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Nigerian Teachers' Perceptions and Experiences of Integrating Literacy Strategies Into Science Instruction

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This is to certify that the doctoral study by

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has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
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2022

Abstract

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by

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MSc, Buffalo State University, 2005

BA, University of Jos, 1995

Project Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

Reading problems among students in Nigeria prompted the implementation of a literacy across the curriculum initiative in a cluster of schools within a district, where all teachers were required to integrate literacy strategies into their lessons. The problem investigated in this study was that the teachers' instruction of science at Beta Schools had not produced the expected results with respect to integrating literacy strategies into the science lessons. The purpose of this basic qualitative study was to understand the teachers experiences and perceptions of literacy integration in science lessons. Grounded in the content area literacy conceptual framework, the research questions examined science teachers' perceptions of the requirement to embed literacy instruction in their pedagogy, the instructional strategies they viewed as adequate, and the ways by which they might improve their implementation of the recommended strategies. A purposeful sample of nine science teachers were interviewed using open-ended questions. Thematic analysis of interview data supported with the use of ATLAS.ti software revealed low levels of pedagogical knowledge, implementation of instructional strategies, and teacher motivation. There were also challenges with communication from administration and inadequate professional development. The study findings were the basis for a position paper that outlined ways that stakeholders could (a) establish support mechanisms for embedding literacy strategies into science lessons and (b) design targeted professional development for their teachers. Implementing these changes may improve teachers' aptitudes and contributions to discourse on literacy integration into science curricula and support systems of professional development. These teachers could help to equip students with the literacy skills they need for creativity and innovation within their communities.

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Dedication

I dedicate this project to all educators in Nigeria who are working hard at improving themselves, against all odds, so they can support their students.

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Section 1: The Problem

Introduction

In this project study, I interviewed Nigerian science teachers about their perceptions and experiences of integrating literacy strategies into instruction. The findings supported the development of a professional development (PD) for teachers and district leaders on ways to embed literacy strategies in science instruction (see Appendix A). Reading difficulties amongst Nigerian students are attributed to varied causes ranging from poor quality instruction, socioeconomic background of parents, and limited exposure to quality texts, and these difficulties often result in poor performance in standardized assessments (Abu-Ubaida et al., 2017; Alade et al., 2017; Mbah & Iduma, 2016; Obiegbu, 2018; Osalusi & Oyewole, 2016). In a state in northern Nigeria, only 40.4% of male and 37.5% of female 12-year-old students were successful in the simple reading proficiency test (Kaduna State Government, Kaduna State Planning and Budget Commission, 2017); most students entered into secondary school at age 12. The test checked students' ability to read a simple sentence in English. The head of the West African Examinations Council (WAEC), which hosts the standardized tests for the end of Grade 12, released a report stating that only 35.1% of students achieved five credits (pass grades) including mathematics and English, in the 2019 examinations ("WAEC Releases Results," 2019). WAEC results summaries for science subjects repeatedly indicate challenges with the application of literacy skills in student papers (WAEC, 2018, 2019; see also Appendix B). PD on how to embed literacy strategies in science instruction may be beneficial to the state educators in their efforts to increase students' literacy skills.

The Local Problem

In response to this challenge, the Beta Schools (pseudonym), a cluster of five schools within a large school district rolled out a literacy across the curriculum initiative to improve literacy levels amongst the students within the district. The initiative requires all teachers to be teachers of English by integrating literacy strategies into their teaching and learning, according to the director of Beta Schools. Similar initiatives have been shown to be effective in increasing reading outcomes for both elementary and high school students (Lai et al, 2014; Romance & Vitale, 2017). A subsequent literacy audit conducted across the Beta Schools showed gaps in practice in the sciences, with regard to embedding literacy at the local level (see Appendix C). The gaps include insufficient use of reading for inference, extension of writing using key vocabulary in older years, effective short writing skills in younger years, and writing conventions for spelling and grammar.

The problem investigated in this study was that the teachers' instruction of science at Beta Schools had not produced the expected results with respect to the integration of literacy strategies into the science curriculum. Although some PD had been provided for the teachers, the science teachers' perceptions about teaching literacy strategies specifically needed to be examined in order to identify possible challenges with the implementation of required literacy strategies within their subject area. Actively addressing the possible challenges could have a positive impact on student attainment in science standardized assessments over time.

