Challenges and Solutions: The Experiences of Newly Qualified Science Teachers

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Abstract
We explored the challenges that five newly qualified teachers (NQTs) faced in the teaching and learning situation and how they addressed their challenges. The teachers taught integrated science at the Junior High School (JHS; ages 12-15 years). Data were collected through observation, interview, and content analysis. We used the inductive and deductive analytic methods, and we found out that the NQTs faced the following challenges among others: (a) lack of resources for teaching and learning, (b) time management, (c) deficiency in content knowledge, (d) their students’ inability to understand the lessons taught, (e) student indiscipline, (f) lack of their students’ interest in science, and (g) their inability to complete the integrated science syllabus. The challenge of lack of resources and deficiency in content knowledge cut across all the NQTs. Some of the methods that they used to solve their challenges are (a) improvising equipment, (b) modifying their teaching, and (c) talking with parents. It was recommended, among other things, that the basic schools should be supplied with equipment/materials and also that preservice training should equip prospective teachers with skills to help them face their challenges.

Keywords
challenges, teaching and learning materials, newly qualified teachers, integrated science, improvisation, solutions to challenges, junior high school.

Newly qualified teachers (NQTs) have been the focus of many studies because the first years of teaching are fraught with many challenges (French, 2004; He & Cooper, 2011; Liston, Whitcomb, & Borko, 2006; MacMahon, 2006; McKenzie, 2005; Özturk, 2008; Senom, Zakaria, & Shah, 2013; Sunde & Ulvik, 2014; Wang, Odell, & Schwill, 2008; Watson, 2006; Windschitl, Thompson, Stouppe, Chew, & Wright, 2010). Some of the challenges cut across subject areas, others are peculiar to the school, and others are peculiar to the individual.

The literature abounds in studies that have been done to find the challenges of NQTs but few studies have been done on NQTs who teach science, and almost all the studies have been done in the more developed countries. Generally, these studies are deficient in focusing on the solutions that the NQTs have applied to their situations. This study enriches the literature in this area by focusing on science teachers’ challenges as well as the solutions they have used. Knowing their challenges and how the NQTs have solved them will provide information that will help to equip future teacher trainees to cope with similar challenges.

Background to the Study
In Ghana, NQTs are posted to teach in the villages. This has its own challenges (Pryor & Ampiah, cited by Adu-Gyamfi, 2014). Schools in such areas tend to lack good infrastructure and other facilities that are associated with those in the towns and cities. Generally, pupils in village schools in Ghana come from poor socioeconomic backgrounds and have more challenges with the English language. According to Pryor and Ampiah, cited by Adu-Gyamfi (2014), the pupils’ handicap in the usage of the English language is one of the factors that cause the teachers to use teacher-centered methods in their lessons. In a study to find out the challenges faced by the Junior Secondary School (JHS) integrated science teachers in Ghana, Adu-Gyamfi (2014) found that their major challenge was the nonavailability of teaching and learning resources. All the teachers in that study were experienced teachers with an average teaching experience of 5 years. There was no indication in the study as to whether they were trained using the 2007 specialist science curriculum or not.

X College of Education is one of the colleges that have been equipped to train specialist science teachers to teach integrated science at the JHS level with a new curriculum

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that was implemented in 2007. Indeed, it is the only well-equipped science college in the whole of the Central Region of Ghana for implementing the 2007 integrated science curriculum. It is, therefore, assumed that NQTs who had their preservice education there have had the benefit of being equipped to deal with challenges in the teaching and learning of integrated science. Besides that, the two-semester-long practicum (Institute of Education, 2005) the teacher trainees experience as mentors in village basic schools as part of their preservice training is supposed to equip them for that purpose. The village teaching experience notwithstanding, with the previous curricula some of the JHS science teachers had challenges in the teaching of integrated science (Teacher Education Division, 2007), and that was why the science colleges such as X College of Education were set up.

The purpose of this study was, therefore, to explore the challenges that five NQTs trained at X College of Education face in the teaching of integrated science at the JHS level and how they have solved them.

The following two research questions guided this study:

**Research Question 1:** What challenges do the NQTs face in teaching science at the JHS level?

**Research Question 2:** How do the NQTs solve the challenges they encounter in teaching science?

**Literature Review**

**The Types of Challenges NQTs Face**

The term “newly qualified teacher” has been used for different durations of the teaching of teachers who are fresh from college. This is because the exact time needed for a beginning teacher to develop into a teacher expert is impossible to determine (Prucha, cited by Wiegerová & Szimethová, n.d.). To some, it can last for 5 years (MertLife Survey of the American Teacher; National Commission on Teaching and America’s Future; Ingersoll; cited by Bozack, 2008), whereas to others it lasts 3 years (Bartell, 1995) or more. In Anglo-Saxon literature, other concepts such as beginning teachers, novice teachers, and new teachers are also commonly used in place of the NQT (Fransson & Gustafsson, 2008).

