Journal of Education and Practice www.iiste.org
ISSN 2222-1735 (Paper) ISSN 2222-288X (Online) DOI: 10.7176/JEP
Vol.10, No.18, 2019

Influence of Preservice Teacher Learning on the Application of Laboratory Experiment Teaching Method

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Abstract

This paper sought to establish the influence of Laboratory Experiment Teaching Method on the Bachelor of Education (B.Ed) Science students' performance during teaching practice. The sample comprising 107 B.Ed Science students, their respective Head of Subjects, and the three faculty provided the study data through questionnaires, interview schedules and the teaching practice assessment form. The data were analyzed descriptively and inferentially. The study concluded that (i) the Laboratory Experiment Teaching Method as taught in the university-based subject Methods Course and applied by the B.Ed Science students on TP is limited. (ii) The HoS can be an important school-based resource for provision of technical support (iii) the classroom is a potential context for learning to apply as well as hone the Laboratory Experiment Teaching Method. The study recommended that (i) technical support be enhanced to further adoption of and hone the instructional practices found 'difficult' or superficially developed (ii) Lobby for a structured supervision partnership with the HoS (ii) faculty tu design a portfolio of learning experiences on application of the Laboratory Experiment Teaching Method that relate to the individual and context-specific needs, and use the data to improve the B.Ed Science students' experiential learning both at the university and at the school-based teaching practice experiences.

Keywords: Laboratory experiment, teaching practice, competency, performance

DOI: 10.7176/JEP/10-18-15

Publication date:June 30th 2019

1. Introduction and Background

The subject matter of science comprises the material world. As such, learning science should involve seeing, handling and manipulating real objects and materials, while teaching science should involve acts of 'showing' as well as of 'telling' (Millar, 2004). According to UNESCO (2005) the achievement of students in science subject depends on the education of their teachers. This implies that teachers' competency in teaching science is an important factor in determining the success of a learning session. This makes it critical that preservice teachers are helped to develop the cognitive and behavioral skills that can enable them to make the learning tasks more accessible and visible to secondary school students, hence improved learner achievement.

The rationale of this study stems from the fact that the development of method-specific instructional practices in which the B.Ed Science students develop their intellectual and procedural skills is critical because the skills are transferable and are key in the application of teaching methods in science classrooms. However, what is not clear is the influence of the preservice teacher learning in the mandatory university-based subject methods course, and the resulting pedagogical understanding of the instructional practices that constitute a teaching method that they may choose to apply in a lesson during teaching practice. This study therefore examined the preservice teachers' acquisition of theoretical and practical knowledge of the Laboratory Experiment Teaching Method, and the subsequent application of the same in real classrooms during teaching practice.

1.1 Statement of the Problem

Studies show that often students do not learn from a laboratory experiment what their teachers expect them to learn (Millar, 2009). Notably, a common criticism in science education is that as typically taught and conducted, the laboratory experiment is 'recipe following', with the students often not thinking about *why* they are doing *what* they are doing. This contributes to the low learner achievement synonymous with most developing countries. For instance, the performance of science subjects in the Kenya National Examination Council is below average with reports that performance in the practical paper is below expectation. For instance, in the last six years the results are as in table 1 below:

Table 1: KCSE Science Subjects Performance for 2013 – 2017

Subject	*2013 Mean Score*	*2014 Mean Score*	*2015 Mean Score*	*2016 Mean Score*	*2017 Mean Score*
Biology	26.21	31.63	31.83	34.80	18.93
Chemistry	27.93	24.83	32.16	34.36	24.05
Physics	37.87	40.10	38.84	43.68	35.05

Source: KNEC (2018) Examination Report

The low learner achievement in the National examination suggests a persistent inappropriate teaching of science subjects at secondary schools in Kenya. This status quo resonates with the status of science education globally and draws a general concern about teacher preparation for quality education that centers on what teachers need to know and be able to do. Specifically, the instructional practices that preservice teachers need to learn how to implement (Ball & Forzani, 2009) particularly for effective laboratory experiment teaching. The objective of the study was to establish preservice teacher preparation for application of Laboratory Experiment Teaching Method.

1.2 Purpose

The purpose of this study is to investigate the influence of the university-based and school-based learning on the application of the Laboratory Experiment Teaching Method during teaching practice of the B.Ed Science students. The aspects studied are in terms of theoretical and practical application of the Laboratory Experiment Teaching Method. The contribution is analyzed as a whole by showing the relationship among the four components studied. Contribution and the competency factors identified are expected to help in improving the quality and standards of designing, planning, structuring and presenting scientific experiments in secondary schools.

1.3 Objective

To establish the influence of the Laboratory Experiment Teaching Method on the B.Ed Science students performance during teaching practice.

1.4 Hypothesis

The null hypothesis formulated from the objective was: H_0: Laboratory Experiment teaching method has no significant influence on the teaching practice performance.

2. Review of Related Literature

In the secondary science education scientific concepts and principles are established and verified through observation and analysis of experiments in the laboratory. However, many teachers do not effectively facilitate and guide students during experiments and therefore students' cognitive processes is low when conducting the experiments. Copriady (2014) explains that this is because the design, planning, structure and presentation of the learning tasks is not done in ways that can help the learners construct knowledge. Effective experimentation occurs when teachers have the pedagogical understanding of the instructional practices that constitute the Laboratory Experiment Teaching Method. Such teachers have the ability to appropriately design the learning material, plan, structure and implement practical experiments.

The Laboratory Experiment supports students to link two 'domains' of knowledge: the domain of objects and observable properties and events on the one hand, and the domain of ideas on the other hand. According to Millar (2009) experiment in science education serves to connect the domain of objects and observables to the domain of ideas. The domain of ideas have a significantly higher learning demand than the domain for observations of events, hence the need for student support to make sense of the activity. This implies that to explain scientific phenomena, teachers must appropriately link the hands-on experiences to the brains-on real life experiences of learners. This has potential to promote knowledge construction and help students to develop deep understanding of concepts. However, Hofstein & Lunetta, (2004) observe that it is because the students participation in the prescribed laboratory experiment procedures and equipment is passive and of low cognitive level. Therefore to address the gap between ideas and the phenomena, science subject teachers should be prepared to guide learners in discussing the phenomena studied in the experiment, and verify their ideas with real life experiences. In this regard, focus of the mandatory university-based subject methods course should be the development the pedagogical understanding to help the student to explore, analyze, explain and apply data in abstract situations. This will enable preservice teachers to connect the science content and real-life phenomena.