Students' WAEC online results summaries presented suggestions for teachers and students to improve students' attainment in sciences, and there was a recurring focus on the need for improved literacy skills (WAEC, 2018, 2019). A more deliberate focus on literacy skills in science lessons becomes a logical consequence of the feedback shared in the online summaries. In the literature, Cannady et al. (2019) recommended that scientific literacy, which includes framing good questions and promoting argumentation about scientific ideas, should be taught in the ideal science lesson. McMillen et al. (2018) posited that educators need to find more successful ways of explicitly integrating science literacy skills in secondary classrooms. Vacca et al. (2017) noted that content area teachers need to show students how to apply literacy strategies and skills in their specific disciplines, as this will enable them to make and communicate meaning from the different digital and print texts they encounter in their lessons. It is possible that the science teachers might not have had the training required to explicitly integrate the suggested literacy strategies into their daily lessons or their understanding of science literacy might not be rich enough for them to implement the recommended strategies effectively (Patterson et al., 2018). They might possibly also undervalue the importance of the LAC initiative to their specific discipline. The specific reasons for the challenges associated with integrating literacy strategies into their teaching were unknown. Gaining insight into these formed the crux of this project study.

Rationale

Local Evidence

The Beta Schools are a cluster in a large school district that fall within the suburban area of the community. Although literacy levels are higher in this suburban community than in the more rural communities, English is an additional language learned in school, as most families have a local language as their first language. Access to a full range of resources for teaching and learning including laboratories, compared to schools in developed nations, remains limited (Opeyemi et al., 2019; Samuel et al., 2019; Yusuf & El-Yakub 2020). The Beta Schools adopted the UK National Curriculum for Key Stages 3 and 4 (for middle school and high school, respectively). The National Curriculum details expectations for all subject areas and provides international standard benchmarks to guide schools' provision of instruction (U.K. Department of Education, 2015). The expectations for science include the need for students to communicate their understanding using reasoned explanations and science-specific vocabulary, and to evaluate their claims through critical analysis of the methodology, evidence, and conclusions, both quantitatively and qualitatively (U.K. Department of Education, 2015). Across the school district and Nigeria at large, students are required to take WAEC examinations. The 2018 and 2019 WAEC reviews of students' attainment in biology, physics, and chemistry assessments outlined some areas for improvement among candidates, including poor spellings of key vocabulary, poor expression in questions requiring explanations and application of knowledge, and grammatical errors, among others (WAEC, 2018, 2019).

The LAC initiative rolled out in the Beta Schools by the director was meant to improve the students' ability to achieve the curriculum expectations and also improve their attainment in the local standardized assessments administered by WAEC. The literacy audit conducted in 2019, as part of the initiative, revealed the need for improvement in reading for inference, the consistent use of subject-specific key vocabulary (orally and in writing), the need to improve extended writing in the sciences, and the need to improve marking and feedback, among others (see the literacy audit in Appendix C). The findings from the audit in the Beta Schools were similar to those published as areas for development by WAEC (WAEC, 2018, 2019), and that raises questions about the effectiveness of the initiative in addressing concerns about teacher implementation and student attainment.

Evidence From Literature

As secondary school (middle and high school) students prepare for universities and the world of work, they need to develop the ability to read and understand texts of varying levels of complexity, to acquire discipline-specific vocabulary, and to communicate their understanding in meaningful, effective ways (Gelfuso, 2018; Green & Lambert, 2018; McMillen et al., 2018; Vacca et al. 2017). Using appropriate writing strategies should improve the quality of written responses in science standardized assessments, for example, and improve attainment levels in university (Miller et al., 2018). Students learning English in a foreign language or other language contexts, such as some students in the Beta Schools, often face challenges with trying to master academic literacy and content knowledge (Cammarata & Haley, 2018; Lo & Jeong, 2018;

Obiegbu, 2018). Students need to understand why key vocabulary are important in different contexts, to deduce the nuances that words have within different disciplines, and to correctly apply their knowledge in real life scenarios as well (Gunawardena et al., 2017; Gelfuso, 2018; Vacca et al. 2017; Vaughan et al., 2016).