We took into consideration the inconsistency in the definition of a NQT/novice teacher in the reading of relevant literature because research on novice teachers does not always preclude those who have taught for more than 1 year (Bozack, 2008). In this study, the NQT had taught for more than 1 year but less than 3 years. More recently, wider literature on graduate teachers with respect to the early stages of their career indicates the following challenges: (a) threat of unemployment, (b) inadequate knowledge and skills, (c) decreased self-efficacy and increased stress, (d) early attrition, (e) newcomers’ role and position in a work community, and (f) importance of workplace learning (Tynjälä & Heikkinen, 2011). After following five secondary preservice teachers for 2 years during their teacher education programme and their first year of teaching in a study, He and Cooper (2011) found that although the participants were proud of their accomplishments, they had challenges. The following are the challenges He and Cooper identified in their participants: (a) testing pressures, (b) lack of administrative support, (c) lack of up-to-date resources, (d) lack of parental involvement, and (e) the difficulty of balancing their teaching responsibilities and their personal lives. Liston et al. (2006) identified that (a) some NQTs say the theoretical grounding that they learned in teacher preparation does not equip them sufficiently for the demands of daily classroom life, (b) they wrestle with the emotional intensity of teaching, and (e) they often teach in workplaces that are not adequately organized to support their learning (Liston et al., 2006). In other situations, the challenges faced by some new teachers are that they are prevented from implementing many innovative classroom practices and they are isolated (Mckenzie, 2005). Some of the range of dilemmas that novice teachers encounter is in areas such as curriculum, lesson planning, assessment, management, time, and school culture (Feiman-Nemser, 2003; Oakes & Lipton, cited by Agarwal, Epstein, Oppenheim, Oyler, & Sonu, 2009). Other challenges are (a) inability to identify pedagogical implications for individual students, (b) not knowledgeable in their subject, and (c) less focused self-reflections (Reynold, cited by Bozack, 2008). Veeman, cited by Bozack (2008), stated eight problems often encountered by NQTs as (a) discipline, (b) motivating students, (c) how to deal with individual differences, (d) assessment of students’ work, (e) relationships with parents, (f) class work organization, (g) inadequate teaching materials, and (h) dealing with the problems of individual students.

After observing former graduates of a teacher training programme from their preservice training to their first year of teaching in a secondary school, Windschitl et al. (2010) found that they all faced three similar challenges with respect to helping their students to intellectually engage in the development of scientific ideas. Their challenges are as follows:

1. Fundamentally, many of the beginners could not identify the substantive relationships between concepts in the form of scientific models that help learners understand, explain, and predict a variety of important phenomena in the natural world.
2. The participants could only initiate a conversation in the classroom but lacked the skill to sustain a science discourse in the classroom.
3. They chose broad themes such as, “student ownership,” “critical thinking,” and “relevance,” for planning their lessons. This made it difficult for conceptualization and, therefore, was not effective. Meanwhile, when they were students, they were trained with the correct way of lesson planning using the investigative paradigm. Most of them had forgotten that. Panteli (2011), in a study to find out the
induction needs of Cyprus’s newly qualified primary school teachers, found that the vast majority of them said that they encountered all the 33 problems specified in the questionnaire. Some of the problems are (a) coping with individual pupils facing learning difficulties, (b) time management, (c) inadequate school equipment, and (d) classroom organization and management.

The literature reviewed so far shows the challenges faced by NQTs vary and most of them are related to teaching and learning. These are the types of challenges we explored in this study.

