Enhancing Pre-Service Science and Mathematics Teachers' Competence-based Teaching through School Attachment

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Abstract

This study intended to investigate how pre-service science and Mathematics teachers improve their competence-based teaching when they are engaged in educative mentorship in a school attachment intervention. Forty undergraduate pre-service science and Mathematics teachers from one university in Tanzania participated in the study. Quasi-experimental research design was employed to assess the changes made by the pre-service teachers as they practised competence-based teaching. The findings indicated that the intervention enhanced pre-service teachers' knowledge and skills in competence-based teaching. Recommendations are made for teacher training colleges, researchers and policy makers to integrate the school attachment strategy in the initial teacher education to promote competence-based teaching.

***Keywords**:* competence-based teaching, pre-service teachers, school attachment, science and Mathematics

Introduction

Over the past three decades many countries have made curriculum reforms in their education systems to prepare competent individuals who can fit in the world of work. Competence-based education emerged in the United States of America in the 1960s out of a concern that students were not taught essential life skills (Kim, 2015). When introduced for the first time, the competence-based curriculum was popular in vocational education and training before it spread across educational fields, with many countries adapting it (Byrne, Downey & Souza, 2012). The

competence-based curriculum ascribes to constructivist approaches to teaching and learning that regard learners as individuals who are capable of constructing and applying knowledge rather than mere assimilators of knowledge (Lupeja & Komba, 2021). In higher education, the term competence is commonly perceived as the ability to do something successfully or efficiently based on a range of knowledge, skills and attitudes (Bergsmann, Klug, Burger, Först & Spiel, 2018). With respect to teaching, teachers are expected to develop knowledge and skills and positive attitudes that can influence students' learning (Uztosun, 2018). Competence-based teaching is a teaching pedagogy that requires knowledge, skills, values and attitudes to reflect on learners' ways of thinking and acting (Bergsmann, Schultes, Winter, Schober & Spiel, 2015; Komba & Mwandanji, 2015). This pedagogy requires a learner-centered teaching approach whereby teachers demonstrate knowledge, skills and attitudes, while assuming the role of facilitators.

In Tanzania, the competence-based curriculum was first introduced in the secondary education in 2005 to equip school graduates with sufficient knowledge and life skills needed in the contemporary world (Kitta & Tilya, 2010). However, its implementation has been facing several challenges including lack of teachers' awareness of the curriculum, shortage of teaching facilities for its implementation, mismatch between examinations and students' actual learning style, prevalence of content-based textbooks (Mosha, 2012; Lupeja & Komba, 2021). Other challenges are associated with lack of in-service training to teachers on how to implement the curriculum (Makunja, 2016; Paulo & Tilya, 2014). These challenges have been hindering effective competence-based teaching across subjects, particularly science and Mathematics. In that case, competence-based teaching skills among science and Mathematics teachers need to be developed as early as possible during their initial training (Bergsmann et al., 2015; Serdenciuc, 2013). Teaching and learning strategies under competence-based curriculum in secondary schools require teachers to be competent in competence-based teaching, which is a pedagogy that embraces a learner-centered teaching approach whereby teachers demonstrate knowledge, skills and attitudes, while assuming the role of facilitators (Bergsmann et al., 2015). Teachers are therefore supposed to acquire competence-based teaching skills either during the pre-service training or during in-service training.

Several studies conducted in Tanzania have indicated that the teaching and learning process in secondary schools has remained predominantly teacher-centred (Komba & Mwandanji, 2015) while assessment is mainly for accountability purposes (Kyaruzi, 2019). Despite the opportunity to do teaching practice and other initiatives to improve competence-based teaching skills of pre-service teachers, studies indicate that graduate teachers do not always demonstrate skills that are up to

the standards required in competence-based teaching (Makunja, 2016). It has been shown that teachers find it difficult to integrate learner-centered teaching approaches to improve classroom interaction and promote students' autonomy in learning (Byrne et al, 2012). Nevertheless, studies indicate that professional development in terms of training has the potential to improve teachers' instructional and assessment practice as well as ability to control large classes (Kyaruzi, Strijbos & Ufer, 2020; Mwakabenga, 2018). School attachment has been acknowledged as a programme that may improve teachers' competence-based teaching during the initial teacher training.

