Assessment of Preservice Science Teachers' Support for Teaching Practice in the Context of Two Teachers' Colleges in Zimbabwe

C. Mutseekwa[1] and T.D. Mushoriwa[2]

[1]*Bindura University of Science Education, Bindura Zimbabwe*
[2]*Midlands State University, Gweru Zimbabwe*

Abstract: **Using three objectives this study sought to: examine the extent to which mentors provided guidance to pre-service teachers, establish the support type and assess colleges' support provision.An exploratory sequential mixed methods research design was used to guide the collection and analysis of data. Data were sourced from 18 Science teacher educators and 108 final year Science student teachers through a semi-structured questionnaire, follow-up interviews, focus groups and documents. The findings show that support was in the form of (a) science-teaching theory (b) support materials such as handouts and handbooks with tips on lesson planning and other teaching practice requirements (c) placement in schools for practice (d) provision of mentors (e) occasional workshops and (f) clinical supervision. However, support that targeted science students' unique requirements was largely found lacking, suggesting the need for practices such as field-based methods courses and educative mentoring that foster closer collaboration between colleges and schools.**

Keywords: **educationment, orship science placement practicum**

I. INTRODUCTION

The world over, teaching practice, which is a component of teacher education,is key to pre-service teacher preparation. While literature (e.g. Willemse et al. 2015; Hund et al. 2019)is replete with research on how to support student teachers in general on teaching practice attachment, there is a paucity of literature on how science student teachers in particular can be assisted in their attempt to applyscience-teaching theory into practice.Assisting the science student teachers ensures quality field experiences and coherent teacher education programmes (Robnett et al. 2018; Assuo-Baffour et al. 2019. For Fullan (2007), a coherent teacher education programme is not complete without a clear and common vision in all coursework and clinical experiences; well defined standards of practice and performance; a curriculum grounded in substantial knowledge of educational theory; extended clinical experiences and strong relationships (between college and schools) built around common knowledge and shared beliefs.

The value of strong and sustained relationships between university faculties of education or teachers' colleges and hosting schools, where student teachers go for practicum, is more widely acknowledged now than ever before (Larose et al. 2005;Mukeredzi 2017). Larose et al. (2005:113) advocate a "socio-motivational perspective of constructive educational relationships" that should exist between schools and universities or schools and the teachers' colleges to fulfil autonomy, relatedness and motivational needs of both parties. In order to fulfil these needs, three attributes are needed; structure (the degree to which teacher educators and mentors provide clear guidance and expectations of their students to be self-determined), involvement (colleges' ability to provide resources such as time, material and emotional resources), and autonomy (supporting the uniqueness of individual students) (Larose et al. 2005).

The study is anchored in Miller et al. (2013) framework for science teacher preparation called the Model of Research-Based Education for Teachers (MORE for Teachers). MORE for Teachers is built on a conceptual framework based on empirical knowledge bringing together (i) what is known about how people learn science, and (ii) a teacher education preparation infrastructure that encompasses rigorous content, focused pedagogy, and integrated field experiences with quality mentoring and support programmes(Miller et al. 2013). Critical in this framework is the rigour that is required in the study of scientific content knowledge, teaching approaches that are informed by research, a strong workforce of committed college tutors and mentors who offer quality support and mentorship, and a focus on what is crucial for student science learning.Cognisant of the need for quality mentoring and support programmes a recent development in the field is a growing number of researches that focus on mentors' professional development. Melton's et al. (2019) article describeskey features of a hybrid professional development (PD) programme. Their programme was designed to prepare classroom teachers to mentor preservice teachers for effective science instruction. According to Melton et al. (2019) the PD programmetrained the mentors in learner-supportive mentoring practices with an online module component on coaching for effective science instruction. Using survey results, Hund et al. (2019) identify behavours such as flexibility, communication and trust and a set of practicessuch as coaching for learners' instructional gain as possible content and materials for mentorship training programmes. Hund et al. (2019) propose a model where mentorship training is formalized at graduate and postdoctoral level. Results from both studies have shown positive effects of PD on mentor teachers with Melton et al. (2019: 23) reporting that, "…participants showed statistically significant increases in their ability to use coaching as a default mentoring stance, to focus on evidence of students' science learning, and to draw on a consistent framework for effective science instructions for their conversations".