**Reasons Why NQTs Face Challenges**

Some of the reasons given for why some NQTs face challenges are (a) teacher preparation programmes do not prepare them for the real task they must accomplish, (Korthagen, Loughran, Russell; Teichler, cited by Liston et al., 2006; Tynjälä & Heikkinen, 2011); (b) teacher preparation programmes give too much attention to theory at the expense of practical skills; (c) wrong theories are taught in teacher preparation programmes (Liston et al., 2006); (d) they are often placed in hard-to-staff-schools with insufficient supplies (Achinstein, cited by Rizza, n.d.); (e) they are often given the most challenging assignments and work under conditions that do too little to foster their success; (f) they work in isolation from their colleagues, receive little guidance and mentoring, and virtually no useful feedback about their developing skills and abilities (Bartell, 1995); and (g) unlike many professions where beginners take minor responsibilities, NQTs take full responsibility of their duties as soon as they enter the classroom (Director General of Education & Culture, 2010; Jensen, Sandoval-Hernández, Knoll, & Gonzalez, 2008; Tynjälä & Heikkinen, 2011). Teaching is, therefore, described as an early plateau profession (Tynjälä & Heikkinen, 2011). This situation can also lead to isolation and a praxis shock (Director General of Education & Culture, 2010). Posting policies sometimes aggravate the problems that NQTs encounter. For example, in the United States and in most parts of Europe, new teachers are posted to areas with high needs in rural or urban areas where the students have their own problems such as poverty and the students speak many different languages making the class highly multilingual (Castro, Kelly, & Shih; Achinstein, & Athanases, cited by Rizza, n.d.).

Sometimes NQTs do not outlive their challenges. Aitken and Harford (2011) found in a case study that they conducted with secondary school teachers in the Republic of Ireland that both NQTs and returning teachers had broadly similar challenges in the following areas: handling discipline problems, working with colleagues, negotiating a new school culture, and dealing with management. But in another study, the only challenges that both NQTs and experienced ones shared was classroom management skills. Some of the NQTs in that study had high need for professional development in the following areas: (a) development of skills to create more teaching and learning time in class, (b) addressing effectively student discipline and behavior problems, and (c) classroom management skills (Jensen et al., 2008).

Beginning science teachers encounter more complex challenges in planning and teaching each day compared with teachers of other disciplines (Sanford et al., cited by Watson, 2006). This is because their instructional practices involve decisions about what to teach, how to teach, and improvisation among other things. Besides, some science teachers have to teach across several different fields of science at once. In many cases, there is a mismatch between these disciplines and the teacher’s own content preparation and field experiences (Ingersoll, 2001; Sanford, cited by Watson, 2006). Watson (2006) used a sample of three novice science graduate teachers from the University of East Carolina to

**Survival Strategies of NQTs**

Several studies have shown that beginning teachers rather go through a process of survival instead of learning from experiences (Korthagen, 2010; MacMahon, 2006; Secret Teacher, 2012). This is because they face challenges such as struggling for control, feelings of frustration, anger, and bewilderment (Korthagen, 2010). The reality of the survival is narrated in the following:

It is a year of perpetual newness. Teaching lessons you’ve never taught before, facing hundreds of pupils you’ve never met before, and reacting to many new situations every day. This creates a workload that moves many NQTs’ focus away from teaching and towards survival. Survival for a NQT is passing a series of half-termly observations by a mentor or a member of the senior staff. These observations are ranked on a four point scale: unsatisfactory, satisfactory, good or outstanding. Put simply, if you get satisfactory or better in each observation then you will get through and can become a teacher. From these six, hour long observations your year is mapped; six hours as a judgement on your year of teaching. (Secret Teacher, 2012, p. 1)

MacMahon (2006) also stated that there are stages that some new teachers go through during their first year of teaching. The stages are “anticipation,” “survival,” “disillusionment,” “rejuvenation,” reflection, then back to anticipation. In the anticipation stage, the teachers are happy that they have got a job and are eager and excited about their initial teaching post. But reality hits because they become overwhelmed with some aspects of the job, such as working full-time and others that they did not anticipate. Then, they enter the disillusionment stage, where they wonder whether they are in the right profession. After going through half of the year, they feel refreshed because they would have done some work and they look forward to the end, which is in view. Having gained some coping strategies, they gain some confidence and become more optimistic about their capabilities.
find out the challenges of novice science teachers. The teachers had all completed a bachelor of science degree in science education. They had strong backgrounds in the sciences (60+ hr), and they were all excellent students with high grade point averages (above 3.5). The novice teachers expressed the following concerns: (a) the completion of endless paperwork for which they had not been prepared, (b) the first several weeks of school were fraught with many changes in schedule and placements, and (c) problems in dealing effectively with management and discipline issues, and lack of mentoring from experienced teachers although that was the norm (Watson, 2006).

The literature reviewed so far reveals that the challenges faced by NQTs are varied.