The research literature shows that, similarly to those in the Beta Schools, teachers often struggle to implement meaningful literacy instruction into science lessons which can lead to negative outcomes for students (Cannady et. al., 2019; Sumirattana et al., 2017). Recommendations for teaching scientific practices in reformed science classrooms support the development of scientific literacy such as framing good questions and promoting argumentation about scientific ideas, yet often these practices are not implemented (Cannady et al., 2019). The competencies directly related to literacy skills include framing good questions and promoting argumentation about science ideas aimed at developing scientific thinking; without these, science classrooms will not be reformed, and higher learning gains will not be achieved (Cannady et al., 2019). Vacca et al. (2017) also suggested the use of literacy strategies such as visual and graphic organizers in deducing meaning from digital and print texts. Teachers, therefore, need to take responsibility for teaching students how to effectively use these tools as they encounter the content in various disciplines (Vacca et al., 2017).

Some research shows that limited and traditional methods of instruction (such as memorization) within content area subjects often result in low levels of content area literacy among the students, especially in underresourced settings (Lysenko et al., 2019; Sumirattana et al., 2017). Teachers may benefit from adopting a more social approach to

teaching reading, where students are encouraged to engage in multiple levels of conversations with their peers and adults to develop stronger literacy skills, as opposed to rote memorization of discipline specific words (Kepe & Linake, 2019). Wen et al. (2020) offered that using both the traditional textbook-based instruction and the more modern guided inquiry with simulation approach can improve students' scientific literacy on the short term; however, their research data show that the guided inquiry with simulation approach is more effective for students to develop more permanent scientific literacy. Teachers in underresourced communities, such as the Beta Schools community, may therefore find themselves in a disadvantaged position when it comes to using more modern approaches to embed literacy instruction into content-area lessons (Lysenko et al., 2019).

The literature presents different approaches to embedding literacy into science curricula. However, the purpose of this basic qualitative study was to understand the teachers experiences and perceptions of literacy integration in science lessons, within this context. I sought to also understand their perceptions about the role of literacy as a skill in science in general.

Definition of Terms

Literacy: The ability to use printed and written materials to create, comprehend, decode, communicate, and to compute (Montoya, 2018).

Professional development (*PD*)*:* All formal teacher training opportunities engaged by teachers.

UK National Curriculum: National standards from the United Kingdom that outline the knowledge and skills that students within specified stages should know and be able to apply (U.K. Department of Education, 2015). In this study, I focused on two stages: Key Stage 3 (ages 11-14) and Key Stage 4 (ages 14-16).

West African Examinations Council (*WAEC*): An entity that is responsible for conducting standardized assessments in all subject areas for secondary school students across West Africa (WAEC, n.d.).

Significance of the Study

Although the LAC initiative was in its fourth academic year of implementation, and there had been some PD sessions held to reiterate the expectations, the science teachers were unable to meet the expectations with regard to integrating literacy strategies in their subject. In order to understand why this gap in practice remains, I sought to gain an understanding of their perceptions and experiences with obstacles to doing so. This knowledge could facilitate interventions aimed at improving their competencies with regard to literacy instruction. This basic qualitative study could potentially provide important data to bridge this gap in practice.

As Patterson et al. (2018) suggested, educators should be guided to the most effective theories and best practices which impact on student learning in the sciences. The Beta Schools rolled out the LAC initiative in order to implement recommended practices that had been shown to be effective in a variety of schools and school systems (Gelfuso, 2018; Gunawardena et al., 2017; Vacca et al. 2017; Vaughan et al., 2016). In this educational setting, teachers' improved competency in implementing literacy instruction

is likely to improve students' academic learning. At a district level, the potential findings could be integrated into targeted, district-wide PD within effective professional learning communities (PLCs). Within these communities, disciplinary teachers could collaborate and identify strategies to successfully implement supportive literacy skills to include within science curricula. More students would thereby be empowered to be more successful in real life and the world of work.

Research Questions

I sought to answer three research questions (RQs):

RQ1. What are the science teachers' perceptions of the requirement to embed literacy instruction in their pedagogy?

RQ2. What instructional strategies do the science teachers currently use for teaching literacy within their subject?

RQ3. What is the science teachers' perception of ways by which they could improve their adoption and implementation of recommended literacy strategies in their lessons?

Review of the Literature

In the first part of the literature review, I discuss Vacca et al.'s (2017) theory of content area reading. This theory served as the conceptual framework for the study. Next, I explore the broader problem in the literature on integrating literacy into content area lessons, the input of teachers, and their PD needs.