Invariably, creating a scenario for integrated field experiences for the science preservice teachers remains impossible without the support from both college-based tutors and school-based teachers. Effective instructional gains can be realized if the new teachers are provided with multiple support opportunities to engage in sustained professional development experiences (Zan-Mary &Donegan-Ritter 2014; Tinoco-Giraldo 2020). However, some studies (e.g.Kagoda&Sentongo 2015; Mukeredzi 2017) reveal a lack of requisite support for preservice teachers in their application of science teaching theory into practice, resulting in a myriad of challenges. In their report,Kagoda and Sentongo (2015) observethat practising teachers perceived student teachers positively, with most student teachers beingrated as good on professionalism and ethics, dressing and participation in school activities, but lacking in the area of subject mastery. Other similar challenges are documented such as: limited instructional support for preservice teachers (Robnett et al. 2018), attitude of mentors that are detrimental to preservice teachers' professional growth (Assou-Baffour 2019), little or lack of financial incentives for mentors (Goldhaber et al. 2019) and failure by mentors and college-based supervisors to adapt support strategies to the needs of different student teachers and a single student over time (Hund et al. 2019. Conscious of these challenges, the current study sought to find out the nature of support provision student teachers get before, during and after teaching practice attachment.

Research objectives

The study was guided by the following research objectives:

a) To examine the extent to which schools and mentors provided guidance to science pre-service teachers during teaching practice
b) To establish the support typethat science pre-service teachers required for effective practice
c) To assess how colleges' support provisions for science pre-service teachers during their practicum.

II. METHODOLOGY

Research paradigm

The current study is located in the post-positivist paradigm. The paradigm is characterized by its emphasis on meaning-making and creation of new knowledge, integration of theory with practice, and a balance of personal views of the researcher with professional and theoretical viewpoints (Ryan 2006; Henderson 2011).The paradigm allowed the use of the mixed methods approach in collecting and analyzing data. For Johnson and Christensen (2012), the triangulation of quantitative and qualitative approaches through the use of the mixed methods approach does not only result in the collection of multiple kinds of data but also in comparing and validating data collected through different ways. For these reasons, the present researchers found the paradigm to be very appropriate for the study.

III. RESEARCH DESIGN

The study adopted a sequential explanatory mixed methods design. Quantitative and qualitative data were collected in a sequence, with qualitative data largely used to validate and cross –check observations made through quantitative data. Thus, this design had the advantage of permitting the triangulation of different data collecting instruments.

Participants

This study involvedfinal yearpreservice science teachers (PSTs) (n=108) in 2017in two secondary school teachers' colleges (COL-A & COL-B). The sampleof the student teachers (n=108) obtained through random purposive sampling was representative given that the student population was 1 019.Thus, the student sample represented 10.5% and according to Van Dalen (2000), in descriptive research (which this study is), anything from 10% to 20% of the population is representative. For Creswell (2007), careful sampling of participants improves the validity of research results while a representative sample enhances the credibility of research results. Thus, random purposive sampling helped to achieve breadth and in-depth coverage of the study by focusing on a representative sample and on information-rich participants purposively selected from the two colleges.

Instruments

Data were collected through a semi-structured questionnaire, follow-up interviews, focus groups and documents. The semi-structured questionnaire which contained open and closed –ended items collected both quantitative and qualitative data. The non-imposing open-ended items allowed the hearing of the participants' views as much as possible but of course within the confines of the research design. On the other hand, closed items were useful in generating frequencies of responses that were statistically treated and reported in percentages. Views sought revolved around three basic questions that examined the extent to which mentors provided guidance to pre-service teachers, the support type that individual students got and how colleges' support provisions assisted the pre-service teachers' professional growth during teaching practice. Follow-up interviews, which were conducted after an initial analysis of results from the questionnaire, were meant to probe into subtle issues and to have obscure and unexpected responses clarified. These interviews also helped the researchers to see the motivations of the participants and their reasons for responding the way they did. Focus group discussions with both teacher educators and student teachers as well as document analysis yielded qualitative data .While some of the qualitative data were categorized into themes and analysed accordingly, other qualitative data were used to buttress/ refute observations made through the questionnaire.

