, with an F value of 128.411, indicates the results of an Analysis of Variance (ANOVA) for the regression model. The associated significance level (Sig.), denoted as .000, is less than the typical significance threshold of 0.05. This implies that the overall model, which includes predictors like Training on laboratory safety, Training in equipment manipulation and maintenance, Training about preparation of practical sessions, is statistically significant. In simpler terms, there is strong evidence to assume that at least one of the predictors in the model has a significant impact on the dependent variable, students' academic performance in sciences subjects in selected schools of Musanze district. This indicates the importance of these teachers' training factors in influencing students' academic performance outcomes.

The findings are consistent with Narad and Abdullah's (2016) emphasis on academic performance as the evaluation of knowledge acquisition and achievement through teacher-assigned marks and educational goals. The study's focus on training factors influencing students' academic performance aligns with Narad and Abdullah's perspective on assessing educational achievement.

Stratford Peer Reviewed Journals and Book Publishing
Journal of Education
Volume 7||Issue 1||Page 27-37 ||January||2024|
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Table 4 Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.297	.169		1.758	.081
	Training about preparation of practical sessions	.217	.071	.201	3.042	.003
	Training in equipment manipulation and maintenance	.259	.059	.265	4.422	.000
	Training on laboratory safety	.480	.076	.461	6.336	.000

a. Dependent Variable: Students' academic performance

Project performance = 0.297+0.217(Training about preparation of practical sessions) + 0.259(Training in equipment manipulation and maintenance) + 0.480 (Training on laboratory safety)

In Table 5, the constant term, representing the estimated intercept of the regression model, has an unstandardized coefficient of 0.297 with a standard error of 0.169, but it is not statistically significant with a Sig. value of 0.081. The unstandardized coefficients for the predictor variables show their individual impacts on Students' academic performance. Specifically, Training about preparation of practical sessions has a coefficient of (β= 0.217, t=3.042, p value=0.003), Training in equipment manipulation and maintenance has a coefficient of (β= 0.259, t=4.422, p value=0.000), and Training on laboratory safety has a coefficient of (β= 0.480, t=6.336, p value=0.000). All these coefficients are statistically significant on students' academic performance in sciences subjects in selected schools of Musanze district, as indicated by their associated Sig. values below 0.05.

The findings align with Joshua Makundu *et al*. (2017) emphasis on the purpose of employee training and teacher development. Their focus on increasing teachers' knowledge, professional skills, commitment to their roles, and capacity to engage students and integrate real-world aspects into teaching is reinforced by the significant impact of specific training areas on students' academic performance, illustrating the importance of ongoing training and development in education.

Table 6: Hypotheses results

Hypotheses	**P Value**	**Comment**
Ho: There is no significant influence of teachers' training on the performance of students in sciences subjects in secondary schools	p<0.05	**Rejected**
Hoa: There is no significant influence of teachers' training about preparation of practical sessions on students' academic performance in sciences subjects in secondary schools	p<0.05	**Rejected**
Hob: There is no significant influence of teachers' training on equipment manipulation and maintenance on students' academic performance in sciences subjects in secondary schools	p<0.05	**Rejected**
Hoc: There is no significant influence of teachers' training on laboratory safety on students' academic performance in sciences subjects in secondary schools	p<0.05	**Rejected**

The results of the hypotheses testing in Table 6 provide significant overviews into the influence of teachers' training on the performance of students in sciences subjects in secondary schools. Each null hypothesis (Ho, Hoa, Hob or Hoc) has been rejected ($p < 0.05$), indicating strong evidence against the idea that these training practices have no significant effect on the performance of students in sciences subjects in secondary schools. Specifically, teachers training, Training on laboratory safety, Training in equipment manipulation and maintenance, Training about preparation of practical sessions, all demonstrate a significant influence on the performance of students in sciences subjects in secondary schools. These findings emphasize the critical role of comprehensive teachers training in achieving the performance of students in sciences subjects in secondary schools.

5. Conclusions

The study assessed the influence of teachers' training on the performance of students in sciences subjects in secondary schools, with a focus on Training about preparation of practical sessions, Training in equipment manipulation and maintenance, and Training on laboratory safety. The findings show valuable observations into the effectiveness of these teachers' training tools.

Specifically, teachers training, on laboratory safety, training in equipment manipulation and maintenance, training about preparation of practical sessions, all demonstrate a significant influence on the performance of students in sciences subjects in secondary schools. These findings emphasize the critical role of comprehensive teachers training in achieving the performance of students in sciences subjects in secondary schools. The coefficients for these training on practices were statistically significant ($p<0.05$), supporting their positive influence on the performance of students in sciences subjects in secondary schools. The study rejects the null hypotheses (Ho, Hoa, Hob, and Hoc), affirming that these training practices have a substantial effect on achieving the performance of students in sciences subjects in secondary schools.

6. Recommendations

- Teachers' training in secondary schools should emphasize practical session preparation by incorporating hands-on activities and real-world applications into the curriculum to enhance students' understanding and performance in science subjects.
- Ministry of Education is recommended to also plan teachers' training in equipment manipulation and maintenance, ensuring educators are proficient in using and maintaining laboratory equipment, which is crucial for effective science education and improved student performance.
- To enhance students' academic performance in science subjects, Musanze district should emphasize teachers' training on laboratory safety, promoting a safe and secure learning environment through proper safety protocols and procedures.

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