Although the Tanzanian government has been concerned with the provision of quality teaching, more efforts are needed to develop competent science and Mathematics teachers. As teachers are at the centre of any educational reform, it is imperative to have a well-established initial teacher education that prepares competent teachers. A well-established teacher education would become a remedy to the problems related to competence-based teaching since, according to Mosha (2006), poor quality of teaching in Tanzanian secondary schools is partly attributed to inadequate initial teacher education. Most of the present pre-service teacher training programmes are charged with being too demanding as they require teacher trainees to master a lot of content which does not match with what has to be taught in the actual teaching and they do not provide teacher trainees with enough time to engage with the subject content or practice teaching (Kitta & Fussy, 2013). As a result, these teachers get employed in the teaching job while they are not fully prepared. For example, in the small-scale study conducted with Tanzanian and Malawian teachers, the teachers claimed that there was drastic incompatibility between what they learned in their initial teacher training programmes with what they had to practise later in their actual teaching (Mkandawire, Mwanjejele, Luo & Ruzagiriza, 2016). The challenges of teaching science and Mathematics in Tanzania are multifaceted but could be largely a result of poor teacher preparation.

One of the best ways recommended for preparation of pre-service teachers is to attach them to local schools surrounding the college (Goodlad, 1991; Teitel, 2003) so that they get ample time to practise teaching. Studies have shown that if pre-service teachers are appropriately attached to school environments and work under the support of experienced teachers, they tend to improve their teaching abilities (Amedeker, 2002). Goodlad (1991, p. 10) concluded that "any teacher education programme created or conducted without the collaboration of surrounding schools is defective" . It is important that the theoretical knowledge learned at the university is linked to practical classroom activities (Teitel, 2003). This study therefore focuses on enhancing pre-service science and Mathematics teachers' competence-based teaching skills through a school attachment programme. Attachment of science

and Mathematics teachers to schools gives them an opportunity to engage in the ongoing implementation of the competence-based teaching skills and experience the classroom challenges.

Attaching pre-service science and Mathematics teachers to local schools available in the catchment area has been practised across educational systems. For example, at the University of Monash, the Science Department has been offering student teachers the opportunity to engage in experiential learning through attaching students in schools (Loughran & Gunstone, 1997). Similar programmes are also conducted in African universities such as the University College of Education Winneba in Ghana, which introduced the school attachment programme in 1993 (Amedeker, 2002). In general, school attachment is a form of apprenticeship in which the student-teacher is partly involved in the actual school environment under the supervision of an experienced teacher. This type of learning fosters learning by doing, which is grounded within sociocultural learning perspectives. Similarly, the attachment theory by John Bowlby has implications for understanding adult learning in context (Fleming, 2008) such as pre-service teacher learning in schools. This theory provides an insight to teacher educators that attachment can help students learn in a conducive environment. Once an appropriate style is applied, the pre-service teachers will benefit by improving their teaching skills that can enhance student learning in the competence-based classroom. The attachment theory posits that "a secure attachment may allow students (pre-service teachers) to focus directly on the challenges of the task and immerse themselves in the activity" (Fleming, 2008, p.42).

In assessing competences, Bergsmann et al. (2018) developed the Competence Screening Questionnaire for Higher Education (CSQ-HE). The questionnaire was developed based on the levels of the SOLO (Structure of Observed Learning Outcomes) taxonomy which aims at assessing the quality of students' competences. The SOLO taxonomy, as propounded by Biggs and Collis (1982), provides information on the progression of competences. The taxonomy consists of competence levels which involve understanding only one or several, unrelated aspects of the task, integrating these unrelated aspects and generalising, and transferring them to a previously unknown task. So, the specific and overall teaching and professional competences as outlined by different scholars (Shulman, 1987; Uztosun, 2018) and indicated in the science and Mathematics syllabi were integrated into the SOLO taxonomy. These competences included assessment and evaluation of teaching and analysis of secondary school syllabi for science and Mathematics. Other aspects are characterized by preparation of a scheme of work and a lesson plan, application of learner-centred teaching approaches, designing learning materials, classroom management and problem solving. The

SOLO taxonomy guided the assessment of pre-service teachers' achievement in competence-based teaching.