Validity and reliability of the questionnaire

The validity and reliability of the questionnaire were tested through the inter-rater method. This involved giving the questionnaire to experts in the field of Teacher Education. The experts were requested to check the questionnaire for suitability / validity and to rate it (out of 10) as a measure of people's perspectives. All the 6 experts agreed that the questionnaire was suitable / valid. For reliability, the ratings were correlated and an inter-rater reliability co-efficient of 0.6 was yielded, indicating that to a high degree, the raters agreed that the questionnaire was reliable.

The questionnaire was then test-run with a group of students different from those taking part in the actual study. After minor modifications and adjustments, the questionnaire was administered to the study sample.

Credibility of qualitative data

The credibility of qualitative data from focus group discussions and document analysis was ensured through member-checking(verifying information with the informants) prolonged engagement in the field (staying longer in research sites cross-checking information) and through triangulation of different data collecting instruments.

IV. RESULTS

Basing on the study's research objectives, results from both colleges (COL-A and COL-B) were presented. Participants' responses to closed statements of the questionnaires were recorded using spreadsheet and descriptive statistics, that is, mean scores expressed as a percentage, to explain the trends. Respondents were asked to score the extent of their agreement using the likert type scale (Strongly Agree=5; Agree=4; Not Sure=3; Disagree=2; Strongly Disagree=1). A mean score for each questionnaire variable was calculated from the scores each variable received from the respondents. The mean score, which was found by adding the participants' scores on the variable divided by the total number (n) of the participants, was converted to a percentage for easy reporting. The mean scores were used to gauge the weight of respondents' perspectives towards certain variables. High mean scores (78% and above) reflected respondents' high opinion about the questionnaire variable, sixty six percent (66%) to seventy seven percent(77%) were regarded as representing moderate opinion, while low mean scores (65% and below) showed their low regard on the same.

Schools and mentors' guidance to science pre-service teachers during teaching practice

Table 1 shows the mean scores for preservice science teachers (PSTs) for COL-A and COL-B on a number of aspects asked about the mentors' and schools' support. There were mixed feelings about the way mentors supported and guided pre-service science teachers on practicum. SPTs in COL-A for instance thought that the mentors had moderate knowledge on mentorship, rating them at seventy four percent (74%) while those in COL-B had a suppressed moderate opinion of the mentors' knowhow at sixty eight percent (68%). Knowhow and awareness were both assessed in the study. Mentors' awareness of their roles in supporting PSTs in COL-Awas rated with a moderate seventy two percent (72%) while those in COL-B rated theirs highly with a mean score of seventy eight percent (78%). Asked if the mentors supported the PSTs on an individual basis, SSTs from both colleges showed their low regard of mentors' support for individual trainee professional growth. On this aspect the SPTs in COL-A rated the mentors at fifty eight percent (58%) while those in COL-B had a mean score of sixty percent (60%). Ratings of sixty four percent (64%) from COL-A and sixty percent (60%) from COL-B in a question asking if mentors held post observation discussion with mentees confirmed reliability of PSTs' responses on support for individual trainees. Emergent themes from qualitative data were limited clinical supervision by the mentors, inadequate support in the early days of beginning teaching, the need for expert support, little or no dialogue after assessment, conflicting comments from mentors if a student happened to have more than one mentor in the duration of their practicum. In the Focus Group discussion the SPTs indicated that mentors who were science majors offered better support than those trained to specialize in other subject areas.

Overall, mentors operated in varied school environments. Some schools were rated to have adequate science equipment for learning while some were rated as having moderate equipment, COL-A eighty percent (80%) and COL-B sixty eight percent (68%). However, PSTs from both colleges were moderately satisfied with the participation of their host schools in local science exhibition, COL-A seventy eight percent (78%) and COL-B seventy percent (70%).Inadequate staffing was reported in some schools as PSTs lamented supervision by mentors who are non-specialist in science. The PSTs were not very happy with the non-availability of mentors, COL-A fifty eighty percent (58%) and COL-B sixty two percent (62%) and this is despite the high satisfaction expressed earlier with equipmentation of the same schools. The same respondents reported moderate satisfaction with the aspect that mentor was a subject specialist, COL-A sixty percent (60%) and COL-B fifty five percent (55%). Follow up discussions with the science pre-service teachers revealed thatsome mentorswere unaware of college expectations, their roles, teaching requirements and professional exercise. Further, in some cases, despite availability of resources, some mentors were reluctant to assist PSTs, citing lack of recognition and remuneration for the job and some school heads or heads of departments locked up science materials in base rooms and storerooms. The heads doubted the pre-service teachers' expertise in the handling and use of the equipment or wanted to preserve materials and equipment so they last longer.