Studies done on application of Laboratory Experiment Teaching Methods in science teaching (Dillon, 2008; Delargey, 2001; Buffler, Allie, & Lubben (2001); Fischer, Shah, Tubiello, and van Velhuizen, 2005; Fadzil & Saat, 2013; Woolnough, 1991; Lunetta, Hofstein & Clough (2007). and Ben-Zvi., Hofstein, Samuel and Kempa

(1976) show that often students do not learn from the Laboratory Experiment Teaching Method what their teachers expect them to learn because laboratory experiment follow a prescribed procedure and therefore do not enhance learning of theoretical concepts (Millar, 2009, Abrahams, 2011). This has raised questions on the contribution of Laboratory Experiment Teaching Method to science teaching and learning. Thus the fact that there is consensus among researchers that secondary students face challenges in regard of science knowledge and process skills, and with reports that the Laboratory Experiment Teaching Method on its own is not an effective learning tool, the objective of this study is to establish the influence of the Laboratory Experiment Teaching Method as learnt in the subject methods course on the B.Ed Science students' performance during teaching practice.

2.1 Theoretical Framework

Learning to apply the teaching methods for science subjects is best carried out in a context similar to that in which the preservice teachers will eventually apply the skills learnt. This epistemological root establishes the constructivist theory of learning and informs the preparation of B.Ed Science students. Ciminelli (2009) holds that constructivist pedagogy requires that the teacher has the competency to create an environment where students learn from one another. print material, manipulate equipment and technologies, hold subject discourse and engage in deep reflection, hence construct own mental models of concepts.

3 Methodology

3.1 Research Design

The current study involved a clearly defined problem and definite objective as well as a hypothesis. According to Best and Khan (2008) when the problem is clearly defined and the objectives are definite, a descriptive survey research design is most appropriate.

3.2 Target Population and Sample Size

The target population of the current study was 145 B.Ed Science students who had completed and passed the Subject Methods course, hence qualified to proceed for teaching practice, their respective HoS in the TP schools and 3 faculty. The researcher used Yamane's sample size formula for sampling and determined a sample size of 107 B.Ed Science Students. An equal number of HoS in the teaching practice schools and 3 faculty members participated in the study.

3.3 Data Collection

By focusing on the B.Ed Science students' fluency of demonstration of the instructional practices adopted during the mandatory university-based subject methods course made it possible to observable and measure the application of the Laboratory Experiment Teaching Method. This made it possible to identify *what* the B.Ed Science student know and can do at the onset of TP. As argued by Harlem (2015), instructional practices that describe agreed aspects of a teaching method determines the data to be collected and the criteria for judging whether the application of the teaching method is or is not meeting the expected standards. In that respect, two questionnaires were constructed to determine the sampled B.Ed Science students and the HoS views while a guided expert interview Schedule was administered to faculty to provide their views on the content and nature pre-service teacher preparation for application of the Laboratory Experiment Teaching Method. Factor analysis was conducted to determine whether the instrument items measure the construct they purport to measure (Field, 2013). Specifically, Bartlett's test of sphericity and Kaiser-Meyer-Olking (KMO) were conducted and the results showed acceptable degree of sampling adequacy, hence verified the constructs as valid and therefore fit for analysis (Saunder et. al., 2007). Internal consistency was tested using Cronbach's Alpha of coefficient test (Drost, 2012) and results revealed 0.74 for teaching practice supervision and assessment, and 0.78 for the Laboratory Experiment Teaching Method. This was above the 0.70 value suggested by Nunnally (1978), hence the data were reliable and acceptable for further analysis.

Data for the sample B.Ed Science students TP performance was obtained from scores awarded on the Lesson Development Component of the official Teaching Practice supervision form. The Lesson Development Component focuses on mastery, treatment and sequence of subject content, appropriate use of teaching methods such as lecture, discussion etc, learner involvement, and is scored out of 25 marks. The score attained was recorded at the onset and towards the end of the teaching practice session. In the lesson development component the B.Ed Science students is scored on their fluency to apply particular teaching methods by assessing and then assigning a score.

3.4 Data Analysis

Investigation of the influence of preservice teacher learning on the application of laboratory experiment teaching method is a social phenomenon. As such, the influence it has o on the teaching practice performance cannot be measured directly. Therefore, descriptive statistics were used to describe and summarize the variables, while inferential statistical tools were used to used to test for the hypothesis. Specifically, the Standard Linear Regression model, was adopted to test the hypothesis, the Standardized Beta coefficients determined the partial effect of the Laboratory Experiment Teaching Method on the TP Performance of the B.Ed Science students, and correlation analysis was conducted to determine the nature of the relationship between the Laboratory Experiment Teaching Method and the teaching practice performance of the sampled B.Ed Science students.

To compute multiple regression, the data were assessed for normality, homoscedasticity, outliers and linearity. It was found that the data set did not violate statistical assumptions, hence was reliable and fit for multiple regression modeling. Moderation analysis was used to determine the moderation effect of TP supervision and assessment on the relationship between the Laboratory Experiment Teaching Method and the Teaching Practice performance of the sampled B.Ed Science students. Both analyses were used to test the research hypotheses at significance levels of 0.05.

3.5 Ethical Consideration

The ethical principles observed and applied throughout the study were prior informed consent of the participants, their privacy, and confidentiality (BPS, 2006), and concern for participants' interests were emphasized (Barrett, 2007; BPS, 2006; Cohen, Manion & Morrison (2007). The researcher through an introductory letter informed the respondents about the purpose of the research, procedure of participation, the benefits to be gained and the extent of confidentiality. The participants consented by signing informed consent forms prior to data collection.

4. FINDINGS AND DISCUSSIONS

4.1 University-Based Teacher Preparation for Application of the Laboratory Experiment Teaching Method

The student questionnaire sought to establish the sampled B.Ed Science students' experience of learning how to apply teaching methods in the subject methods courses for science subjects. The statements were anchored on a Likert-type scale and respondents were asked to indicate the extent to which they agreed to the statements.