**NQTs Solutions to Classroom Challenges**

In the light of the challenges faced by NQTs, different survival strategies are used: “some thrive, some sink without trace, and most find it difficult but struggle through” (Secret Teacher, 2012). The fact that NQTs tend to struggle on their own is supported by Tynjälä et al. (2011). According to Howe, quoted by Tynjälä and Heikkinen (2011), “instead of supporting new teachers, sometimes the tacit teaching culture advocates a ‘sink or swim’-mentality: beginning teachers sometimes have even excessive burden placed on their first years” (p. 12). He and Cooper (2011), after following some participants through their preservice programme to their first year of teaching, noted that when facing challenges in their teaching, the participants developed various strategies including (a) learning from their students; (b) getting proper knowledge of their students and families by using assignments; (c) sustaining their motivation to teach by focusing on good experiences such as student accomplishments, and commendations from parents; and (d) devising individual methods to manage stress and frustration.

**Equipping NQTs With Survival Skills**

There are some suggestions in literature as to how NQTs can be equipped to cope with their challenges (Darling-Hammond, 2006; Zeichner & Liston, quoted by Darling-Hammond, 2006). Zeichner and Liston, quoted by Darling-Hammond (2006), suggested the continuous learning by NQTs to address their problems and those of their colleagues. To this end, they suggested that programmes must equip teachers with the following relevant skills:

- Teachers must be able continually to learn to address the problems of practice they encounter and to meet the unpredictable learning needs of all of their students—and they must take responsibility for contributing what they learn not only to their own practice but also that of their colleagues. This means that programs must help teachers develop the disposition to continue to seek answers to difficult problems of teaching and learning and the skills to learn from practice (and from their colleagues) as well as to learn for practice. These expectations for teacher knowledge mean that programs need not only to provide teachers access to more knowledge, considered more deeply, but also to help teachers learn how to continually access knowledge and inquire into their work. The skills of classroom inquiry include careful observation and reasoned analysis, as well as dispositions toward an open and searching mind and a sense of responsibility and commitment to children’s learning. (pp. 304-305)

Darling-Hammond (2006) suggested that in the light of the fact that there has been an increase in the range of knowledge required for teaching that cannot be mastered by any one teacher, and the fact that there is diversity in the ways students learn, which demand of teachers to show continual adaptation, it is necessary that in the preparation of teachers, they are equipped with research and also collaboration skills so that they can learn from each other.

There is abundant literature on using induction programmes to equip NQTs to survive their first years of teaching (Bartell, 1995; Council on Alberta Teaching Standards, 2008; Keogh et al., cited by Tynjälä & Heikkinen, 2011; Wang et al., 2008). According to Bartell (1995), teachers can be left to struggle or get by as best they can during their first challenging years of teaching, or they can be guided to be successful. In a study in which He and Cooper (2011) collected data from five participants over a 2-year period of their preservice training and the first year of their teaching, it was revealed that the NQTs had challenges. He and Cooper recommended as a solution to the challenges faced by the NQTs the following:

1. Opportunities should be provided to preservice teachers to interact with the community and with diverse student populations to better understand their responsibilities beyond academic content instruction.
2. The teacher educators should experience the same challenges faced by their teachers.
3. To better equip their teachers for the future, the preservice teachers should be trained in handling specific issues in context instead of just learning about them.

The literature we have reviewed shows that NQTs have varied challenges for which they are not equipped, and some of them learn survival tactics to keep going. Some teacher educators have suggested that the preservice teachers should be equipped to handle some of the challenges in the preservice programme. This article contributes to knowledge on how NQTs solve some of the problems they encounter by using a case study to understand their challenges and how they solved them.
Method

Research Design
This study was designed as a qualitative multiple case study that explored the challenges faced by selected NQTs trained at Foso College of Education in the teaching and learning situation and how they addressed the challenges. Creswell (2003) described a qualitative study as one that takes place in the natural setting and the researcher goes to the site to conduct the research to enable him or her to get detailed information about the problem. We fulfilled that by going to the schools where the participants taught to conduct the research. Next, we introduce the five participants, with pseudonyms for anonymity and then describe the data sources and analysis.

Participants
The five participants were selected based on the fact that (a) they attended X College of Education, which was the only college in the central region of Ghana that was well equipped for the specialist science programme; (b) the fact that they had taught science at the JHS level for more than 1 year; and (c) they willingly volunteered their time for the study. Next, we present information on the characteristics of each of the participants who were all aged between 24 and 28 years.

Asaph's highest academic qualification was Senior Secondary School Certificate and his highest professional qualification was a diploma in basic education. With regard to teaching experience, he had taught 5 years at the Junior High School. He completed his preservice training in 2011. Before embarking on the preservice training, he taught 3 years in a private school. He taught JHS 1 to JHS 3.

