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Pre-service Science Teachers' Integration of Constructivist Ideas in the Lecture Method

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Abstract. The teaching and learning of science subjects at secondary schools in Sub-Saharan Africa is currently dominated by application of the lecture method in delivering learning material. In the Lecture Method, the teacher discusses and shows the learning material. Studies showed that the lecture method can be made interactive, and, hence, more effective if teachers appropriately integrate constructivist ideas in the method. Therefore, this study aims to examine the BEd (Science) students' integration of constructivist's learner-oriented instructional practices in the lecture method during teaching practice (TP). Data were collected from 107 BEd(Science) students, their Head of Subjects in the TP schools and the university supervisors at the onset and towards the end of a 14-week TP. The instruments used to collect data were questionnaires and interview schedules. The data were analysed descriptively and inferentially. Descriptive statistics focused on frequencies, percentages, means and standard deviation which summarised the variables in terms of demonstration of instructional practices, supervision and assessment practices. Findings revealed that the BEd(Science) students faced difficulties in their attempt to integrate constructivist ideas in the lecture method. T-test showed a positive effect of teaching practice on the integration of constructivists' ideas in the lecture method. The study provides several recommendations based on the findings.

Keywords: lecture method; constructivism; integration; learner-oriented; instructional practices

1. Introduction

One of the harshest criticisms of teacher preparation is the approaches and methods of teaching (Maphosa & Ndebele, 2014). Specifically, the effectiveness of the lecture method has been questioned because of its inherent weaknesses as informed by the transmission of pedagogical approaches. Nevertheless it is widely used for curriculum delivery in secondary science education, particularly in Sub-Saharan Africa countries (Altinyelken, 2010; Barakabitze et al., 2019;

Lauwerier & Akkari, 2015; Westbrook et al., 2013). In the lecture method, learner involvement is minimal with the teacher as the key element in the learning process (Mohammadjani & Tonkaboni, 2015). Notably, the method is not efficient enough to leverage the all-important goal of effective knowledge construction, and ultimately, improve learner outcome in science education. Hussain et al. (2011) averred that, in particular, because newly qualified teachers are limited in pedagogy, they prefer the application of the lecture method for its inherent minimum learner involvement. To overcome this drawback, there is a need to help pre-service teachers to develop pedagogical expertise to integrate constructivist ideas in the lecture method. According to Prakash (2010), explicit constructivism is fundamental in enhancing the effectiveness of the lecture method. This will enable teachers to present learning materials in ways that expand students' understanding of concepts and processes (Kang & Zinger, 2019; Maphosa & Ndebele, 2014).

To influence pre-service teacher's knowledge, understanding and skills for application of teaching methods, teacher preparation programmes provide mandatory methods courses and supervised experiential learning (Ersoy, 2010; Woolley, 2011). While the methods' courses provides a vision of teaching practices with the potential to alter the pre-service teachers' preconception about teaching (Ambusaidi & Al-Balushi, 2012; Buldur, 2017), experiential learning on TP provides opportunities for pre-service teachers to enact and reflect on their understanding amid pedagogical support from peers and supervisors (Kazempour & Sadler, 2015; Ochanji et al., 2015; Tesfaw & Hofman, 2014).

1.1 Statement of the problem

Numerous researches have been conducted with findings that criticise pre-service teacher preparation (Buldur, 2017; Demirdöğen, 2016; Kazempour & Sadler, 2015; Maphosa & Ndebele, 2014; Nieme, 2002; Zeichner, 1996). In particular, findings reveal that, although pre-service teachers are taught about constructivist pedagogy, the majority experience difficulties in applying constructivist ideas in science education (Revell & Wainwright, 2009; Strengthening of Mathematics and Science at Secondary Education [SMASSE] Project Impact Assessment, 2007; Yavuz, 2010; Yoon et al., 2012). This is evident in Kenya where many teachers of science subjects have been found to experience difficulties in integrating constructivist instructional practices in their teaching. A survey conducted by SMASE showed that many teachers choose to apply the lecture method in science lessons to cover more content, and, in the process, minimise learner involvement, leading to very little in terms of learning outcomes. This implies that many science teachers enter the teaching profession without adequate pedagogical knowledge, understanding and skills to integrate constructivist instructional practices in the lecture method. The output results in learners' partial understanding of scientific concepts, and, hence, learners' poor achievement in science subjects, as observed in Kenya in the last five years (Kenya National Examinations Council [KNEC], 2019). Consequently, education stakeholders have raised concerns regarding how science teachers are prepared to apply teaching methods in lessons. To address this, the Kenya government, through MoEST, and the Government of Japan, through JICA, rolled out the SMASSE in-service training for science and mathematics teachers to upgrade and strengthen science teaching methods