Support type that science pre-service teachers required for effective practice

This section targeted support to PSTs that came from science teacher educators (STEs). Table 2 shows the mean scores on the level of satisfaction on support type given to individual trainees. The table shows that support type that PSTs required can be provided at three levels; before the practicum, during and after. Generally, high mean scores were recorded in the following: PSTs receiving frequent supervision visits, STEs modelling teaching approaches that could be useful on practice and preparing PSTs to deal with their own beliefs during the teaching of science.Moderate to low mean scores were recorded for STEs' professional support for individual trainees' unique growth and sufficient time allocated for reflections on practicum. The PSTs in COL-A were not satisfied (mean score=56%) that after the completion of the teaching practice stint, STEs did not engage them in reflections. The same applied for COL-B (mean score=58%). The PSTs expressed almost similar dissatisfaction on the aspect of STEs' professional support for individual trainees' unique growth. This same result on the lack of STEs' professional support for individual trainees' unique growth showed up with mentors also. Qualitative data from group discussions confirmed the same. The following discussion with PSTs in COL-A illustrates some of the findings.

> ***PST_8:***I think for the college they mostly concentrated on assessment not supervision. They just come, want to see what you are doing for the day, leave a mark without assisting you on your challenges, not even telling you the actual thing you should do as a science teacher.*
>
> ***PST_{12}:*** *I think lecturers should assist students as much as possible, particularly as we begin to teach for the first time there maybe loopholes that need some little support and advice.*
>
> ***PST_8:*** *The one problem I noticed on this issue of individual support is that in science, when they come for the first time, when you still have many challenges with science teaching, they bombard you with a lot of negative comments such that at times you are left puzzled, without a clue where to start. Because the idea should be to lift each other so that a student sees direction, the opposite happens. It differs with lecturers of course, but generally, you are left groping in the dark as to what you should do next. If it were possible, first visit should not carry a mark so that it is left for purely assisting the student in order to give support.*

In COL-B one PST (**$PST_{27)}$** commented:

> *My feeling is that lecturers do not give us adequate support when we are on Attachment Teaching Practice. Yes, they come to supervise us but sometimes we do not reflect our challenges together. Sometimes we have problems that I feel could be solved if we came together and discuss these issues during attachment teaching practice. The other thing is that after teaching practice, there are no reflection sessions at college. Once you are back in college, everything about teaching practice is forgotten, no reflections on the challenges you met.*

Colleges' support provisions for science pre-service teachers.

Although some SPTs reported of schools that had inadequate science equipment or had science kits that were locked up and gathering dust, the STEs revealed that they tried their best to deploy science trainee teachers to schools with resources for the subject. Table 3 shows the level of SPTs' satisfaction with approaches that the colleges used to prepare SPTs' for teaching practice.

Overall, the SPTs were highly satisfied with the approaches that were used to prepare them for teaching practice in a science subject. For instance, syllabus interpretation was rated with a mean score of eighty eight percent (88%) in COL-A and eighty six percent (86%) in COL-B. Adequate content knowledge for science teaching eighty four percent (84%) in COL-A and a high of ninety two percent (92%) in COL-B.

An analysis of the respondents' narratives in the discussions and their documents revealed some interesting corollary findings pertaining to approaches that colleges used to prepare SPTs forteaching practice. In line with some survey (questionnaire) views held by the respondents, narratives in COL-A and COL-B revealed the following distinct practices:

i. Developing skills on lesson delivery;
ii. Developing skills in improvisation;
iii. Developing skills to adapt to changing environments;
iv. Developing practical teaching skills through peer teaching;
v. Developing practical teaching skills through micro teaching;
vi. Developing competencies in content mastery;
vii. Familiarising students with the nature of teaching practice supervision;
viii. Equipping students with skills in lesson planning; and
ix. Compiling Resource and teaching practice files.