The process of developing teaching competence among teachers is crucial, especially for pre-service science and Mathematics teachers. There are many ways in which pre-service teachers can develop competence-based teaching skills including classroom observation, microteaching, and teaching practice (Bates, 2019). In Tanzania, the government usually funds teaching practice to enhance pre-service teachers' teaching competence to teach various subjects. Although pre-service teachers are posted to various secondary schools for the period of eight weeks in the first and second year of undergraduate teacher training programmes, pre-service teachers might require more training opportunity to advance their competence-based teaching skills to complement teaching practice. Such an opportunity is rarely available in teacher training colleges and universities in Tanzania. During the third-year, pre-service teachers do not get the opportunity to practise what they learned during the teaching practice. To address this professional development challenge, this study aimed at finding out if a school attachment and mentorship programme for the third-year pre-service science and Mathematics teachers is likely to promote their competence-based teaching. The study was therefore guided by the following research questions:

1) What is the level of understanding of pre-service science and Mathematics teachers of the concept of competence-based teaching before the school attachment programme?
2) What changes do pre-service science and Mathematics teachers demonstrate in their understanding of competence-based teaching as they participate in the school attachment programme?
3) What teaching competences do pre-service science and Mathematics teachers demonstrate after participating in the school attachment programme?

Methodology

The study involved 40 third-year pre-service science and Mathematics teachers from Dar es Salaam University College of Education (DUCE) in Tanzania. The sample comprised 62.5% male and 37.5% female obtained through purposeful sampling technique. Before engaging in the school attachment intervention, the pre-service teachers were pre-tested through a questionnaire and interviewed to assess their prior knowledge and skills on competence-based teaching. In addition, 38 science and Mathematics teachers from 10 secondary schools nearby the University were involved to mentor the pre-service teachers.

The study employed a mixed-methods research approach informed by the quasi-experimental research design. Quantitative data were collected through a questionnaire adopted from the Competence Screening Questionnaire for Higher Education–CSQ-HE (Bergsmann et al., 2018). The questionnaire scales had sufficient reliability ranging from 0.71 to 0.91 during pre-test and from 0.88 to 0.93 at posttest. Quantitative data were complemented with qualitative data obtained from focus group discussions, classroom observations and reflective journals. Prior to the school attachment, a two-day intensive training intervention was conducted to equip pre-service teachers with knowledge and skills on competence-based teaching and guide the teacher mentors on educative mentorship skills. This pre-attachment training was complemented by continuous mentorship from trained teacher mentors and researchers. Each pre-service teacher taught a maximum of two lessons per week, equivalent to 80 minutes.

Focus group discussions involving four to six participants were conducted with pre-service teachers before the training workshop and after implementing the competence-based teaching programme in schools. The discussions intended to yield more information about pre-service teachers' knowledge and skills in competence-based teaching. Similarly, classroom observations were conducted by researchers and mentor teachers at different times. As Efron and Ravid (2013) recommend, the pre-service teachers kept the reflective journals and recorded all important events that happened during the intervention. To facilitate self-reflection, pre-service teachers were given guiding questions such as "What competence-based knowledge and skills have I learned today?" Descriptive and inferential statistics were used to analyse qualitative data in SPSS version 25 and the NVivo 11 software was used to analyze qualitative data.

Results and Discussion

This section presents quantitative and qualitative results and a corresponding discussion of the findings obtained in response to the research questions. The quantitative data is presented first to indicate the pre-service science and Mathematics teachers' understanding of competence-based teaching before the training and the school attachment programme. At some point, the quantitative findings are integrated into the qualitative data to reinforce the teachers' change in competence-based teaching after they had undergone training on competence-based teaching and received mentorship from teachers and the researchers.