(SMASSE Project, 2007). Additionally, in Kenya, empirical research findings concerning how the integration of constructivist instructional practices in the lecture method is developed at the university and later applied in secondary science lessons during teaching practice are limited. Further, the effect of experiential learning on the BEd(Science) students' integration of constructivist instructional practices on teaching methods as learned at the university is not clear.

1.2 Purpose of the study

This study contributes to the existing knowledge on pre-service science teacher preparation by focusing on the BEd(Science) students' integration of the constructivist ideas in the lecture method during teaching practice. Specifically, this study addressed the following research questions:

> (1) Is there any significant difference in the BEd(Science) students' integration of the constructivist instructional practices in the lecture method at the onset and towards the end of teaching practice?
> (2) To what extent do the pedagogical supervision practices support the BEd(Science) students' integration of constructivist instructional practices in the lecture method?

2. Literature Review

2.1 Integration of constructivist ideas in the lecture method

Currently, there is increased emphasis on the integration of constructivist instructional practices in teaching methods (Dikshit et al., 2013; Passey & Zozimo, 2016; Pinger et al., 2018; Turpen & Finkelstein, 2009). Constructivist instructional practices are the interactive learner-oriented activities of structuring and presenting the learning material in ways that support learners to construct their knowledge of scientific concepts. Specifically, integration of learner-oriented instructional practices can transform the passive lecture method into an interactive lecture that promotes knowledge construction and leads to deep learning (Miller et al., 2008). The passive lecture method is against the principles of constructivist pedagogy, cannot facilitate the construction of knowledge among learners and, consequently, subject matter comprehension (Addae & Quan-Baffour, 2018; Piaget, 1973; Vygotsky, 1978). Ultimately, a deep understanding of basic scientific concepts is not achieved and the scientific misconception(s) persist (Ahmad & Aziz, 2009; Powell & Kalina, 2009; Trna & Trnova, 2015). Empirical research has been conducted to demonstrate the need for teacher preparation for the integration of constructivist instructional practices in the lecture method to enhance learner engagement (Borda et al., 2020). Results uncovered that 90.9% of the teachers still apply the passive lecture method in science teaching (Zakirman et al., 2019).

Research on how to best support teachers in the integration of learner-oriented instructional practices has been carried out (Darling-Hammond & McLaughlin, 2011; Gunckel, 2013; Idris, 2016; Opfer & Pedder, 2011). Findings showed that the teachers require opportunities to collaboratively share what they know and enact their learning. Further, studies conducted on the application of the lecture method in science education (Al-Modhefer & Roe, 2010; Atherton, 1972; Bok, 2006; Kärnä et al., 2012) report that teachers do not appropriately integrate learner-oriented activities in the lecture method. Moreover, Korthagen and Kessels (1999) explain that beginning teachers' preconceptions are not in congruence with the realities of the classroom, and argue that the content knowledge is more theoretical and abstract, hence its implementation in the classroom remains difficult. This establishes that there still exists the problem of skills transfer from the pre-service teachers' university-based learning to real classrooms (Leijen et al., 2015). Accordingly, Kloser (2014) aver that pre-service teachers are immersed in practice-based learning and should be supported to integrate constructivist instructional practices in the teaching and learning activities.