Table 2 University-based learning for application of teaching methods

	Agree	Undecided	Disagree
I gained knowledge of how to apply each of the teaching methods	101 96.2%	0 0.0%	4 3.8%
I was shown how to apply each teaching methods	59 56.2%	10 9.5%	36 34.3%
We collaboratively planned and prepared a lesson plan with my class mates	67 63.2%	6 5.7%	33 31.1%
I practiced all the teaching methods in a short lesson to my classmates who acted as students	55 51.9%	9 8.5%	42 39.6%
I evaluated my application of teaching methods together with my colleagues	57 53.8%	16 15.1%	33 31.1%
I was given a chance to re-plan and re-teach the teaching methods	6 5.7%	4 3.8%	95 90.5%
The course helped me learn how to plan for teaching	101 98.1%	1 1.0%	1 1.0%
The course helped me learn how to organize and sequence the content to teach and match it with appropriate teaching method	74 69.8%	21 19.8%	11 10.4%
The course helped me learn how to assess student based on my teaching method	46 43.4%	37 34.9%	23 21.7%
The course was relevant for my learning how to apply the teaching methods	97 92.4%	3 2.9%	5 4.8%
I had an opportunity to do micro-teaching	69 66.3%	5 4.8%	30 28.8%
The microteaching sessions were adequate for my learning how to teach	22 20.8%	18 17.0%	66 62.3%
Microteaching sessions helped me learn to appropriately apply the different teaching methods appropriately	38 35.8%	16 15.1%	52 49.1%

Finding of item 1 and 2 showed that the B.Ed Science students attributed the instructional practices that constitute particular teaching methods that they adopted to the university-based subject methods course. The finding of items 3-6 revealed that the B.Ed Science Degree Program comprised an experiential learning component whose learning tasks were modelled on practices in a context similar to which they would apply the teaching methods. The results of items 7 – 10 revealed that the practical aspect of the subject methods course

comprised experiential learning designed to expose the B.Ed Science students to approximations of classroom practices. A minority however, reported that they did not find the subject methods course relevant for their learning how to teach. The results of items 11-13 revealed that the B.Ed Science students found the microteaching sessions insufficient for their learning how to apply the teaching methods in lessons because they did not get adequate opportunity for approximations of practice which is key in transferring theory into practice.
This finding established that the B.Ed Science curriculum is cognizant of the fact that the theory of learning connects to experience. Additionally, the findings illustrate that collaborative reflection and repeated instructional practices help B.Ed Science students to identify the mis-matches between their prior knowledge and understanding, and current instructional practices, and provide the possibility to hone them. However, a shortcoming noted is that the B.Ed Science students in the current study were not engaged in multiple cycles of planning, teaching, and reflection. Nevertheless, they collaboratively reflected on their teaching and received feedback from peers.

4.2 Descriptive analysis of the Laboratory Experiment Teaching Method

The objective of the study was: *To establish the influence of the Laboratory Experiment Teaching Method on the B.Ed Science students' performance during teaching practice*. A descriptive analysis was conducted both at the beginning and at the end of the teaching practice session. Focusing on the instructional practices that constitute Laboratory Experiment Teaching Method made it possible to identify what the B.Ed Science student know and can do as a result of their learning how to apply the Laboratory Experiment Teaching Method in the mandatory university-based Subject Methods Course.

Table 3 Application of Laboratory Experiment Teaching Method by B.Ed Science Students at the onset of TP.

Statement		SD	D	U	A	SA
The teacher wrote the objectives of the experiment on the board	**Count**	0	1	2	24	79
	%	0.0%	0.9%	1.9%	22.6%	74.5%
The subject experiment procedures are prescribed in the class text books	**Count**	0	0	0	22	84
	%	0.0%	0.0%	0.0%	20.8%	79.2%
The teacher organized students to work in small groups	**Count**	6	29	7	31	34
	%	5.6%	27.1%	6.5%	29.0%	31.8%
The teacher ensured students have the right apparatus and chemicals	**Count**	1	0	4	74	27
	%	0.9%	0.0%	3.8%	69.8%	25.5%
The teacher did not tell students the expected results/observations in advance	**Count**	1	0	4	67	34
	%	0.9%	0.0%	3.8%	63.2%	32.1%
The teacher demonstrated activities ahead of a subject laboratory experiment	**Count**	5	40	13	40	8
	%	4.7%	37.7%	12.3%	37.7%	7.5%
The teacher provided an opportunities for students to manipulate apparatus during the experiment	**Count**	0	1	0	77	27
	%	0.0%	1.0%	0.0%	73.3%	25.7%
The teacher provided clear instructions at key points during the experiment.	**Count**	9	49	7	28	12
	%	8.6%	46.7%	6.7%	26.7%	11.4%
The teacher allowed students to observe, measure, record and report experiment results.	**Count**	0	0	0	69	36
	%	0.0%	0.0%	0.0%	65.7%	34.3%
The teacher allowed students to present and discuss the subject experiment results	**Count**	5	53	4	30	13
	%	4.8%	50.5%	3.8%	28.6%	12.4%

Total average score of Application of laboratory teaching method at the beginning of TP

N	Mean	%mean	SE	SD	Skewness	SE
107	3.8383	76.8%	0.0445	0.4578	0.255	0.235

Journal of Education and Practice www.iiste.org
ISSN 2222-1735 (Paper) ISSN 2222-288X (Online) DOI: 10.7176/JEP
Vol.10, No.18, 2019

Table 4 Application of Laboratory Experiment Teaching Method by B.Ed Science students towards end of TP.