V. DISCUSSION

On one hand some PSTs reported good experiences with the mentors and on the other they reported that some mentors were unaware of college expectations, their roles, teaching requirements and professional exercise. The later tallied with observations by Kiraz and Yildirim (2007) that mentors did not understand the coursework the student teachers did before coming for practicum and therefore, had poor conceptualization of the college expectations, and sometimes did not visualize how they fitted in the college vision. In another study, Mpofu and Hove (2016: 204) noted that:

> *The mentors who were interviewed indicated that they were never oriented on how to mentor the students but were, however, trying their best to help the students. Students also had concerns in this regard when they echoed that what the mentors advised them to do was sometimes different from what they were taught at college.*

The observation that mentors were sometime unaware of their roles and expectations further

Strengthens the case for mentors PD, a call that is becoming louder in recent studies (Melton et al. 2019; Hund et al. 2019). Although Hund et al. (2019) propose a PD model that begins at the undergraduates and postdoctoral students level, the researchers in the present study call for aspects of mentoring to be taught even to diploma students particularly after they complete their practicum. It is envisaged that offering training on aspects of mentoring in teachers' colleges that offer diploma programmes is beneficial at two levels. First, PSTs eventually become future mentors after graduation. PD at that level allows for teacher graduatesthat enter the profession with mentorship skills already rather wait to offer in-service after completion. Second, learning about mentorship skills after PSTs' practicum offers opportunities for posteriori reflections. As PSTs engage in content on mentorship they reflect on their practicum experiences. Reflections on teaching practice experiences has been reported in other studies (eg, Siry& Martin 2014; Mukeredzi 2017) as a crucial component of the PSTs' professional growth.

The other challenge of shortages of specialist teachers reported in the study confirms the perennial debate about depressed numbers of students taking up STEM-related fields in tertiary education (Sutcher et al. 2019; Christensen et al. 2019). Having a non-specialist teacher as a mentor is detrimental to PSTs' professional growth. PSTs needed precise and specialised support and guidance that came from experts (be they college supervisors or school mentors) in their subject areas. Science teaching is very specific, requiring certain kinds of knowledge and skills that are unique to the subject. Avraamidou (2014) traced a beginning elementary teacher's development of identity for science teaching. She argues that, if science teachers need to achieve the goals of preparing literate science pupils, they needed to possess certain knowledge and skills, namely; understanding initial ideas pupils bring to school and how to best develop the ideas, understanding of engineering and scientific practices, constructing science-specific pedagogical content knowledge, understanding how students learn and develop a range of instructional strategies to support student learning. Development of such specialized instructional skills as advocated by Avraamidou (2014) does not occur adequately when college tutors or school mentors who are not specialists in the subject supervise pre-service science student teachers. It would be desirable if colleges required that at least the first supervision visit to the PSTs by the college be done by specialists in the subject area and that PSTs are specifically attached to mentors who are Science majors. Hund et al. (2019) contends that effective mentors must adapt to individual PSTs' needs in order to provide focused coaching.

Data gathered in the follow-up interviews and group discussions confirmed thePSTs' satisfaction with the prior teaching practice preparations in their colleges. Both colleges prepared their student teachers through a variety of core activities that equipped them with skills to plan, deliver lessons, adapt to new environments, handle large classes, manage student behaviours, run laboratories and handle science equipment and chemicals to some extent. Further, findings from the present study indicated that PSTs needed guided support that enabled them to see direction. A number of ways to support pre-service teachers on teaching practice have been put forward. Crawford and Cullin (2004) report on how prospective teachers' conceptions of modeling were supported in Science teaching through scaffolds infused in the Model IT software. Bradbury (2010) argues that educative mentoring helps novices use their own practice as a site for learning as they collaborate with mentor teachers to build academic and professional mentorship relationships. Educative mentoring; fosters dispositions of inquiry, focuses student teacher thinking and understanding, promotes dialogic management of problems, promotes critical reflection and mutual respect of participants' ideas on teaching.