Pre-service teachers' level of understanding of competence-based teaching

The first research question sought to find out the level of understanding about competence-based teaching among pre-service science and Mathematics teachers before the training and the school attachment programme. The results showed that pre-service teachers had some knowledge about competence-based teaching prior to the school attachment programme. The knowledge was significantly enhanced after the school attachment programme especially in areas such as assessment and evaluation, syllabus analysis, preparation of schemes of work, preparation of lesson plans, and approaches to teaching. However, there were no significant change of the knowledge in terms of designing learning material, classroom management skills and problem solving. Table 1 summarises pre-service science and Mathematics teachers' knowledge of competence-based teaching before and after the training workshop.

Table 1: *Pre-service Science and Mathematics Teachers' Knowledge about Competence-based Teaching*

Factor	Pre-test	Post-test	N	t	df	p	η^2
	Mean (SD)	Mean (SD)					
1. Assessment and evaluation	4.53 (1.13)	5.25 (0.86)	34	-3.42	33	0.002	0.26
2. Syllabus analyses	4.88 (1.31)	5.63 (0.96)	34	-3.09	33	0.004	0.22
3. Scheme of work	5.04 (0.92)	5.54 (0.88)	28	-2.45	27	0.021	0.18
4. Lesson plan	4.98 (1.14)	5.70 (0.94)	33	-3.36	32	0.002	0.26
5. Teaching approaches	4.70 (1.36)	5.67 (0.94)	33	-3.59	32	0.001	0.29
6. Designing learning materials	5.39 (0.80)	5.66 (1.05)	33	-1.51	32	0.142	0.07
7. Classroom management	5.32 (1.22)	5.60 (1.08)	34	-1.58	33	0.123	0.07
8. Problem solving	4.99 (1.06)	5.30 (1.09)	31	-1.46	30	0.155	0.07

Note: df = degree of freedom, η^2 = eta squared effect size

The data in Table 1 indicate that during the pre-test, the pre-service teachers were knowledgeable about various competence-based teaching constructs such

as assessment and evaluation, syllabus analyses, scheme of work, lesson plan and teaching approaches. At the pre-test stage, pre-service teachers' knowledge ranged from a mean of 4.53 in assessment and evaluation to a mean of 5.39 in designing learning materials. Based on the interpretation of the rating scale, pre-service teachers' knowledge of competence-based teaching was at level 4 (contextualization) – ability to put knowledge in relevant context, and level 5 (expansion) – ability to create new knowledge in a narrow defined area and simple form. The findings are somewhat congruent with previous findings from other researchers who acknowledged the role of mentor teachers in supporting pre-service teachers (Lejonberg et al., 2018; Musingafi & Mafumbate, 2014). Furthermore, it was noted that pre-service teachers preconceived that knowledge of competence-based teaching might have positively or negatively influenced their practice. Reflecting on the issue of lesson preparation, it appeared that teachers' inability to prepare lesson plans could be influenced by negative perceptions held towards them. These findings are somewhat contrary to those of Alanazi (2019) who found that the importance of lesson planning was very well understood and valued by the pre-service teachers but there were other issues that prevented the teachers from making effective preparation of lessons. However, when the pre-service teachers in the current study demonstrated understanding of lesson plan preparation and the uses of a lesson plan, they improved the practice.

Changes in teachers' understanding of competence-based teaching

The second research question focused on changes in the pre-service teachers' knowledge of competence-based teaching as a result of participating in the school attachment programme. Questionnaires, focus group discussions and teachers' reflective notes were used to track the changes. In addition to quantitative results presented in Table 1, the qualitative results indicated that there were changes in competence-based teaching practices among the pre-service teachers. The changes in these teachers' understanding of competence-based teaching were most noticeable in lesson preparation, and designing of lesson materials as presented in the subsequent sections.