Bernard's highest academic qualification was West Africa Senior Secondary Certificate and his highest professional qualification was a diploma in basic education. His total teaching experience was 1 year and 5 months at the JHS level. He had no prior teaching experience, he had taught 5 years at the Junior High School. He completed his preservice training in 2011. He taught JHS 1 to JHS 3.

William's highest academic qualification was Senior Secondary School Certificate and his highest professional qualification was diploma in basic education. He had taught for 2 years at the JHS level. He had no prior teaching experience before his preservice training. He completed his preservice training in 2011. He taught JHS 1 to JHS 3.

Edward’s highest academic qualification was Senior Secondary School Certificate. His highest professional qualification was diploma in basic education. He had taught for 2 years at the JHS level. He had no prior teaching experience before his preservice training. He completed his preservice training in 2011. He taught JHS 1, 2, and 3.

Bernard’s highest academic qualification was West Africa Senior Secondary Certificate and his highest professional qualification was a diploma in basic education. His total teaching experience was 1 year 5 months at the JHS level. He completed his preservice training in 2011. At the time of the research, Bernard taught in two different classrooms, namely JHS 1 and 3.

Asaph’s highest academic qualification was Senior Secondary School Certificate and his highest professional qualification was a diploma in basic education. His teaching experience was 3½ years and that was at the JHS level. His teaching experience before preservice training was 1 year in a public JHS. He completed his preservice training in the year 2010. Asaph taught integrated science in three different classrooms namely JHS 1, 2, and 3.

Samuel’s highest academic qualification was West Africa Senior Secondary Certificate and his highest professional qualification was a diploma in basic education. His total teaching experience was 1 year and 5 months. That comprised 1 year and 2 months teaching after professional training and 3 months teaching before preservice training. He completed his preservice training in 2011. He taught JHS 1 to 3 students.

School Settings
All the teachers taught in public Junior High Schools in the central region of Ghana. All the schools were in different districts except two schools, which were in the same district. The schools were in villages at varying distances from the regional capital, Cape Coast. In Asaph’s and Bernard’s schools, the buildings were uncompleted. All their students were both males and females who sat on dual desks. On both sides of their classrooms were sets of windows and the blackboard was cemented on the wall that faced the class. It was only in Bernard’s case that the blackboard was on an improvised easel.

Data Collection Methods
In this study, we used multiple data collection methods to allow for the triangulation of data. The methods were interview, observation, and content analysis. We developed one semistructured interview guide, which comprised a section on their demography and a section on their constraints in the teaching and learning of science. The interview was for an average duration of 30 min. All the interviews were audio recorded. The lesson observation schedule was semistructured in the sense that it not only contained the teaching and learning methods intended to be observed but also made provision for the collection of other data (field notes) that illuminated the teaching methods/activities predetermined in a far less systematic manner (Patton, 2002). The guidelines for making the NQTs’ observation protocol were based on the goals of the integrated science syllabus for basic schools in Ghana. It consisted of a list of process and experimental skills and activities to engage students, on the extreme left side followed by a column for ticking which of them applied in the lesson, and in the last column was space for comments if any. The purpose of this instrument was to collect data on the pedagogical skills of the NQTs. Each NQT was observed at least five times. Each observation lasted 70 min, which was equivalent to two periods. The lesson plans of the NQTs were also analyzed to find the teaching methods they had been using.

Data Analysis
The NVivo software programme was used to code and analyze the interview transcripts. Classroom observation data were
Results and Discussion

What Challenges Do the NQTs Face in Teaching Science at the JHS Level?

The analysis of data revealed that all the NQTs faced some form of challenge in teaching integrated science at the JHS level. The areas in which the NQTs faced challenges are (a) time management, (b) content knowledge, (c) teaching and learning resources, (d) student understanding, (e) lesson note conflict/writing, (f) student punctuality, (g) class management, (h) student’s interest in science, (i) getting sources of information, (j) workload, and (k) weak background of students.

Lack of teaching and learning resources. One of the challenges that they all faced was nonavailability of teaching and learning resources. They all complained of not getting teaching and learning materials. This was evident when I, the lead author, observed their lessons. In addition to not getting TLMs, Edward’s other challenge was his inability to get resource persons. Edward’s situation is explicit in what he said:

Resource personnel, there are some things you will need some people to explain them better but you don’t have those people around.