Statement		SD	D	U	A	SA
The teacher wrote the objectives of the experiment on the board	**Count**	0	1	1	29	76
	%	0.0%	0.9%	0.9%	27.1%	71.0%
The subject experiment procedures are prescribed in the class text books	**Count**	0	2	1	29	75
	%	0.0%	1.9%	0.9%	27.1%	70.1%
The teacher organized students to work in small groups	**Count**	6	29	7	31	34
	%	5.6%	27.1%	6.5%	29.0%	31.8%
The teacher ensured students have the right apparatus and chemicals	**Count**	0	2	3	50	52
	%	0.0%	1.9%	2.8%	46.7%	48.6%
The teacher did not tell students the expected results/observations in advance	**Count**	1	0	2	54	50
	%	0.9%	0.0%	1.9%	50.5%	46.7%
The teacher demonstrated activities ahead of a subject laboratory experiment	**Count**	6	30	6	32	33
	%	5.6%	28.0%	5.6%	29.9%	30.8%
The teacher provided an opportunities for students to manipulate apparatus during the experiment	**Count**	0	2	3	53	49
	%	0.0%	1.9%	2.8%	49.5%	45.8%
The teacher provided clear instructions at key points during the experiment	**Count**	1	24	7	40	33
	%	1.0%	22.9%	6.7%	38.1%	31.4%
The teacher allowed students to observe, measure, record and report experiment results.	**Count**	1	0	2	54	50
	%	0.9%	0.0%	1.9%	50.5%	46.7%
The teacher allowed students to present and discuss the subject experiment results	**Count**	1	28	3	41	32
	%	1.0%	26.7%	2.9%	39.0%	30.5%

Total average score of application of Laboratory Experiment method in teaching at the end of TP

N	Mean	%Mean	SE	SD	Skewness	SE
107	4.1565	83.1%	0.0517	0.5349	-0.676	0.234

The results of items 1 and 2 revealed that majority of the sampled B.Ed Science students were fluent in the instructional practices of beginning the experiment by writing the objectives of the experiment on the board and facilitated the laboratory experiments as per the prescribed procedures and apparatus giving no room for alternative ways of performing the experiment. Kim, and Chin (2011) cautions that following the prescribed instructions is not sufficient to enhance inquiry skills and minds. The fact that no significant improvement in adoption of the practices occurred over the TP session indicates that the two practices were well developed during the university-based coursework.

The results of items 3 and 4 show that the conception about use of group work in Laboratory Experiment Teaching Method was not well developed during the university-based subject methods course and did not improve much over the TP session. Thus seemingly, the B.Ed Science student conception of the use of group work was unstable, and the repeated practices over the school-based learning did adoption of the practice. This means that those who had existing knowledge could not hone their practices. Frykedal and Chiriac (2012) observe that many teachers abandon group work because they consider use of group work as a pedagogical tool less useful, and therefore refrain from using group work. The current study, however, focused on group work as a curriculum outcome in the subject methods course for the B.Ed Science students.

The results of items 5 and 6 show that the B.Ed Science students had existing knowledge of how to create cognitive challenge for learners leading to innovation. By demonstrating the experiment, the B.Ed Science students were able to promote the ability of learners to conduct the experiment process. The significant increase in the number of those who adopted instructional practices during teaching practice, implying that although the practice was initiated in the university-based subject methods course, it was not stable and requires repeated practice in real classroom for sustainability. Kloser (2014) advices that during teacher preparation the preservice teachers should engage in real-world phenomena through demonstrations, hands-on activities, and laboratory investigations so as to initiate the development of conceptual understanding. Observation of faculty modelling could be an opportunity for mental practice leading to formation of mental models.

The results of items 7 and 8 reveal that a majority of the sampled B.Ed Science students came into teaching practice with a well-developed pedagogical understanding of the practice of helping learners manipulate apparatus during the experiment while only a few had concrete knowledge of effectively directing students through the experiment. There was a significant increase of (31.4%) in the number of B.Ed Science students who learnt and adopted the practice during the TP session while 21.4% who came into teaching practice with existing knowledge of the practice refrained from using it. This indicates that the practice, even though developed at the university-based subject methods course was superficial, hence was unstable. Nevertheless, the practice can also be developed within the classroom context. Berg, (2009) points out that teachers use laboratory experiment as an instructional method to link theories and the real life phenomena and equipment. In the current study, the B.Ed

Science students had no teaching experience but had been exposed to the information on the possible indicators and what should be observed during the university based subject methods course.

The results of items 9 and 10 indicate that the sampled B.Ed science students came into teaching practice with concrete knowledge for promoting acquisition of foundational science skill. With regard to provision of opportunity to discuss results of the experiment, there was a significant increase (28.5%) in the number of B.Ed Science students who adopted the practice within the classroom context. This means that the practice can also be learnt in the classroom context, and further implies that the classroom context is appropriate for the B.Ed Science students with unstable pedagogical understanding to hone their practice.

The total average score for application of Laboratory Experiment Teaching Method show that approximately %M=76.8% (M=3.8383) of the B.Ed Science students on TP demonstrated fluency in the application of Laboratory Experiment Teaching Method during lessons at the beginning of the TP session, while towards the end of the TP session the score increased by 6.3% so that approximately %M= 83.1% (M=4.1565) of the sampled B.Ed Science students on teaching practice demonstrated fluency in the instructional practices that constitute that laboratory teaching method during lessons. This is consistent with the B.Ed science students' and their HoS opinion, as well as faculty interview response in which they indicated that the B.Ed Science students found the Laboratory Experiment Teaching Method easy to apply. Further, the high total average scores suggests that most B.Ed Science students went into teaching practice having already developed a concrete knowledge of most of the instructional practices that constitute the Laboratory Experiment Teaching Method, from the university-based subject methods course. This could be the reason majority found the Laboratory Experiment Teaching Method easy to apply (based on their own self-reports and the HoS reports). For instance the Faculty who taught Subject Methods: Physics Education on how they prepare the B.Ed science students to effectively demonstrate or facilitate the secondary school laboratory experiments when he said;

> *... we train them on the use of a* ***Kit Course. T****here is a kit that is normally prepared* ***SEPU,*** *and another one by Jomo Kenyatta. So a teacher who has been trained and goes to a school where we don't have enough laboratory equipment will be able to adopt the teacher demonstrations, where the apparatus are limited (September, 2017).*

The faculty who taught Subject Methods 331: Biology Education clarified further saying the B.Ed Science students;

> *...do practical for various academic course units e.g. ecology, genetics, bio chemistry ie secondary school practical are the simplified form of this practical and therefore the B.Ed Science students should be in a position to handle them effectively. (September, 2017)*

This suggests that the use of highly structured tasks enabled the B.Ed Science students to facilitate laboratory experiment activities as intended by the secondary school curriculum.