Change in the understanding of competence-based teaching concept

Before the intervention, most of the pre-service teachers conceptualized competence-based teaching as a mere teaching approach. The teachers thought that competence-based teaching was an approach used to teach students to apply what they learnt in

the classroom in the actual context. Expressing her understanding of the concept, one Biology pre-service teacher elaborated: ‘‘When we talk about competence, we mean to do things practically” (Participant 16). Another pre-service teacher commented, “Competence-based teaching means that the learner after getting the knowledge from the expert (a teacher) uses that knowledge in different situations in real life” (Participant 14). This idea was highlighted by a pre-service Mathematics teacher who said that in competence-based teaching students should be assisted to apply numbers and letters. The evidence from the quotes above indicated that pre-service teachers’ understanding was limited to students’ application of the learned content. Moreover, none of the teachers articulated how theoretical learning can be applied in the actual environment. With the knowledge obtained from the training and through classroom practices, some pre-service teachers began to view the concept of competence-based teaching in a broader sense. Admitting that their initial conceptualization of competence-based teaching was too limited, one of the pre-service teachers narrated:

> This attachment has improved my understanding that competence-based teaching is not only about teaching the content, but rather it is about ensuring that learners understand and do something by focusing on developing competences among them rather than finishing a topic in one day (Participant 21).

This change of knowledge was indicated in the pre-service teacher’s reflective notes. Overall, these teachers came to realize that competence-based teaching meant learners’ mastery of intended learning abilities and knowledge construction (Bergsmann et al., 2018). In line with the findings of this study, studies conducted in Tanzania show that many teachers could not effectively implement the competence-based curriculum (Lupeja & Komba, 2021; Makunja, 2016).

Shift in the understanding of competence-based lesson preparation

Prior to the intervention, almost all pre-service teachers claimed that they were aware of the importance of lesson preparation. A few of them did not see the essence of having a lesson plan. These teachers claimed that they could teach and prepare the lesson plan even later after class. For example, towards the end of the programme, one among those few pre-service teachers commented: “Previously, I used to prepare the lesson plan after instruction. Now I know it must be done before entering the class” (Participant 17). Another pre-service teacher added that: “For example, during regular teaching practice, a student teacher can copy a lesson plan… in order to present to supervisors” (Participant 40). Literally, it appears that

this pre-service teacher was aware of the use of a lesson plan but neither realized its value nor understood how to use it appropriately. As a result, the teacher found no difference between preparing a lesson plan before and after teaching. Impliedly, the lesson plan was conceived as a tool for accountability rather than a tool for facilitating teachers' instructional practices.

In the course of school attachment programme, the pre-service teachers consolidated their understanding of the meaning of lesson planning as they realized that it is in the lesson plan where competences are formulated, time is allocated to topics and learners' activities are planned to facilitate systematic teaching. For instance, one realized that planning a lesson helped him to teach more competently, compared to his previous practice. Another pre-service teacher explained that it was important to learn how to align competences in the plan: "Basically, I have learned to prepare a competence-based scheme of work and lesson plan, and how to deliver the lesson using competence-based teaching approach" (Participant 09). Interestingly, another teacher came to know that lesson planning would only be sound if it is preceded by syllabus analysis, of which she had to do as a teacher. Noting in her reflective notes, the teacher admitted, *"*Through this project, I have learned that syllabus analysis is part of my job as a teacher" (Participant 39). It can be concluded that the mentorship provided to the pre-service teachers helped them to improve their understanding of the lesson preparation.

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Change of understanding about using teaching materials in competence-based teaching

One of the foci of this research project was to clearly understand utilization of teaching materials in competence-based teaching. Pre-service teachers were

pretested to check the extent of their understanding of the use of teaching materials in competence-based teaching. The pre-service teachers claimed orally that they had sufficient understanding of teaching materials. However, later on after the intervention, some admitted that they had no clear understanding of how to select appropriate materials or design them in a competence-based teaching stance. The testimonies given by some pre-service teachers imply that they had limited competence in material designing.

After the intervention, one of the pre-service teachers learnt that they needed to be knowledgeable about how to collaborate with students and the community and to prepare some teaching materials at a low cost. The pre-service teacher commented: "I have understood that not only a teacher is supposed to find learning and teaching materials but also a learner can find the real materials through a task which the teacher can provide" (Participant 10). Another pre-service teacher commented that he learned how to prepare teaching aids which helped other teachers as well.