Conceptual Framework

I based the conceptual framework for this study on Vacca et al.'s (2017) work on content area reading, also referred to as content literacy. Content area reading, or literacy, encapsulated Beta Schools' requirements for science teachers to embed literacy strategies into their lessons. Content area reading refers to students' ability to use reading, writing, listening, and viewing processes to understand material across the curriculum (Vacca et al., 2017). Vacca (2002) noted the need to incorporate content standards into literacy-based instruction and to adopt strategies for deeper levels of text comprehension in content areas.

As teachers are central to students' growing dexterity with understanding and responding to texts, they need to employ careful and detailed planning to engender high levels of student collaboration and engagement in lessons (Flores, 2016; Vacca et al., 2017). They need to deploy appropriate, differentiated instructional strategies and practices to guide students through multiple opportunities to develop vocabulary knowledge and to understand how words are conceptually linked within content areas (Vacca et al., 2017). This can result in deeper levels of understanding. For instance, science and math teachers who adopt the use of graphic organizers in their lessons facilitate students' conceptual understanding, even when the students have no prior knowledge to reference (Armstrong et al., 2018; Roman et al., 2016).

Teachers should adapt their instructional strategies and practices to students' unique experiences, their linguistic and cultural differences, and the challenges they encounter as they engage content area reading material (Gunawardena et al., 2017;

Leonard, 2018). Activating prior knowledge and interest using key vocabulary to help students make vital connections with the texts they read, as recommended by Vacca et al. (2017), would enable them to achieve deeper levels of understanding. In RQs 1 and 2, I sought an understanding of the different strategies and practices that Beta Schools' science teachers had been using as compared with the strategies recommended in the research. Vacca et al. (2017) presented challenges that are encountered when students struggle with texts including low achievement and low levels of engagement. An array of texts in multimedia formats address different learning styles of students, exposing them to essential 21st-century literacy skills that they need for life as adults (Vacca et al., 2017). An exploration of the recommended strategies and those the science teachers perceive as being ways by which they could improve their students' literacy skills was the focus of RQ3.

For the data analysis, I drew from Vacca et al.'s (2017) recommendations. The interview questions remained open-ended to elicit rich data from the participants (Merriam & Tisdell, 2016). I looked out for themes such as the use of graphic organizers, the use of digital text, and the emphasis of key vocabulary—all recommended strategies for embedding literacy in content area subjects (Vacca et al., 2017)—and used them to code the interview data.

Review of the Broader Problem

In completing this literature review of the broader problem, I used key words and phrases that were connected to the topic and the problem. The key words and phrases included *content area literacy*, *disciplinary literacy*, *challenges with teaching English as*

a Second Language, *Science teachers' perspectives on content area literacy*, *secondary teachers' perspectives to teaching literacy*, *professional development for science teachers in Nigeria*, *integrating literacy skills into science lessons*, and *literacy initiatives in secondary schools*. I used Google Scholar, and Walden University Library resources including Education Source, ERIC, SAGE Journals, ProQuest (Wiley online library, Springer, Taylor & Francis online), and ScienceDirect databases to locate articles.

Literacy in Content Area Lessons

Secondary school (middle and high school) students need to develop the ability to read and understand a variety of texts, in different content areas, and to communicate their understanding meaningfully (Gelfuso, 2018; Green & Lambert, 2018; McMillen et al., 2018). Some researchers have recommended that teachers should develop well-planned cross-curricular lessons based on texts that students are interested in reading, such that reading and writing skills are more easily integrated into content area lessons (Gelfuso, 2018; Greenleaf et al., 2018; McMillen et al., 2018). Providing advanced literacy instruction in content areas (discipline literacy) improves students' abilities to critically analyze texts read within their content areas, to weigh options as citizens and to perform daily tasks (Green & Lambert, 2018; McMillen et al., 2018). Kirsten (2019) suggested that content area teachers should focus more specifically on teaching the literacy required within their disciplines. They will need to develop their aptitude to effectively teach literacy, so the teaching of literacy is not relegated to elementary school teachers and their students can learn and deploy literacy skills appropriately within their subject discipline (Armstrong et al., 2018; Kirsten, 2019).