Research findings show that constructivist instructional practices that teachers need to adopt and implement include;

- Pausing analytical questions to activate learners' prior knowledge towards an instructional goal (Grossman, 2018; Prakash, 2010; Warner & Myers, 2008)
- Posing a problem linked to the concept so as to elicit and expose their learners' prior knowledge and viewpoints (Grossman, 2018; Kloser, 2014; Sherin et al., 2011; Windschitl et al., 2012)
- Exploring learners' ideas to consolidate prior knowledge and explain phenomena (Grossman, 2018; Kloser, 2014; Prakash, 2010; Windschitl et al., 2012)
- Integration of technology (Dufresne et al., 2010; Ghavifekr & Rosdy, 2015; Groenke & Paulus, 2007; Inan & Lowther, 2010; Kim & Freemyer, 2011)
- Adapting curricular to address the preconceived ideas, providing an opportunity for discourse to foster shared meaning concepts (Ghousseini & Sleep, 2011; Grossman, 2018; Kloser, 2014)
- Establishing group discussions to encourage students to reflect, make a prediction and account for contradictions (Grossman, 2018; Kloser, 2014; Windschitl et al., 2012)
- Use of appropriate and relevant analogies and examples to engage learners (Brown & Salter, 2010; Grossman, 2018; Lolita, 2015)
- Allowing and supporting small group discussions for learners to examine their existing views to modify and refine flawed conceptions (Grossman, 2018; Ghousseini & Sleep, 2011; Prakash, 2010; Sherin et al., 2011)
- Follow-up questions to assess student's learning and further engagement (Grossman, 2018; Kloser, 2014)
- Summarising the learning points (Grossman, 2018; Kloser, 2014).

Integration of the constructivist instructional practices in the lecture method provides concrete experience from which learners can build new knowledge. Biadgelign (2010) recommends that the instructional tasks should be short, explicit and intellectually engaging with the teacher explaining the ideas in ways that are accessible and comprehensible to the learners.

2.2 Experiential learning for integration of instructional practices

The pre-service teacher requires opportunity for experiential learning to enact integration of constructivist instructional practices, as well as pedagogical support so as to effectively describe or explain scientific concepts and appropriately connect to natural phenomena and to learners' real-life experiences (McDonald et al. 2013). The enactment of integration of instructional practices in teaching exposes the misconceptions the pre-service teachers may hold (Marios & Iosif, 2016). Research findings reveal that experiential learning allows the mismatch between pre-service teachers' existing conceptions based on the theoretical method courses, and the envisaged future teaching practices to be addressed (Britton & Anderson, 2010; Gok, 2012; Grossman et al., 2009; Hismanoglu & Hismanoglu, 2010; Mannathoko, 2013; Ochanji et al., 2015; Schreiber & Valle, 2013). Enactment of the method-specific instructional practices during teaching practice allows for the operationalisation of a teaching method and embedded instructional practices. The assessment of whether the pre-service teachers have acquired the necessary cognitive and procedural skills or not serves to identify what they know and can do as a result of their learning (Deacon, 2016; Ingvarson & Rowley, 2017; Marios & Iosif, 2016; Stahl et al., 2016).

2.3 Development of self-efficacy in teacher learning

The development of teacher self-efficacy is a significant concern for education stakeholders about the reforms in teaching methods. Bandura (1995, 1997) conceptualised pre-service teachers' teaching efficacy based on the social cognitive theory and his construct of self-efficacy. Bandura (1986) established that a person's actions are learnt by observing expert teachers modelling teaching practices, after which they approach the practices with confidence. Studies conducted on the association between self-efficacy beliefs and learner engagement reveal that self-efficacy beliefs and student engagement are crucial factors for effective teaching (Beri & Stanikzai, 2018; Kazempour & Sadler, 2015). In educational settings, teacher self-efficacy is conceptualised as the teacher's beliefs in their ability to plan, organise and implement effective instructional practices in a lesson (Kazempour & Sadler, 2015; Sarfo et al., 2015). Bandura (1995) postulated that teachers who perceive a task as difficult are likely to abandon it, and vice versa, implying that the self-efficacy of a teacher can impact their ability to appropriately implement instructional practices.

Research has concluded that high self-efficacy enables teachers to complete a task, particularly in a complex context such as a classroom setting (Kazempour & Sadler, 2015), and is associated with knowledge construction as well as teachers' perceptions of self-efficacy influence their classroom practice (Bandura, 1997; Cansiz & Cansiz, 2019). Therefore the opportunity to enact integration of learner-oriented instructional practices in lessons enables the development of self-efficacy as the teacher gains intellectual and procedurals skills that are transferable and can be applied in varied contexts (Bandura, 1997; Ciminelli, 2009; Kazempour & Sadler, 2015). In particular, modelling of, and the enactment of conceptions of teaching, learning and assessment practices coupled with supervised collaborative reflections provide a vision for the implementation of teaching activities and ensures that the instructional practices are not abandoned later (Amobi & Irwin, 2009; Grossman, 2011; Leijen et al., 2012; Opfer & Pedder, 2011).