4.3 Influence of Teaching Practice Session on Application of Laboratory Experiment Teaching Method by the B.Ed Science Students

Table 5 Mean difference in application of Laboratory Experiment Teaching Method at the onset and towards of TP

	Paired Differences							
				95% Confidence Interval of the Difference				
	Mean Difference	Std. Deviation	Std. Error Mean	Lower	Upper	T	Df	Sig. (2-tailed)
Pair 1	.31599	.68448	.06648	.18416	.44781	4.753	105	.000

Table 5 shows a slight significant improvement of 6.3% in the number of students who were able to demonstrate fluency in the instructional practices that constitute the Laboratory Experiment Teaching Method during the TP session (*Mean Difference=0.31599 (6.3%), SE = 0. 066481,* t *= 4.753,* df*= 105,* p_value *= 0.000< 0.05*). The increase of 6.3% indicates that TP supervision practices can be a good resource to promote fluency in the demonstration of instructional practices that constitute the Laboratory Experiment Teaching Method hence TP performance. Additionally, the increase of 6.3% though small was significant and implies that the classroom context has potential for adoption of instructional practices if appropriate technical support is provided, as well as honing of ones that may have been superficially acquired. The slight improvement of 6.3% noted was perhaps due to repeat practices of experiment skills coupled with technical support from the HoS and university supervisors. According to Kim and Chin (2010) science subject teachers face challenges when carrying out laboratory experiments because of lack of technical support. Without technical support, teaching and learning materials, implementing laboratory experiments can be difficult and challenging. Therefore, to further, enhance acquisition of the practices and therefore access to scientific knowledge and its relationships, the B.Ed Science students need to be helped to develop concrete knowledge to direct the learners to the aspect of focus, and to reflect on the observations made in a particular way. This finding is consistent with the findings of a study reported by Kärnä, Hakonen, and Kuusela (2011). In the study, the effect of several procedures were evaluated by correlating the mean of a certain method of teaching as reported by the learners mean result of the tests. The results showed that laboratory experiment is the strongest contributor in developing cognitive knowledge in science subjects.

4.4 Teaching Practice Performance of B.Ed Science Students

The researcher sought to determine the TP performance of the B.Ed Science students specifically their scores on the teaching methods component which was scored out of 25%.

Table 6 Performance of B.Ed Science students both at the onset and towards the end of the TP

Average TP Performance	Valid n	Minimum value	Maximum value	Mean		SD	Skewness	
				Statistic	SE		Statistic	SE
Overall score at the onset of TP	105	55	84	69.74	.574	5.885	.090	.236
Overall score towards end of TP	107	57	84	71.93	.579	5.994	-.292	.234
Component score at the onset of TP	103	12	23	16.97	.234	2.378	.107	.238
Component score towards end of TP	106	10	23	17.48	.274	2.819	-.388	.235

The score results showed that at the beginning of the TP session the sampled B.Ed Science students had an average score of 16.97 on the Lesson Development Component, which was slightly lower than that towards the end of 17.48. The scores reveal that generally the performance was maintained over the TP period. This performance however, fell short of the expected performance of 25% perhaps due to systemic challenges and barriers.

Table 7 Paired sample T test for difference in average TP performance at the onset and towards end of TP

		Paired Differences					T	Df	Sig. (2-tailed)
		Mean Difference	SD	SE of mean	95% CI of the Difference				
					Lower	Upper			
Pair 1	OSE – OSB	2.219	7.616	.743	.745	3.693	2.986	104	.004
Pair 2	CSE – CSB	.553	3.383	.333	-.108	1.215	1.660	102	.100

OSE: *Overall TP performance score towards the end of TP*
OSB: *Overall TP performance score at the onset of TP*
CSE: *Lesson Development Component score at towards end of TP*
CSB*: Lesson Development Component score at the onset of TP*

With regard to the variation in the lesson development component scores, the results of table 7 shows that for Pair 2 the mean difference was not significant towards the end of the TP session compared to the beginning of the TP session [*Mean Difference=0.553, SE = 0. 333,* t *= 1.660,* df*= 102,* p_value *= 0.001 < 0.05*].

The performance results of teaching methods further revealed a mean difference of .553 suggesting that the B.Ed Science students have the capacity for immediate improvement in their application of teaching methods if the university-based and school-based experiential learning is geared towards stimulating their development as effective teachers, appropriate technical support is provided, and the challenges experienced are addressed. This finding resonates with the finding of a study carried out by Gary, Kevin and Fortner shows that teachers' effectiveness in the classroom improves substantially between their first and second years on the job. Since teacher performance during a lesson is determined by application of teaching methods applied for the learning materials, Coskuner, (2001) and Hismanoglu & Hismanoglu, (2010) advice that to meet the learning needs of students, beginning teachers need support to address their own developmental needs first before they can facilitate learning in real classrooms.

4.5 Supervision Practices of the HoS and University Supervisors

The sampled B.Ed Science students on TP were asked to state the practices of their respective HoS and university supervisors during their school-based experiential learning. The findings were as indicated in table 8 and 9 below.

ISSN 2222-1735 (Paper) ISSN 2222-288X (Online) DOI: 10.7176/JEP
Vol.10, No.18, 2019