He clarified the kind of help he needed in the following comments:

Like the, like metals I mean, when you are teaching metals, you look at the properties of metals like the malleability, the ductility and so on you need, you can at least have the blacksmiths, you go to him or maybe invite him into and you can send the people there and he can demonstrate it, the malleability property of metal to them, to know that truly metals can be either drawn into wires or they can change the sizes can be changed or their form can be changed and so one, but I don’t have those people around so . . .

For Asaph, his problem was about facilities for the teaching and learning of science. This he articulated in the following comment:

In this school apart from the TLMs, ok there are also some, because of I can say that because we don’t have some industries or some companies especially I was teaching electricity and then how electricity is being wasted and the rest, you have to send the people to an industry or company that makes use of a lot of electricity for them to ask questions and observe how the electricity is being used massively, but because this area we don’t have any industry or any company we are not able to go, so in understanding some concepts it becomes very difficult for the kids, and then apart from that, I think that is that . . .

The unavailability of teaching and learning materials was one challenge that they all experienced. Asaph was the one who spoke at length on this challenge. This is how Asaph expressed his frustrations with the teaching and learning materials:

Having access to some of the TLMs teaching learning materials in teaching, such as maybe some of the chemicals that help me to teach them well, especially in teaching acid, base and salt in form 3. It is basically titration, yes the process we use in titration this is the case because of we don’t have any science lab, we lack some of the instruments like the pipette, the burette, the conical flask, the volumetric flask and the rest. We lack some of these materials so teaching that topic in the JHS 3 is very difficult for me. My challenges over here is lack of teaching material, that is affecting me. Aside that I don’t think any other topics that I think I have to go extra mile. Yes I will be eager to go extra but because of limitation in the syllabus sometimes I am not able to give them all the information about a topic so they lack something about their topic, yes.

Samuel said this about the teaching and learning materials:

My greatest challenge has to do with equipments and materials because in certain topics if you got materials around and you read sometimes you see that you have understood the lesson, and sometimes teaching lesson shouldn’t be, in teaching science sometimes the lesson is more easy when taught with some of these equipments and facilities. Sometimes when you are teaching and you even mention, I was teaching a topic in form one, and I mentioned calipers, the pupils were just looking at me, they have not seen some before.

For William, one of his two challenges was the nonavailability of TLMs and how to get them. The situation was the same for all of them, and it really hampered the use of a variety of teaching and learning methods according to the newly qualified science teachers. Content analysis of the NQTs’ lesson plans and the observation of their lessons showed that they used mainly brainstorming, demonstration, and lecture. The demonstrations were generally charts. Because of that the process skills dependent on teaching and learning materials were hardly attained as the interviews revealed.

The experimentation and then also this, I think the experimentation is much difficult because some of the materials that should be available so that you use for the experimentations are not available, or if they are available they are few for the teacher’s
use especially when I was teaching acid, base and salt, I have to
group them so that each will get some acid and some base, or we
have to experiment and add the acid to some base to produce
something but because the materials are not available I have to do
it for them to watch, because of that they wouldn’t get the feeling
of it, and I think because of that it makes the teaching very
difficult for them to understand. (William)

For Asaph, the only TLMs that he showed me they had in
the school are (a) one wash bottle, (b) one leaking separating
funnel, (c) one pipette, (d) six bars of magnet, and (e) some
iron filings. For Bernard, they did not have any except for
some empty canned tomato tins that the students had used to
carry stones from their homes to the school. The lesson
observations revealed that they were used as beakers and
Petri dishes. Edward had only a few cracked cylinders and
test tubes. Sometimes, when they used the cracked tubes,
they worked but according to him, he wanted complete test
tubes and not half tubes. He found the cylinders, test tubes,
and some expired chemicals in an old trunk used for storing
teaching and learning materials. The situation was not differ-
ent for William. In all, the lessons that I, the lead author,
observed mostly improvised materials were used for the
demonstrations.

Their challenges with TLMs corroborate what was found
in studies by He and Cooper (2011), Panteli (2011), and
Veeman, cited by Bozack (2008). The challenges identified
by them are (a) lack of up-to-date resources (He & Cooper,
2011), (b) inadequate teaching materials (Veeman, cited by
Bozack, 2008), and (c) inadequate school equipment (Panteli,
2011). The only difference is that in this study, the TLMs
were just not available and there was no case of obsolete
equipment as was found by He and Cooper (2011).

Challenges with content knowledge
The other challenge that they all reported in the interview
that they faced was the teaching of basic electronics.