3. Method

3.1 Sampling and participants

The study employed a mixed-methods survey design. Quantitative data were collected at the onset and towards the end of a 14-week teaching practice session while qualitative data were gathered from interviews of the faculty.

The target population comprised 145 BEd(Science) students stratified into three subject-specific categories of chemistry, physics and biology that comprised 45, 64, and 36 students, respectively. The sampling units in each stratum were obtained by simple random sampling. A disproportionate stratified random sampling technique was used to obtain the distribution of the sample across the strata (Cochran, 1997).

Yamane's (1973) formula determined the study sample size.

$$n = \frac{N}{1 + Ne^2}$$

where;

n =desired sample size
N =target population
e =error limit = 0.05
Source: Yamane (1973)

The resulting distribution of the sample was 33, 47 and 27 for chemistry, physics and biology subjects, respectively, hence a sample size of (n=107). An equal number (n=107) of Head of Subject (HoS) in the TP schools to match the BEd(Science) students sample participated in the study. Three subject methods course pedagogy faculty (n=3) were purposively selected for interview.

3.2 Context and procedure

The TP schools were spread nationally and data were collected as per the sample placement. Administratively, each BEd(Science) student reported to the HoS of their teaching subjects in their TP schools. The BEd(Science) students were supervised and assessed by university faculty on a determined schedule of at least three supervisions.

3.3 Research instruments

Two questionnaires (Appendix 2 and 3) were used to gather information regarding application of the lecture method by the sampled BEd(Science) students, and the HoS and university supervisors' pedagogical supervision practices during TP. A guided interview schedule was used to collect data from the university lecturers who prepared the BEd(Science) students' for the application of teaching methods.

Instrument analysis was conducted for content and construct validity and sampling adequacy tests as employed by Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity, respectively. The constructs were found valid (Appendix 1) indicating that the dataset was fit for further analysis (Liu, 2010; Williams et al., 2012).

The reliability index computed using Cronbach's alpha of coefficient test revealed a coefficient of 0.81. This is above the threshold of 0.70, indicating that the instruments were reliable for further analysis (Drost, 2012; Nunnally, 1978).

3.4 Data analysis techniques

Data were analysed descriptively and by inferential statistics. The student t-test was used to determine the significant difference in the average application score at the beginning and towards the end of TP. The software used to conduct the analysis was SPSS version 23.

3.5 Ethical considerations

The study observed the principles of respect, competence, responsibility and integrity.

4. Results

4.1 Is there any significant difference in the BEd(Science) students' integration of the constructivist instructional practices in the lecture method at the onset and towards the end of teaching practice?

The total average scores for the BEd(Science) students' integration of constructivist instructional practices (Appendix 2) and the pedagogical practices of the HoS and university supervisors (Appendix 3) are as in Table 1 below.

Table 1: Statistics for integration of constructivist practices in the lecture method and pedagogical practices of the HoS and university supervisors

Variables	Total average score						
	N	Mean	%Mean	SE	SD	Skewness	SE
Onset of TP	107	3.0832	61.7	0.0373	0.3843	0.006	0.235
End of TP	107	3.1919	63.8	0.0629	0.6510	0.623	0.234
HoS Pedagogical Supervision Practices	107	2.1761	43.2	0.0451	0.4669	0.511	0.234
University Supervisors' Pedagogical Supervision Practices	107	3.1939	63.9	0.0921	0.9486	-0.409	0.235

Combining "agree" and "strongly agree" (Appendix 2) produced mixed results. Similarly, when "disagree" and "strongly disagree" are combined, the results showed mixed results. The positive results showed that the majority of the participants were observed to implement the practice of eliciting learners' preconceptions, which means they had a concrete frame of reference for the practice. Additionally, a majority were observed to integrate analogies and examples in concept teaching. Thus more participants integrated the practices towards the end of TP, implying that those with a partial understanding at the onset honed the practices while those who initially could not visualise the practice adopted it in the course of TP. Further, the majority of the participants were observed to facilitate discussion relating to controversial content. Notably, about a half of the participants were observed to facilitate collaboration and sharing of ideas among learners, half the participants integrated appropriate visual aids to support the lesson at the onset of TP, while those who were observed to integrate audio-visuals in teaching increased towards the end of TP. Further, while averagely only half the participants could highlight the key learning points in a lecture, the majority were observed to successfully integrate the practice of assessing the learning in the lesson.