Pre-service teachers' change of practices in the competence-based teaching

The third research question was about how pre-service science and Mathematics teachers demonstrated teaching competences after participating in the school attachment programme. Having presented the findings on knowledge change among the pre-service science and Mathematics teachers, the following analyses focused on the change of their skills pertaining to competence-based teaching. Questionnaires, interviews, teachers' reflective notes and classroom observation helped to illustrate these changes. Table 2 summarises the key findings from the pre – and post-test questionnaires with respect to pre-service science and Mathematics teachers' competence-based teaching skills.

Table 2: *Pre-Service Science and Mathematics Teachers' Skills of Competence-Based Teaching*

Factor	Pre-test	Post-test	N	t	df	p	η^2
	Mean (SD)	Mean (SD)					
1. Assessment and evaluation	4.47 (1.24)	5.18 (0.97)	34	-3.03	33	0.005	0.22
2. Syllabus analyses	4.89 (1.31)	5.64 (1.04)	33	-3.05	32	0.005	0.23
3. Scheme of work	4.89 (1.17)	5.56 (0.97)	34	-3.46	33	0.001	0.27

Factor	Pre-test	Post-test	N	t	df	p	η^2
	Mean (SD)	Mean (SD)					
4. Lesson plan	4.94 (0.93)	5.46 (0.89)	31	-2.69	30	0.011	0.20
5. Teaching approaches	4.58 (1.35)	5.59 (0.92)	33	-4.64	32	0.000	0.41
6. Designing learning materials	5.14 (1.08)	5.61 (0.98)	33	-2.57	32	0.015	0.18
7. Classroom management	5.49 (1.05)	5.70 (0.93)	34	-1.49	33	0.146	0.06
8. Problem solving	5.02 (1.04)	5.48 (0.92)	34	-2.45	33	0.020	0.16

Note: df = degree of freedom, η^2 = eta squared effect size

The findings in Table 2 indicate that pre-service teachers' pre-test knowledge about competence-based teaching ranged from a mean of 4.47 in assessment and evaluation to a mean of 5.49 in classroom management. Ideally, based on the competence screening scale, pre-service teachers' competence-based teaching skills were at level 4 (contextualization) and level 5 (expansion) which is the ability to create new knowledge in a narrow defined area. Table 2 also indicate that at post-test, the school attachment programme significantly improved the pre-service teachers' competence-based teaching with respect to assessment and evaluation, syllabus analysis, scheme of work, teaching approaches, designing of learning materials and problem solving. These findings suggest that the training had improved their knowledge and skills in all the listed variables. Nevertheless, classroom management was the only factor which had no significant changes, even though pre-service teachers rated themselves higher in this aspect at pre-test and post-test. Interviews, teachers' reflective notes and classroom observations helped to illustrate the quantitative findings as described in the next subsections.

Changes in classroom management competences

While most of the teachers said that they had some skills in handling students' behaviour, others were not certain of demonstrating effective classroom management. When the researchers probed the pre-service teachers on how they handled students' misbehaviours in the classroom, one of them responded "*by punishing them"* The teacher insisted that... *"if you keep using merewords, sometimes students are very*

stubborn" (Participant 11). The teacher further explained that he had a tendency of avoiding a class which had stubborn students because it was difficult for him to change their attitudes. These findings suggest that some teachers think that the best way to deal with students' misbehaviours is to punish or avoid them. Such a strategy of behaviour management is not appropriate and thus pre-service teachers were advised to think of the best approach to manage classes during the school attachment programme.

A change in ability to manage large classes was reported in reflective notes by most of the participants. So, this change is considered as one of the competences achieved during the implementation of competence-based teaching. Reflecting on how the classroom management competence was necessary in competence-based teaching, three pre-service teachers noted that their teaching could be somewhat difficult if they had no techniques for managing large classes of 80 students and above. Almost all observations made by researchers indicated that the pre-service teachers demonstrated improved competence in promoting students' participation in the classroom and managing students' behaviours.