The International Literacy Association (2017) advocated that students use discipline-specific frameworks to learn common literacy strategies, therefore, content area reading should be integrated with discipline literacy. Savitz et al. (2019) noted that up to 75% of content area subject teachers lack the professional knowledge required to teach these common literacy strategies their middle and high school students. Counihan et al. (2022) reiterated that this gap stemmed from inadequate preparation during initial teacher training, indicating that more program developers and school leaders would need to address this gap. Savitz et al. (2019) found that, upon completion of specific training in content area literacy, the teachers involved in the study experienced a shift in perspectives regarding integrating literacy into their lessons.

Development of Students' Literacy Using Online Sources

Standard 8 of the Next Generation Science Standards (NGSS) articulates the need for all education in science to empower students to be able to read scientific and technological reports in press and online (NGSS, 2013), as such, science lessons are partly language lessons where reading and writing skills are taught. All teachers are encouraged to take responsibility for teaching reading in Nigerian secondary schools (Abu-Ubaida et al., 2017; Onwunali et al., 2022). Reading materials that are focused on the students' interests will facilitate their ability to engage with the content, to understand key vocabulary and deduce the nuances that apply within discipline specific contexts so that their understanding can then be applied to real life situations (Gunawardena et al., 2017; Lupo et al., 2019). Reading an extensive range of texts will support deeper levels

of understanding as students gain exposure to the data of the targeted language, in this case, English (Obiegbu, 2018).

The global move towards the incorporation of technology into everyday life has prompted advocacy for its increased use within educational settings in Nigeria (Opeyemi et al., 2019; Samuel et al., 2019; Yusuf & El-Yakub, 2020). Sourcing for online resources as reading material in schools will facilitate the student's application of their learning in real life contexts. The use of online texts in science lessons, incorporating digital technologies into the lessons, is highly recommended (NGSS, 2013) and has been shown to drive deeper levels of understanding and inquiry amongst older students as they are keen to include technology into their daily practices (Sullivan & Puntambekar, 2018; Samuel et al., 2019; Vacca et al., 2017). As part of this study, I explored Beta Schools science teachers' use of available online reading texts in their lessons.

The Impact of Teachers on Student Learning

Some research suggested that teachers' ability to plan effective lessons, thereby engaging in quality instruction, has the greatest impact on student learning, so their levels of effectiveness can be measured by their students' performance in standardized assessments (Alade et al., 2017; Flores, 2016). Other researchers have posited that measuring teachers' effectiveness using student attainment data, or any other singular instrument including teachers' personalities, can present inaccurate findings as direct links have not been identified over time (Kim et al., 2018; Van Der Schaaf et al., 2019; Wayman et al., 2017). Podolsky et al. (2019) suggested in their critical review of the literature, that more experienced teachers tend to help their students achieve better scores

even in nonacademic measures of success. Although incorporating different systems of data-informed decision making in schools for measuring student success could show improved student achievement, teachers' skills could have more of an impact than the technology itself as people are the actual change agents (Adeniran et al., 2020; Vacca et al., 2017; Vanlommel et al., 2018; Wayman et al., 2017).

Planning effective, impactful lessons would require deep levels of knowledge, with regard to pedagogical practices for teaching and assessing literacy (Swanson et al., 2017; Schulman, 1987). These pedagogical practices are required to provide literacy instruction within their content areas and should be focused on in preservice teacher preparation (Scott, 2018). When teachers lack these practices, students who struggle with reading may have challenges with accessing the learning as these teachers might not be equipped to provide the reading strategies to facilitate their learning (Swanson et al., 2017).

Professional Development for Science Teachers

The responsibility of teaching literacy is to be shared with the disciplinary teacher (But, 2020; Di Domenico et al., 2018); therefore, they should receive inquiry-based PD to improve their capabilities with literacy instruction within their disciplines (Greenleaf et al., 2018; Harper et al., 2018; Kennedy et al., 2017). This could help to address the gap in the use of scientific or science-specific language in lessons. This is because the teachers may lack science-specific literacies themselves and therefore have challenges with teaching them to students, inadvertently limiting the students' ability to apply their learning in real life situations (Fees & Quinn, 2017).