The negative results showed that, towards the end of TP, about 50% of the participants were observed to have abandoned the practices of sharing lesson objectives with their learners, an indication that the pedagogical understanding of the practice was superficial and, hence, unstable. Additionally, at the onset, the majority of the participants were observed as unable to implement the practice of posing a problem linked to the learning concept, although the number increased towards the end, while 70% faced difficulties in the implementation of analogies and examples in concept teaching at the onset of TP. This suggests the participants had an inadequate understanding of the two practices. Further, towards the end of TP, more than 75% of participants were observed to have abandoned the practice of facilitating classroom discourse relating to controversial content, while about half could not visualise the implementation of the practice of collaboration. Notably, although a majority could not initially integrate visual aids in their lessons, towards the end of TP over 80% of the participants had adopted the practice. Towards the end of TP, it was also observed that a vast majority abandoned learner assessment, suggesting the practice was not sustainable within the complex classroom context. Notably, the number of participants that highlighted the key learning points reduced, indicating they had a partial understanding of how to evaluate learning. This demonstrated a disconnect between the participants' beliefs of their ability and the demonstrated instructional practices.

4.2 Effect of teaching practice on the Integration of constructivist practices in the lecture method

Results of the total average score (See Table 3) towards the end of TP was M=3.1919, SD=0.6510 up from M=3.0832, SD=0.3843 at the onset revealing a disconnect between the participants' self-efficacy and the classroom practices that they exhibited. Notably, some participants found particular instructional practices difficult to integrate, and other participants were observed to abandon particular instructional practices. Further, on conducting the t-test, results [Mean Difference=0.10392, SE=0.07043, (t (105) =1.475, p<1.43 indicated that the effect of experiential learning on the integration of instructional practices in the interactive lecture method was not statistically significant (Table 2).

Table 2. Mean difference in application of lecture method at the onset and towards the end 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	.10392	.72516	.07043	-0.03574	.24358	1.475	105	1.43

This affirms that the school-based experiential learning did not affect a significant increase in the integration of instructional practices that were difficult to implement at the onset of TP.

4.3 To what extent do the pedagogical supervision practices support the BEd(Science) students' integration of constructivist instructional practices in the lecture method?

The pedagogical supervision practices were as shown in Appendix 3. The results show the total average score on pedagogical supervision practices for the HoS as M=2.1761 (43.2%), SD=0.4669 (Table 1). When "often" and "always" are combined, results showed majority of the HoS either did not guide the BEd(Science) students in lesson preparation and implementation or guide them appropriately to link theoretical knowledge and classroom practices. Additionally, the timeliness and adequacy of the feedback they provided did not support the integration of constructivist ideas in the lecture method among BEd(Science) students. Notably, 69.8% (32, 42) could use the assessment feedback given for subsequent teaching suggesting that, if empowered, the HoS can provide appropriate pedagogical support.

The total average score for the pedagogical supervision practices of university supervisors (Table 1) was M=3.1939 (M%=63.9%), SD=0.9486 showing mixed results when the "often" and "always" are combined (Appendix 3). Specifically, the majority of the participants received timely feedback of the assessment, which was linked to their implementation of the teaching methods. Further, the feedback informed the BEd(Science) students' subsequent teaching, and areas of growth were pointed out to improve their integration of instructional practices. On the flip side, when "rarely" and "never" are combined, results showed that the university supervisors did not regularly attend lessons, neither did they hold a pre-observation meeting, nor guide on integration of instructional practices in the lecture method. The HoS and university supervisors thus rendered the pedagogical supervision practices unsupportive to the integration of constructivist instructional practices in the lecture method.

5. Discussion

5.1 Is there any significant difference in the BEd(Science) students' integration of the constructivist instructional practices in the lecture method at the onset and towards the end of teaching practice?