VI. CONCLUSION

Teaching is a complex phenomenon, there is need to support students teachers during the actual practice. Findings from the study indicated that schools were doing their best to support PSTs on teaching practice. To some extend schools availed mentors and science equipment to PSTs, for their mentoring and teaching respectively. However, despite the schools' and mentors' efforts, outstanding challenges to do with heads who refused PSTs access to science equipment, mentors with limited skills on mentoring or mentors not keen on mentoring still remained. Other findings suggested that science teacher educators did a lot to prepare student teachers for teaching practice. Equipping student teachers with sufficient skills in handling large classes and laboratory-based work, improvisation in science teaching and adequate subject matter knowledge were developed as prior support for teaching practice in both colleges. However, the PSTs also thought that there was need for support provision during the actual practice through stakeholder workshops, clinical supervision and targeted, specific individual support. In view of the findings, the researchers conjectured that science teacher educators in both colleges needed to provide support that targeted particular aspects of the PSTs' teaching during the time they were on teaching practice. Such aspects included students' ability to reflect on the development of topic specific pedagogic content knowledge, capacity to model science teaching, skills in drawing pupils' prior knowledge and using their 'world views' as a springboard for conceptual learning.

VII. RECOMMENDATIONS

Based on the above findings and conclusions, the following recommendations are made:

i. Science teacher educators in both colleges and mentors need to provide support that targets particular aspects of the instruction in science teaching.
ii. Colleges need to make sure that at least the first supervision visit to the PSTs by the college be done by specialists in the subject area and that PSTs are specifically attached to mentors who are science majors.

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FOOTNOTES

1. In Zimbabwe, teacher education is offered by universities and teachers' colleges. Overall, universities award graduate and in-service (INSERT) degrees and post graduate diplomas for teacher candidates while teachers' colleges offer a diploma in education, a qualification the University of Zimbabwe (UZ) superintends over under an Associateship Scheme.
2. At secondary school level, the teachers colleges offer two programmes: a Post 'O' Level programme done over three (3) years, with three school terms (equivalent to one calendar year) of practicum; and a shorter Post 'A" Level programme done in two (2) years, with two terms (equivalent to six months) practicum.
3. All the participants of this study were PSTs under the three year Post 'O" level programme.

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LIST OF TABLES

Table 1: PSTs' mean scores on the level of satisfaction on mentoring and school related support for trainees on Teaching Practice 1. COL-A (n=59) 2. COL-B (n=47)

Questionnaire variable	*1. PSTs' Mean Score (%)*	*2. PSTs' Mean Score (%)*
Mentors are always availed by the school	58	62
Mentor is a subject specialist	60	55
Mentors' awareness of their roles in supporting Science student teachers	72	78
Mentors' knowledge (knowhow) in mentoring Science student teachers	74	68
Mentors' professional support for individual trainees' unique growth	58	60
Sufficient time allocated to post observation discussion	64	60
The school equipment for Science learning	80	68
School's participation in local Science exhibitions	78	70
Involvement of other experts in Science to support student teachers on Teaching Practice.	72	68

Table 2: PSTs' mean scores on the level of satisfaction on support type given to individual trainees 1. COL-A (n= 59) 2. COL-B (n=47).

Questionnaire variable	*When support is given.*	*1. PSTs' Mean Score (%)*	*2. PSTs' Mean Score (%)*
Science teacher educators' professional support for individual trainees' unique growth	During teaching practice	62	68
Distance Education materials for PSTs on teaching practice	During teaching practice	76	80
Frequent supervision visits for student teachers on teaching practice	During teaching practice	82	80
Sufficient time allocated to post teaching practice reflections	After teaching practice	56	58
Modeling various teaching approaches useful on teaching practice	Before teaching practice	82	82
Preparing PSTs to deal with own beliefs when teaching science	Before teaching practice	80	74

Table3: SPTs' mean scores on the level of satisfaction on the approaches that STEs used to prepare SPTs for teaching practice. 1. COL-A (n=59) 2. COL-B (n=47)

Questionnaire variable	*1. PSTs' Mean Score (%)*	*2. PSTs' Mean Score (%)*
Adequate knowledge of school subject syllabus	88	86
Adequate content knowledge for Science teaching	84	92
Skills in the integration of science concepts	78	84
Skills in handling pupils' misconceptions	84	84
Teacher educators foster skills to use and management of science laboratories.	86	86
Teacher educators equip mentees with skills in holistic (hard, soft & practical skills) assessment	80	88
Teacher educators help with skills in interpretation of syllabus assessment schemes	84	72
Preparing PSTs to teach in differing school contexts	80	86
Preparing PSTs to teach Science in schools without resources	82	82