4.5.1 *Supervision Practices of the HoS*

Table 8 B.Ed Science Students Opinion on the HoS supervision practices

Statement		Never	Rarely	Sometime	Often	Always
The subject HoS holds meetings with me to ascertain that my lesson plan is in line with the schemes of work and objectives	**Count**	0	16	68	19	3
	%	0.0%	15.1%	64.2%	17.9%	2.8%
The HoS guides me on how to effectively integrate teaching methods in my lesson	**Count**	15	46	37	5	3
	%	14.2%	43.4%	34.9%	4.7%	2.8%
My HoS advices me on the appropriate teaching method and every stage of lesson development	**Count**	61	29	11	2	3
	%	57.5%	27.4%	10.4%	1.9%	2.8%
My HoS provides prompt feedback	**Count**	1	45	46	8	4
	%	1.0%	43.3%	44.2%	7.7%	3.8%
My HoS attends my lessons to observe my teaching/learning activities on regular basis	**Count**	11	72	18	3	1
	%	10.5%	68.6%	17.1%	2.9%	1.0%
The assessment feedback my HoS gives me is linked to my teaching practices	**Count**	7	49	39	8	4
	%	6.5%	45.8%	36.4%	7.5%	3.7%
The assessment feedback my HoS gives me is timely	**Count**	18	56	27	4	1
	%	17.0%	52.8%	25.5%	3.8%	0.9%
I am able to use the assessment feedback I am given for subsequent teaching.	**Count**	13	1	18	42	32
	%	12.3%	0.9%	17.0%	39.6%	30.2%
My HoS gives me feedback that is supportive of my learning to teach so that it's clear to me how to improve my performance progressively.	**Count**	50	46	8	3	0
	%	46.7%	43.0%	7.5%	2.8%	0.0%
The feedback my HoS gives me shows the gap between my current and expected achievement level of my application of the teaching methods	**Count**	88	14	5	0	0
	%	82.2%	13.1%	4.7%	0.0%	0.0%

Total average score of performance supervision and assessment by HoS teachers

N	Mean	%Mean	SE	SD	Skewness	SE
107	2.1761	43.2%	0.0451	0.4669	0.511	0.234

4.5.2 *Supervision Practices of the University supervisors*

Table 9 University Supervisors supervision practices

Statement		Never	Rarely	Sometime	Often	Always
The university supervisor holds meetings with me to ascertain that my lesson plan is in line with the schemes of work and objectives	**Count**	10	15	57	13	11
	%	9.4%	14.2%	53.8%	12.3%	10.4%
The university supervisor guides me on how to integrate teaching methods in my lessons	**Count**	13	29	29	23	12
	%	12.3%	27.4%	27.4%	21.7%	11.3%
The university supervisor advices me on the appropriate teaching method at every stage of my lesson development	**Count**	63	9	13	8	12
	%	60.0%	8.6%	12.4%	7.6%	11.4%
The university supervisor provides prompt feedback	**Count**	8	9	32	34	22
	%	7.6%	8.6%	30.5%	32.4%	21.0%
The university supervisor attends my lessons to observe my teaching /learning activities regularly	**Count**	12	43	29	9	12
	%	11.4%	41.0%	27.6%	8.6%	11.4%
The assessment feedback my university supervisor gives me is linked to my teaching practices	**Count**	13	1	18	42	32
	%	12.3%	0.9%	17.0%	39.6%	30.2%
The assessment feedback I'm given is timely	**Count**	13	3	17	34	39
	%	12.3%	2.8%	16.0%	32.1%	36.8%
I am able to use the assessment feedback I am given for subsequent teaching.	**Count**	13	1	18	42	32
	%	12.3%	0.9%	17.0%	39.6%	30.2%
The feedback my university supervisor gives me shows the gap between my current and expected achievement level of my application of the teaching methods	**Count**	13	3	17	34	39
	%	12.3%	2.8%	16.0%	32.1%	36.8%
Feedback I'm given helps me how to improve my teaching performance	**Count**	14	2	13	29	48
	%	13.2%	1.9%	12.3%	27.4%	45.3%

Total average score of TP performance supervision and assessment by University supervisor

N	Mean	%Mean	SE	SD	Skewness	SE
107	3.1939	63.9%	0.0921	0.9486	-0.409	0.235

The results showed that majority of the sampled B.Ed Science students were dissatisfied with the supervision practices of their respective HoS. There was no schedule for supervision by the HoS and therefore the lesson observations were limited and therefore did not provide the B.Ed Science students with adequate and appropriate technical support that they required to improve their application of the Discussion Teaching Method. An analysis of the total average score of TP supervision by the HoS showed a score of a mean of 2.1761 (43.2%) indicating that only 43.2% were satisfied by the supervision practices of their HoS while 56.8% were dissatisfied. According to Zepeda (2013) formative supervision and assessment is the basis towards the improvement of application of a teaching method. This classroom-based supervision is essential because the mandatory university-based experiential learning cannot anticipate all the context-specific challenges that the B.Ed Science students may encounter in the unique environments of individual schools and classrooms. Milanowsik (2011), advice that for classroom observations to influence fluency in teaching practices, the supervisors should have an in-depth understanding of the subject being taught and should be trained in the use of supervision rubrics. This finding is consistent with the findings of a study reported by Tesfaw & Hofman (2012). The study found that beginning teachers' perceived good instructional supervision as that which addresses their professional needs, offers them technical support, gives them help and advice and strengthens a sense of collaboration and trust.

The results of supervision practices of the university supervisors showed that the university supervisors' availability was limited since their visits were scheduled. However, when they made their classroom visits, they provided adequate and appropriate technical support. The keen supervision of professional documents implies that the B.Ed Science students are trained in accordance with standards and policies of MoE. Orenaiya (2014) counsel that it is imperative for supervisors to review teaching artefacts to establish relatedness, completeness of teaching tasks and syllabus coverage. An analysis of the total average score of TP supervision by University supervisors was 3.1939 (63.9%). These results indicate that that whereas approximately 63.9% of sampled B.Ed Science students on TP were satisfied by the supervision practices of their respective university supervisors and 36.1% were dissatisfied,.

However, on classroom visits for supervision and assessment, Tesfaw and Hofman, (2014); Campbell, (2013) Milanowski, (2011), Fry, Ketteridge & Marshall (2009), Holland (2004) contend that formal classroom observations impact on teaching practices which they point out are best in establishing whether teachers are employing effective pedagogical practices and meeting the set teaching standards (or not). These means that supervision practices have the potential to influence the B.Ed Science students' instructional practices.