The study found that the practice of eliciting learners' ideas among the participants was deep-seated except for 4.7% who abandoned the practice, while the use of analogies and examples was largely adopted and honed within the classroom context. Thus, in the face of the complex realities of classroom contexts, instructional practices can be adopted and honed or abandoned depending on whether the pedagogical understanding is superficial or deep-seated, which has implications for their sense of self-efficacy (Bandura, 1995; Cansiz & Cansiz, 2019; Opfer & Pedder, 2011; Warner & Myers, 2008). Therefore, if teachers are helped to develop adequate pedagogical knowledge to appropriately integrate analogies and examples, they can elicit and expose learners' misconceptions, then address them (Duit et al., 2008; Lolita, 2015; Warner & Myers, 2008).

The study further found that the majority of the participants had an inadequate frame of reference and, hence, could not implement the practice of posing a problem linked to the concept at the onset of TP, but this improved towards the end of TP. Concrete pedagogical knowledge enables the teacher to help learners to make sense of the phenomena (Mishra & Iyer, 2015; Sherin et al., 2011).

The study also found that, although the participants familiarised learners with the scope of the learning activity and the support to be provided by sharing objectives (Lampert et al., 2013; Warner & Myers, 2008), they did not sustain the practice. Hence, in the face of classroom complexities, they made the unsound pedagogical decision of abandoning the practice (Korthagen & Kessels, 1999; Warner & Myers, 2008).

Remarkably, the study found that the majority of the participants did not implement the practices for facilitating small group discussions. Educational researchers agree that small group discussions are a cognitive engagement embedded in constructivism, but which is not widely applied (Eggen & Kauchak, 2012; Jacobsen et al., 2009), particularly if the participants were likely unaccustomed to the practice (Ersoy, 2010; Woolley, 2011) they will lack a vision of implementing the practice.

Additionally, based on the obtained results, it is safe to record that the participants had inadequate pedagogical knowledge to identify, select and sustain the use of appropriate technologies. Notably, during the interview, a pedagogy faculty intimated that ICT integration is not yet deeply rooted in the BEd(Science) curriculum. This situation points to inadequate technical, pedagogical and systemic support leading to superficial knowledge of the practice, and explains the significant number who abandoned the practice. Additionally, the participants were likely unaccustomed and, hence, lacked a vision of the practice (Grossman, 2018; Inan & Lowther, 2010). This finding is consistent with a study conducted by Groenke and Paulus (2007) who found that, if technical and pedagogical support is limited, pre-service teachers adopt a teacher-centred approach.

The study found that experiential learning was not sufficient to adequately provide the pedagogical knowledge to summarise the learning points and neither could the practice be honed during TP. Woodring and Woodring (2011) note that summaries and follow-up assignments are opportunities to address learner misconceptions. Further, the study found that, despite the experiential learning, the BEd(Science) students did not adequately integrate the two practices. As proposed by Bandura (1997), successful implementation of instructional practices develops a strong sense of self-efficacy. This was not the case for instructional practices found difficult to implement.

5.2 Effect of teaching practice on integration of interactive instructional practices in the lecture method

The study found that few participants adopted and honed instructional practices within the classroom context. Additionally, the effect of integration of the instructional practices in the lecture method was not statistically significant and revealed that, towards the end of TP, the participants applied a lecture method. This shows that experiential learning did not alter the participants' frame of reference adequately to address their learning needs (Korthagen & Kessels, 1999; McDonald et al., 2013). Therefore exposing pre-service science teachers to the classroom context without adequate conceptual knowledge and sufficient pedagogical support cannot promote the integration of constructivist instructional practices in the lecture method (Stahl et al., 2016). Thus, to alter conceptions, consistent integration of instructional practices and appropriate pedagogical support are required (Duit et al., 2008; Grossman, 2018).

Additionally, the study found that experiential learning did not adequately promote the integration of constructivist instructional practices in the lecture method. This can be attributed to the participants missing out on the consistent pedagogical supervision expertise of the HoS (Zeichner, 1996). The slight increase in average score indicates most participants did not develop a strong self-efficacy and, hence, found instructional practices challenging and difficult to implement (Bandura, 1997; Cansiz & Cansiz, 2019; Kazempour & Sadler, 2015).

5.3 To what extent do the pedagogical supervision practices support the BEd(Science) students' integration of constructivist instructional practices in the lecture method?