Generally, the pre-service teachers acknowledged that they needed some competences in order to manage large classes when they were teaching. The teachers revealed that with the support of their mentors, they developed abilities relevant for managing their classrooms. This finding is consistent with that from a study conducted by Ming and Qiang (2017) in China, which indicated that the majority of teachers sought the best strategies for managing their large classes to facilitate teaching. In a small scale study on enhancing the competences of Turkey English teachers, Uztosun (2018) realised that in order to attract students' attention and teach well, a teacher needs to have appropriate classroom management skills. The findings of this study suggest that teachers need to learn a variety of classroom management techniques and apply them to facilitate learning.

Changes in ability to use interactive teaching approaches

At the beginning of the project, most of the pre-service teachers admitted that lecturing was their predominant teaching method. They were of the view that question and answer and the group discussion methods were only meant for small classes. With the help of their mentors and supervisors, the teachers came to realise that teaching methods can be modified to suit large classes. For example, one of the pre-service teachers said: "What I have learned is that the question and answer method and group discussion are the best methods even in a large class" (Participant 04). Most of the pre-service teachers acknowledged later that they

learned different strategies of teaching large classes during the intervention.

It was also found in this study that pre-service teachers developed competences for engaging students by using interactive teaching approaches. Before the intervention, some teachers disclosed that it was challenging for them to involve students during the lessons due to limited teaching competences, time and resources. During the attachment programme, the pre-service teachers applied some techniques to explore students' prior knowledge of the lesson as a way of engaging them more effectively during teaching. Both the mentor teachers and the supervisors observed that the pre-service teachers spent some time to explore students' understanding of the lesson before introducing a new lesson. During an interview, one pre-service teacher argued that:

> I have learnt that students come in the classroom sessions with basic knowledge about what we teach …I have been telling my students what we would discuss in the subsequent sessions as a result when we met I witnessed students contributing a lot contrary to my thinking that topics were completely new to them (Participant 03).

Supporting the idea of promoting students' involvement through different interactive teaching approaches, another teacher commented that before engaging in the school attachment programme, he rarely used interactive methods that could promote development of the learners' competences. During the final interview, another pre-service teacher testified that he had gained and used some skills on how to involve students in the lesson. The quotations from the interviews with two pre-service teachers on the acquisition of competences to engage students in teaching explain about the change they underwent. One of the teachers commented: "Before this project, I thought it was difficult to engage learners especially in learning Mathematics" (Participant 31). Similarly, another teacher clarified: "This programme has made me aware even if you are teaching a new concept or content as teachers we need to engage students, take them through the content, try to speculate what they know and what they can improve" (Participant 06). The findings suggest that in some circumstances, it was not easy for the pre-service teachers to involve their students in the teaching and learning process, thinking that they would not have anything to contribute. These pre-service teachers reported that they worked with their mentors to create some skills for engaging learners through interactive ways.

All these findings show that some pre-service teachers improved their ability to engage students in learning after participating in the school attachment programme. At least, most of the pre-service teachers learned how to identify the learning needs, prepare specific learning tasks, participatory teaching methods, such as

group discussion and the question and answer technique. Findings similar to these were reported by Zervas et al. (2016) who showed that teachers developed competences in terms of lesson preparation, student involvement in the lesson when they were supported. The findings further indicated that pre-service teachers integrated formative assessment practices in the form of question and answer to clarify learning difficulties within the instructional process. The findings concur with Kyaruzi et al. (2020) who note that teachers' assessment practices can be improved via professional development. In particular, the findings corroborate with the notion of constructive learning through scaffolding practices.

Change in ability to design teaching and learning materials

Prior to the intervention, findings from questionnaires indicated that teachers had commendable abilities in designing learning materials by a mean of 5.14 and a standard deviation of 1.08. However, after engaging in the attachment programme, most of the participants developed abilities in improvisation of teaching materials and use of local resources. In doing so, some teachers claimed that they looked for the available alternative resources, while a few of them borrowed some materials from nearby schools to ensure that their lessons are not delivered without the necessary materials that can facilitate meaningful learning. One of the participants explained: "When I am teaching food test, I give students tasks to bring any food they have… from their homes" (Participant 39). This finding implies that it is good for the teacher to develop skills for improvisation of teaching materials. The teaching materials can be designed from the resources surrounding the local environment, but students can also bring some materials from home. Ndihokubwayo (2017) found that laboratory activities were hampered just because teachers lacked improvisation skills.