I myself I have not seen, only the drawings or the picture, and I
have to explain for them to so I only give them definition and
then those parts. So make teaching of this topic (basic electronics)
very difficult for me. I cannot teach this topic whenever I am
being supervised by an external officer. (Asaph)

Sometimes last time on your second visit I did mention that if
you take most of the topics here you realize that most of these
topics were not taught when we were in the training college so
sometimes it is very difficult to deliver some of these topics so I
sometimes go through hell in teaching most of these topics.
(Samuel)

According to Samuel, he had not taught basic electronics before
but he had problems with it and had, therefore, decided to get
tuition on it. William and Edward reported that they could teach
an aspect of the basic electronics but not everything.
et al., 2008; Watson, 2006). For Bernard, the interview revealed that his students were not interested in science and that was a challenge to him. He needed to motivate them. The challenge of motivating students by NQTs is also confirmed by Veeman, cited by Bozack (2008). It was only Samuel who said he had a challenge with the completion of the syllabus.

That the NQTs faced challenges is in consonance with what is in the literature (French, 2004; He & Cooper, 2011; Liston et al., 2006; MacMahon, 2006; McKenzie, 2005; Özturk, 2008; Senom et al., 2013; Sunde & Ulvik, 2014; Wang et al., 2008; Watson, 2006; Windschitl et al., 2010). Although the literature (Korthagen, 2010; MacMahon, 2006; Secret Teacher, 2012) makes mention of the struggling to survive by NQTs, there were no indications that the NQTs in this study went through such a period. This may probably be because they are used to the classroom teaching situation, having spent a whole academic year of their preservice training in practicum in basic schools under mentors. That length of practicum is characteristic of teacher training programs in many countries. The NQTs were not completely equipped to handle the problems. They, therefore, devised their own individual methods as was found by He and Cooper (2011). That is why one of the reasons given by NQTs in the literature for having challenges is because teacher preparation programmes do not prepare them for the real task they must accomplish (Crebert et al.; Murtonen et al.; Stenström; Korthagen, Loughran, Russell; Teichler, cited by Liston et al., 2006; Tynjälä & Heikkinen, 2011). But, in this study, the NQTs were equipped to some extent for the challenge of nonavailability of teaching and learning materials. They might have solved the other problems from their experiences in their preservice training but that was not found out by this study. Some of the education courses they studied in preservice training such as the “Principle and Practice of Education” deals with some of their challenges such as “discipline.” The fact that NQTs tend to struggle on their own is supported by Tynjälä and Heikkinen (2011).

### How Have the NQTs Solved the Challenges They Encountered in the Classroom?

In almost all the challenges, except for the challenge of getting resource persons faced by Asaph and Edward, lack of industries for field trips (Asaph), student indiscipline (Edward), and students’ lack of interest (Bernard), the NQTs survived by attempting to provide their own solutions to the challenges they faced. For the inadequate TLMs, they had been equipped in their preservice training at Foso College of Education with the skills of improvisation, which enabled them to improvise some of the needed equipment. Edward improvised a cylinder, and for the pipette he used a straw.

With my knowledge in improvisation, an apparatus or instrument like measuring cylinder we were able to use the bottle. Measuring cylinder, funnel, we used the bottle. What do you call it, voltic and those ones, so we make the children cut them into two, we use the top one as funnel, and then the down one, the bottom as the measuring cylinder. (Edward)

But it was not everything they could improvise. For some of them, like Asaph, they bought some of the TLMs.

I bought this. Some of the time you wouldn’t have the filter paper, and we wouldn’t have the litmus. I have to buy it and also we have to organize electrical circuit, I bought my bulb, I bought battery and then those wires used in connecting, I used my money in buying some of those things but we have some books that were bought by the headmistress, that is the Aki Ola, sometimes I refer to it. It was bought by the school. (Asaph)

One of the solutions that they generally used in solving some of their challenges was contacting the people they felt could help them, namely, (a) their head teachers for financial support to purchase the TLMs, (b) experienced teachers who they regarded as mentors, and (c) resource persons. According to Samuel, sometimes even if one had the money, the problem was where to get the TLM to buy. William sometimes depended on the PTA (parent–teacher association) and that did not work properly. For time management, Bernard decided to reduce the number of objectives for his lessons to enable him finish his lessons. To solve the challenge of students’ understanding, Asaph did extended periods of explanation and exercises. Edward mixed vernacular with English to enhance their understanding and proposed that practical work was necessary for enhancing understanding. For Bernard, he assigned them research work to enable them to understand.