The study found that the HoS did not provide sufficient pedagogical support. According to Mergler and Tangen (2010), pedagogical expertise is required for an effective approximation of instructional practices. This finding is consistent with a study by Gunckel (2013) who established that collaborating teachers are often not well-versed with the current learning requirements of pre-service teachers. However, the fact that the participants reported the feedback provided by the HoS as useful for subsequent teaching indicates that, if capacity is built, the HoS can provide appropriate pedagogical support to leverage adoption, honing and integration of the "difficult" instructional practices in the lecture method.

Additionally, the participants reported that the university supervisors had a limited schedule and their main focus was the assessment of the teaching practices. Mannathoko (2013) observed that the limited schedule of university supervisors coupled with the fact that the HoS are usually not engaged by the university to offer pedagogical support denies the participants a firm base on which to build instructional practices, particularly those that may have been deemed "difficult" to adopt, enact and implement.

The participants felt the school-based experiential learning had limited modelling of integration of instructional practices. This denied them the opportunity to observe and enact integration of constructivist instructional practices. Grossman et al. (2013) posit that faculty modelling is a crucial representation of practice as it enables the pre-service teachers to visualise the application of a teaching method. According to Opfer and Pedder (2011), pre-service teachers do not abandon practices that are modelled. Thus, the pedagogical support provided on TP was insufficient in quality as well as quantity. Ayot and Wanga (1987), Leijen et al. (2012, 2015) and Idris (2016) claimed that supervisors should adopt the principles of effective pedagogical supervision so as to enhance the pedagogical support provided.

6. Conclusion

This study examined the BEd(Science) students' integration of constructivist ideas in the lecture method over the TP session during which they were supervised by the HoS and university lecturers. The instruments of data collection comprised questionnaires and interview schedules. The study concluded that:

i. The experiential learning was not sufficient to provide adequate experiences on which to build a strong sense of self-efficacy for successful integration of constructivist instructional practices in the lecture method. Hence, towards the end of TP they still held unaddressed learning needs. Therefore a broad conceptualisation of integration of constructivist instructional practices in science education can promote teachers' self-efficacy.

ii. The slight increase in the average score integration of constructivist instructional practices in the lecture method shows that some participants altered their frame of reference in the course of TP. This indicates that pre-service teachers have capacity for immediate modification of personal frames of reference if they are provided opportunity to construct the method-specific pedagogical knowledge amidst pedagogical support. To further promote the modification of pre-service science teachers' frame of reference, there is need to design a portfolio of learning experiences that relate to integration of constructivist instructional practices in varied contexts.

iii. The pedagogical support was insufficient in quality as well as quantity. Notably, the limited modelling of the instructional practices likely led to lack of a firm base on which to build a clear vision for integration of constructivist instructional practices in the lecture method. There is, therefore, need to build HoS capacity in pedagogical supervision that relates to integration of constructivist instructional practices in teaching methods, and encourage the university supervisors to adopt the principles of instructional supervision.

Future work might focus on longitudinal studies that examine integration of identified constructivist ideas in art-based teaching methods.

7. Limitations

In-service teacher education programs were not represented in the sample and this limited the findings' generalisations to newly qualified science.

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APPENDICES

Appendix 1

Test of sampling adequacy and sphericity.

Factors	KMO Test	Bartlett's Test of Sphericity		
		Approx. Chi-Square	**df**	**Sig.**
Discussion method	.702	84.431	45	.000
Demonstration method	.818	120.946	45	.000
Lab practical method	.714	86.804	45	.000
Lecture method	.700	79.333	45	.000
Moderator (TP supervision)	.722	89.771	45	.000

Appendix 2

Descriptive Statistics for Integration of Constructivist Instructional Practices in the Lecture Method by the BEd(Science) Students at the Onset and Towards the End of TP.