Generally, one of the most interesting findings in this study is that when pre-service teachers were provided with adequate and educative mentorship, they became motivated to learn various teaching skills. The findings are somewhat congruent with previous findings from other researchers who acknowledged the role of mentor teachers in supporting pre-service teachers (Lejonberg et al., 2018; Musingafi & Mafumbate, 2014). Regarding the theoretical perspectives, the scaffolding process to which the pre-service teachers were subjected during the school attachment programme played a significant role in enhancing their competence-based teaching knowledge and skills. The mentor teachers gave pre-service teachers full support in planning lessons, teaching and assessing the students as they arrived at school. The mentor teachers reduced this support as pre-service teachers improved their

teaching competence. Also, as they worked together with mentors, pre-service teachers gained more autonomy on lesson preparation, teaching and assessment, which were fully informed by the social constructivist theory that was identified in the literature review. Social constructivism emphasizes the value of providing pre-service teachers with the opportunity to learn from experienced teachers (Nguyen, 2017). In this study, student-teachers acknowledged that the mentorship support from teachers with regard to lesson preparation, class management and teaching aid preparation enabled them to improve their competence-based teaching.

The study has both theoretical and practical contributions. Theoretically, the study findings suggest that one of the effective strategies to enhance pre-service teachers' teaching competence is to attach them to a school so that they can practice teaching. Attaching pre-service teachers to a school is a useful method in advancing their knowledge and skills in teaching, collaborative lesson planning and effective feedback practices. Another theoretical contribution is associated with having more time for pre-service teachers' teaching practice. Providing the opportunity for pre-service teachers to practise teaching in the final semester of teacher training would increase the chances for developing competence-based teaching skills. On the other hand, one of the practical implications of this study is the possibility of attaching pre-service science and Mathematics teachers to secondary schools that surround the university college. The main idea was to give pre-service teachers an opportunity to improve their teaching competences through practising teaching while continuing with studies in the final semester. Therefore, this kind of school attachment programme seems to promote the teaching competence of the pre-service science and Mathematics teachers, hence it is recommended to be an integral part of pre-service teacher training.

Conclusion and Recommendations

The overall conclusion and some recommendations can be made regarding this study's findings. First, although pre-service teachers understood the concept of competence-based teaching before the school attachment programme, their competence significantly improved through interventional activities. School attachment was one of the interventions that enhanced pre-service teachers' knowledge of competence-based teaching. Second, the changes in the teachers' understanding of competence-based teaching were evident in lesson preparation and designing of lesson materials as they appreciated the role of lesson planning and the use of local materials to enhance teaching. Thirdly, pre-service science and Mathematics teachers demonstrated positive changes in the teaching approaches

they applied, classroom management skills, and problem-solving skills during the school attachment programme. Concerning classroom management, pre-service teachers improved in handling students' disruptive behaviours without using punishment. They also acknowledged strategies for managing large classes, such as questions and answers and group discussions. Generally, pre-service teachers improved their understanding of the role of a lesson plan in promoting competence-based teaching rather than using it as a tool for teaching accountability.

With reference to the findings, it is concluded that the school attachment programme is a viable and useful practice in advancing pre-service teachers' competence-based teaching practices. The intervention programme can be implemented by placing pre-service teachers in schools around the university college to practice teaching while continuing with their studies. We recommend the school attachment programme to be integrated in pre-service teacher education. Apart from enhancing pre-service teachers' teaching competence, the programme will have multiple benefits to students in schools around the university college. Finally, we recommend several issues for further research or implementation. One of them is, we recommend further research to be carried out by employing longer interventions of at least two semesters, which will allow pre-service teachers to have enough time to practise teaching and to work on the feedback they get from their mentors and supervisors so as to improve their practices.

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