4.6 Inferential Analysis of the Laboratory Experiment Teaching Method

The hypothesis formulated and tested was: H_0: *Laboratory Experiment Teaching Method has no significant influence on the teaching practice performance.* A Regression Analysis was conducted and the results revealed that application of the Laboratory Experiment Teaching Method has a statistically significantly unique contribution in the prediction of the TP performance of B.Ed Science students, as indicated in the results of coefficients ($\beta = .659$, $t = 8.562, p=0.000<0.05$). The results of the Zero Order Correlation the study reveals that there is a significantly strong positive correlation between Laboratory Experiment Teaching Method and TP performance of B.Ed Science students on teaching practice ($R = 0.591 > 0.5, p = 0.00< 0.05$). With a Part correlation Coefficient of 0.391, it uniquely explains $0.391^2 = 15.29\%$ of the variance in TP Performance of B.Ed. Science students on teaching practice. Notably, the Laboratory Experiment Teaching Method variable had a positive standardized beta coefficient = 0.632 in the coefficients results. This indicate that a one unit change in the application of Laboratory Experiment Teaching Method during lessons is likely to lead to a rise in the TP performance by 0.632 standard deviation units. These results suggests adequate pedagogical understanding of instructional practices which may have resulted in well developed, deep-seated and stable conceptions of the Laboratory Experiment Teaching Method, and explains the B.Ed Science students' seemingly fluency in most of the instructional practices that constitute the Laboratory Experiment Teaching Method, hence the high performance on teaching practice.

4.7 Moderation Effect of TP Supervision on the Relationship between Laboratory Experiment Teaching Method and TP Performance of B.Ed Science Students

To examine the moderation effect of TP Supervision and assessment on the relationship between Laboratory Experiment Teaching Method and TP performance of sampled B.Ed Science students, an interaction plot was plotted as shown in figure 1.

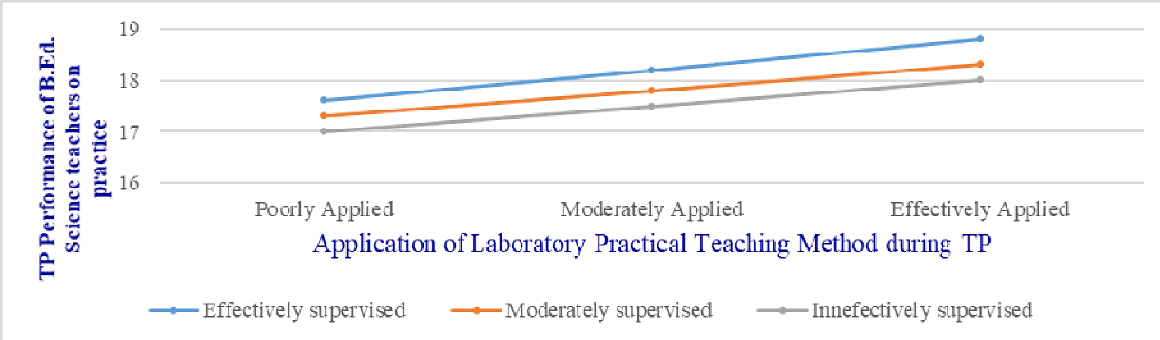

Figure 1: Interaction of Supervision and Application of Laboratory Experiment Teaching Method during TP

An examination of the interaction plot showed an enhancing moderation effect of TP supervision and assessment on the relationship between application of laboratory experiment teaching method and TP performance of the sampled B.Ed Science students on TP. This implied that regardless of the level of application of the Laboratory Experiment Teaching Method, if teachers on TP are supervised and provided appropriate technical support during TP they are likely to achieve high TP performance scores. As noted by Baron and Kenny (1986), teaching practice supervision, (which is the moderating variable in this study), serves to increase or decrease the relationship between Laboratory Experiment Teaching Method and the teaching practice performance of the B.Ed science students.

5 Major Conclusion and Recommendations

5.1 Conclusions of the Study

1. Majority of the B.Ed Science students came into teaching practice with fairly adequate pedagogical understanding of most of the instructional practices that constitutes the Laboratory Experiment Teaching Method which was largely developed in the university-based subject methods course.
2. The mean difference of 6.3% in the application of the Laboratory Experiment Teaching Method realized over the course of TP session is evidence that the Laboratory Experiment Teaching Method as applied by the B.Ed Science students is not as efficient as it should be.
3. The HoS can be an important school-based resource for supporting the B.Ed Science students to connect their university-based learning with their experiences in real classrooms and consequently, improve their application of the Laboratory Experiment Teaching Method.
4. The classroom context has potential to provide an environment for learning to apply the Laboratory Experiment Teaching Method, as well as hone the instructional practices that were inadequately acquired.

5.2 Recommendations from the Study

1. To promote and sustain the B.Ed Science students' pedagogical understanding of the application of the Laboratory Experiment Teaching Method, enhance provision of technical support to further adopt and hone the instructional practices that were found to be 'difficult' and or were superficially developed.
2. To fast-track pre-service teachers development for application of the Laboratory Experiment Teaching Method, focus of the university-based and school-based experiential learning should be directed towards identified 'difficult' instructional practices and provision of appropriate technical support while addressing the systemic and infrastructural challenges experienced.
3. Lobby for and develop a clearly structured supervision partnership with the HoS and provide a criteria for measuring and document performance. This will encourage the HoS to supervise, guide and assess the B.Ed Science students on TP in their application of teaching methods so as to promote the B.Ed Science students professional growth.
4. Design a portfolio of coherent learning experiences on application of the Laboratory Experiment Teaching method for B.Ed Science students that relate to their individual and context-specific needs. Use the data to improve the B.Ed Science students' experiential learning both at the university based subject methods course and the school-based teaching practice experiences.

References

Abrahams, I (2011). *Practical work in secondary science.* London: Continuum International Publishing Group.
Ball, D. L., & Forzani, F. (2009). The work of teaching & the challenge for teacher education. *Journal of*

Teacher Education, Vol. 60, Pgs. 497-511.

Baron, R. M. & Kenny D. A. (1986), "Moderator Mediator Variables Distinction in Social Psychological Research: Conceptual, Strategic, and Statistical Considerations," *Journal of Personality and Social Psychology*, Vol. 51 (6). Pgs 1173–1182.

Barrett, A. M (2007). Beyond the Polarization of Pedagogy: Models of classroom Practice in Tanzanian Primary Schools. *Comparative Education*. Vol. 43(2). Pgs. 273-294

Ben-Zvi R., Hofstein A., Samuel D. and Kempa R. F., (1976). The attitude of high school students to the use filmed experiments. *Journal of Chemistry Education*. Vol. (53). Pgs 575 – 577

Berg, M.A. (2009). Motivation and discourse in a literate environment: A case study of a young adult library: Ann Arbor, MI: Proquest/UMI Publishing.