Integration at the onset of TP)		SD	D	U	A	SA
The teacher set expectations by stating the lesson objectives	**Count**	0	3	5	30	67
	%	0.0%	2.9%	4.8%	28.6%	63.8%
The teacher built curiosity by presenting a problem linked to the concept to be taught	**Count**	15	82	1	8	0
	%	14.2%	77.4%	0.9%	7.5%	0.0%
The teacher asked questions to elicit and gauge students' ideas of content to be taught	**Count**	0	0	1	28	76
	%	0.0%	0.0%	1.0%	26.7%	72.4%
The teacher used analogies and examples to link the lesson content to students' life experiences	**Count**	15	54	8	26	2
	%	14.3%	51.4%	7.6%	24.8%	1.9%
The teacher used contradictions/controversies to engage students in the lesson	**Count**	21	78	2	0	0
	%	20.8%	77.2%	2.0%	0.0%	0.0%
The teacher used small groups to discuss the problem associated to the lecture concept	**Count**	5	45	2	47	7
	%	4.7%	42.5%	1.9%	44.3%	6.6%
The teacher used visual aids to support the learning tasks	**Count**	3	47	4	46	6
	%	2.8%	44.3%	3.8%	43.4%	5.7%
The teacher used audio-visual aids to illustrate facts, principles or procedures of the concept	**Count**	40	29	0	22	15
	%	37.7%	27.4%	0.0%	20.8%	14.2%
The teacher summarised the main points on the board at the end of the lecture	**Count**	5	54	23	19	5
	%	4.7%	50.9%	21.7%	17.9%	4.7%
The teacher gave follow-up assignments based on the lecture	**Count**	1	5	6	73	20
	%	1.0%	4.8%	5.7%	69.5%	19.0%

Total Average Score at onset of TP	N	Mean	%Mean	SE	SD	Skewness	SE
	107	3.0832	61.7%	0.0373	0.3843	0.006	0.235

Integration towards end of TP		SD	D	U	A	SA

The teacher set expectations by stating the lesson objectives	Count	0	43	15	28	21
	%	0.0%	40.2%	14.0%	26.2%	19.6%
The teacher built curiosity by presenting a problem linked to the concept to be taught	Count	1	8	1	47	48
	%	1.0%	7.6%	1.0%	44.8%	45.7%
The teacher asked questions to elicit and gauge students' ideas of content to be taught	Count	0	4	2	36	64
	%	0.0%	3.8%	1.9%	34.0%	60.4%
The teacher used analogies and examples to link the lesson content to students' life experiences	Count	8	51	2	27	18
	%	7.5%	48.1%	1.9%	25.5%	17.0%
The teacher used contradictions/controversies to engage students in the lesson	Count	19	71	6	4	5
	%	18.1%	67.6%	5.7%	3.8%	4.8%
The teacher used small groups to discuss the problem associated to the lecture concept	Count	6	43	3	32	23
	%	5.6%	40.2%	2.8%	29.9%	21.5%
The teacher used appropriate visual aids to support the learning tasks	Count	7	74	6	11	7
	%	6.7%	70.5%	5.7%	10.5%	6.7%
The teacher used audio-visual aids to illustrate facts, principles or procedures of the concept	Count	20	37	2	26	22
	%	18.7%	34.6%	1.9%	24.3%	20.6%
The teacher summarised the main points on the board at the end of the lecture	Count	5	42	4	30	26
	%	4.7%	39.3%	3.7%	28.0%	24.3%
The teacher gave follow-up assignments based on the lecture	Count	8	51	2	27	18
	%	7.5%	48.1%	1.9%	25.5%	17.0%

Total average score of application of interactive lecture method in teaching at the end of TP

Total Average Score towards end of TP	N	Mean	%Mean	SE	SD	Skewness	SE
	107	3.1919	63.8%	0.0629	0.6510	0.623	0.234

Appendix 3

Pedagogical supervision practices.

Head of Subject Pedagogical Supervision Practices						
		Never	**Rarely**	**Sometime**	**Often**	**Always**
The 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 instructional practices in my lesson	**Count**	15	46	37	5	3
	%	14.2%	43.4%	34.9%	4.7%	2.8%
My HoS advises me on the appropriate instructional practice at every stage of the 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 a 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%

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

University Supervisors' Pedagogical Supervision Practices						
		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 supervisor guides me on how to integrate instructional practices in my lessons	**Count**	13	29	29	23	12
	%	12.3%	27.4%	27.4%	21.7%	11.3%
The supervisor advises me on the appropriate instructional practice at every stage of my lesson development	**Count**	63	9	13	8	12
	%	60.0%	8.6%	12.4%	7.6%	11.4%
The supervisor provides prompt feedback	**Count**	8	9	32	34	22
	%	7.6%	8.6%	30.5%	32.4%	21.0%
The 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 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 to improve my teaching performance	**Count**	14	2	13	29	48
	%	13.2%	1.9%	12.3%	27.4%	45.3%

Total average score

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