For the challenges with the completion of the syllabus, Bernard made his students responsible for part of the learning by giving them reading assignments on portions of the content to be discussed later in class. The fact that the NQTs generally used their own initiative was because they were not equipped to handle the problems. They, therefore, devised their own individual methods as was found by He and Cooper (2011). That is why one of the reasons given by NQTs in the literature for having challenges is because teacher preparation programmes do not prepare them for the real task they must accomplish (Crebert et al.; Murtonen et al.; Stenström; Korthagen, Loughran, Russell; Teichler, cited by Liston et al., 2006; Tynjälä & Heikkinen, 2011). But, in this study, the NQTs were equipped to some extent for the challenge of nonavailability of teaching and learning materials. They might have solved the other problems from their experiences in their preservice training but that was not found out by this study. Some of the education courses they studied in preservice training such as the “Principle and Practice of Education” deals with some of their challenges such as “discipline.” The fact that NQTs tend to struggle on their own is supported by Tynjälä and Heikkinen (2011).

### Conclusion

The NQTs face the following challenges: (a) lack of resources for teaching and learning, (b) time management, (c) deficiency in content knowledge, (d) their students’ inability to understand the lessons taught, (e) student indiscipline, (f) lack of their students’ interest in science, and (g) inability to complete the integrated science syllabus. The challenge of lack of resources and deficiency in content knowledge cut across all the NQTs.

The NQTs are not able to solve all the challenges they face. With some few of them, they struggled in consonance with Tynjälä et al. (2011) but for most of them, they devised survival skills (He & Cooper, 2011; Secret Teacher, 2012). For the teaching and learning resources, they solved only
the TLM aspect to some extent by improvising the ones they could.

**Implications**

Although the study used only five cases and only one college and ideally it should not be generalized to all NQTs of the science colleges of education, nonetheless, the study provides important considerations that may be useful for equipping teacher trainees in all the science colleges of education in Ghana with the possible challenges they may face in teaching science at the JHS level and how to handle them. Besides, the fact that teachers face challenges is a reality (French, 2004; He & Cooper, 2011; Liston et al., 2006; MacMahon, 2006; Mckenzie, 2005; Özturk, 2008; Senom et al., 2013; Sunde & Ulvik, 2014; Wang et al., 2008; Watson, 2006; Windschitl et al., 2010).

For the lack of TLMs that the NQTs encountered, it is a well-known fact that in Ghana, TLMs are not generally available for teaching science at the primary and JHS levels (Adu-Gyamfi, 2014; The Gamelian World, 2014). This is why improvisation of science equipment is factored into their preservice training. Considering the fact that the NQTs’ challenges with TLMs also include things they cannot improvise a situation that may be common at the JHS level in Ghanaian basic schools, there may be the need to investigate resource availability for teaching science at the JHS level, and if found to be inadequate, the ones that cannot be improvised should be supplied. There may also be the need to factor into the preservice training of JHS science teachers the sources (universities, senior secondary schools, and science resource centers) of some of the equipment/materials they need, so that they can avail themselves of them.

Although the NQTs tried to survive in the face of most of their challenges, by devising their own strategies which is good, there may be the need to generally equip JHS preservice science teachers to face the challenges they will meet in the teaching and learning situation. There may not be similar challenges as was found in this study. But the fact remains that they may face challenges. This can be done in the following ways:

1. By giving them experiences in the preservice programme, that will equip them with the skills of seeking answers to difficult problems of teaching and learning. This means that in addition to providing them access to more knowledge, teacher educators should help them to continually access knowledge and to inquire into their work as was suggested by Zeichner and Liston (1996).

2. The preservice teachers can also be equipped with research and also collaboration skills in their training so that they can adapt and also learn from each other as was suggested by Darling-Hammond (2006).

3. The preservice teachers can be trained to handle specific issues in context instead of just learning about them (He & Cooper, 2011) so that they have the real experience of the challenges. That will help them to cope if they happen to meet similar challenges.

4. Induction programmes can also be used to equip NQTs of the science colleges of education with the skills to survive their first years of teaching (Council on Alberta Teaching Standards, 2008; Keogh et al., cited by Tynjälä & Heikkinen, 2011; Wang et al., 2008).

The fact that the NQTs were handicapped with respect to science content knowledge, which may also be true for this category of teachers because they were trained in similar institutions and may have similar backgrounds, it may be proper for them to be given inservice training periodically to fill the gaps in their science content knowledge.

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