Best, J.W., & Kahn, J.V.(2008). Research in Education (10th Ed.).New Delhi: Prentice Hall of India.

British Psychological Society (2006). Code of ethics and conduct. Leicester: British Psychological Society.

Buffler, A., Allie, S., & Lubben, F. (2001). The development of first year physics students' ideas about measurement in terms of point and set paradigms. *International Journal of Science Education, Vol.23* (11). Pgs 1137-1155.

Campbell, K. H. (2013). A Call to Action: Why We Need More Practitioner Research. A esponse to "A Teacher Educator Uses Action Research to Develop Culturally Conscious Curriculum Planners". *Democracy and Education*. Vol. 21 (2), Article 7.

Ciminelli, M. (2009). Learning to Teach in a Constructivist Teacher Education Environment. Institute for Learning Centered Education.

Cohen, L., Manion, L., & Morrison, K. (2007). Research methods in education (6th ed.). New York.

Copriady, J. (2014). Teachers Competency in the Teaching and Learning of Chemistry Practical *Mediterranean Journal of Social Sciences* Vol. 5 (8). Pgs 312-318

Conskuner, M. (2001). Turkish provincial state university teachers' perceptions of English language teaching as a career (Unpublished M. A. Thesis, Bilkent University, Ankara).

Delargey, M. J. N. (2001) How to learn science 'quickly, pleasantly and thoroughly': Comenian thoughts. *School Science Review*. Vol.82 (301). Pgs 79–84.

Dillon. J. (2008). A review of the research on practical work in school science. Berkshire: Open University Press.

Drost, B. (2012). An action research study: Engaging in authentic formative assessment. New Jersey: Prentice-Hall

Fadzil, H. M. & Saat, R. M. (2013). Phenomenographic study of students manipulative skills during transition from primary to secondary school. Jurnal Teknologi, 63(2), Pgs 71-75.

Field, A. (2009) Discovering Statistics Using SPSS. 3rd Edition, Sage Publications Ltd., London.

Field, A. (2013). *Discovering Statistics Using IBM SPSS* (4th ed.). London: Sage Publications.

Fischer, G., M. Shah, F.N. Tubiello, and H. van Velhuizen, (2005). Socio-economic and climate change impacts on agriculture: an integrated assessment, 1990-2080. *Phil. Trans. Roy. Soc. B*, 360, 2067-2073

Frykedal K. F, & Chiriac E. H (2012). Group work management in the classroom. Scandinavian Journal of Education Research. Vol. 13. Pgs. 162-178.

Gary T. H, Kevin C B. and Fortner C. K. Effectiveness and Attrition. Educational Researcher. Vol. 40(6). Pgs 271 -280

Hismanoglu, M., & Hismanoglu, S. (2010). English language teachers' perceptions of educational supervision in relation to their professional development: A case study of northern Cyprus. Novitas-ROYALS (Research on Youth and Language), 4 (1), 16-34.

Hofstein, A. & Lunetta, V.N. (2004). The laboratory in science education: Foundations for the twenty-first century. *Science Education,* Vol. 88 (1) Pgs. 28-54

Holland, P. (2004). Principals as Supervisors. A Balancing Act. NASSP Bulletin. Vol. 88(639). Pgs 3 -14

Kärnä, P. Hakonen, R. and Kuusela, J. (2011). Science Knowledge and skills at the 9th class in 2011. Observation report of education, 2, Board of Education. Tampere: University Press.

Kim, M. and Chin, C. (2011). Pre-service Teachers Views on Practical work with inquiry orientation in text-book Science Classroom. International Journal of Environmental & Science Education Vol. 6, (1). Pgs 23-37

Kloser, M. (2014). Identifying a core set of Science Teaching Practices. A Delphi Expert Panel Approach: Core Science Teaching Practices. *Journal of Research in Science Teaching.*

Lunetta,V.N., Hofstein, A. & Clough, M.P., (2007). Teaching & learning in the school science laboratory. An analysis of research, theory, & practice. In, S. K. Abell & N. G. Lederman (Eds), *Handbook of Research on Science Education***.** Mahwah, NJ: Lawrence Erlbaum Associates,

Fry, H., Ketteridge, S. & Marshall, S. (2009). (Eds.). *A Handbook for Teaching & Learning in Higher Education: Enhancing Academic Practice (3rd Ed.).* Rutledge. New York.

Milanowski, A. (2011). Strategic Measures of teacher Performance. *The Phi Delta Kappan. Vol.* 92 (7). Pgs 19-25

Millar, R. (2004). The role of practical work in the teaching and learning of science. Paper prepared for the meeting: High school science laboratories: Role and vision. Washington DC. National Academy of Sciences.

Millar, R. (2009). Practical work. In J. Dillon & J. Osborne (Eds.), Good practice in science teaching: What research has to say, 2nd edn. London: McGraw-Hill.

Nunnally, J. C. (1978). Psychometric t.heory (2nd ed.). New York: McGraw-Hill.

Orenaiya S. A. (2014). Instructional Improvement of Secondary School Teachers through Effective Academic Supervision by the Vice Principals Journal of Education and Human Development. Vol. 3 (2). Pgs. 607-617

Saunders, M., Lewis, P. & Thornhill, A. (2007) Research Methods for Business Students. 4th Edition, Financial Times Prentice Hall, Edinburgh Gate, Harlow.

Tesfaw, T. A. & Hofman, R. H. (2012). Instructional supervision and its relationship with professional development: Perception of private and government secondary school teachers in Addis Ababa

United Nations Educational, Scientific and Cultural Organization (UNESCO), (2005). *World Dataon Education*, Geneva, UNESCO International Bureau of Education. Paris, UNESCO.

Woolnough, B.E., (ed.), 1991. Practical Science. Milton Keynes, Open University Press.

Zepeda, S.J (2013). Instructional Supervision: Applying Tools and Concepts. Routledge. 711 Third Avenue. New York Ny 10017 USA