In reviewing the literature, Smiley et al. (2020) found that in high-resourced international contexts, PD often includes specific literacy coaching facilitated by master instructors. They posited that this form of support needs to be scaled in low-income countries in order for the content of the PD to be accessible to teachers. More frequently than not, this is not the case, and the teachers remain limited in their ability to deliver quality literacy instruction (Counihan et al., 2022; Scott, 2018; Smiley et al, 2020). Where available, PD is often not inquiry based or reflective, both of which provide teachers with opportunities to integrate reform strategies into their classroom practice (Greenleaf et al., 2018). In content areas subjects, the lack of focused PD often results in poor professional knowledge (Todorova, 2017; Meschede et al., 2017), which impacts teaching quality and student learning. Students' ability to develop literacy proficiencies and to correctly transfer them across different disciplines, including real life situations, is often facilitated by teachers (Gelfuso, 2018; Green & Lambert, 2018; McMillen et al., 2018); when these teachers are unable to facilitate this process, gaps in learning emerge (Evans & Mendez Acosta, 2021).

Research also suggests that teachers need to be reflective practitioners who continuously review their content knowledge, pedagogical knowledge, and technical knowledge, and strive to adopt the most current strategies to improve students' levels of reading and writing in content areas (Eaton et al., 2018; Greenleaf et al., 2018; Spires et al., 2018). Paying attention to their personal use of communication skills, in both written and spoken language, will have an impact on students' development (Barnes et al., 2019; Usman, 2017). Teachers also need to review their instructional strategies to include

digital technologies into the students' social learning constructs due to the global surge in the use of technology (Samuel et al., 2019; Vacca et al., 2017). Other researchers have posited that teachers' preparedness to teach English to multicultural and linguistically diverse learners (such as the learners in the Beta Schools) should be monitored continuously in order to safeguard the quality of the instruction over time (Gunawardena et al., 2017; Leonard, 2018).

Implications

Students typically depend on their teachers to impart the literacy proficiencies they would require for universities and the world of work (McMillen et al., 2018). These literacy proficiencies are transferred across various disciplines, and educators teach students the skills they need to understand how texts function in cross-curricular contexts. The LAC initiative implemented by the Beta Schools presented opportunities for literacy skills to be transferred across disciplines, the schools' director noted; however, the gap identified in the sciences demonstrated challenges in this regard.

The gaps could have been as a result of teachers' poor background knowledge of pedagogical skills required to teach literacy in their discipline (Patterson et al., 2018; Swanson et al., 2017), inadequate PD (Abu-Ubaida et al., 2017), and/or insufficient resources for promoting reading in their subject area (Lupo et al., 2019; Obiegbu, 2018), among others. Exploring the perceptions and experiences of the science teachers was essential for stakeholders to gain an understanding of the existing challenges that contributed to the identified gaps in practice. In this qualitative study, I assessed how Beta Schools' science teachers currently embedded literacy strategies into their teaching

as they endeavored to implement the LAC initiative. I identified obstacles to this implementation and suggestions, from the teachers' perspectives, regarding what resources would help them to overcome identified obstacles. I synthesized the findings, made recommendations based on them, and reviewed the literature to ensure the recommendations aligned with current industry practices.

I presented a summary of the key findings and the recommendations in a position paper that stakeholders might use to guide their decisions as they incorporate more targeted PD programs for science teachers in their schools. The position paper also includes a brief literature review of recommended practices and theories for professional development and shows how the research findings align with them. The recommended interventions in the position paper are targeted and the data will help the stakeholders avoid arbitrary programs and establish better support mechanisms for the science teachers (see Patterson et al., 2018; Wayman et al., 2017; Wright et al., 2016).

The recommendations from this research could improve the teachers' integration of literacy strategies into their science lessons and could also improve students' attainment in science assessments. The students would then be empowered with the 21st-century skills literacy skills they need for creativity and innovation as adults within their communities and beyond. The recommendations could be extended to influence the content of district-wide PD within the state.

Summary

In this basic qualitative study, I explored science teachers' perceptions and experiences of integrating literacy strategies into their science instruction at Beta Schools.

Although the literature provides varied plausible reasons for the gaps in practice (Abu-Ubaida et al., 2017; Lupo et al., 2019; Obiegbu, 2018; Swanson et al., 2017), the peculiar perceptions and experiences of the science teachers with regard to implementing the LAC initiative in the Beta Schools had not been addressed and were unknown. I reviewed the science teachers' experiences with planning effective lessons, which included integrating literacy strategies into their science instruction, to offer insight for improving the quality of provision within the Beta Schools. Understanding their use of literacy strategies as recommended by Vacca et al. (2017), or lack thereof, would be instructive in suggesting recommendations for interventions and for targeted PD. The recommendation to include digital texts in lessons and trade books in content area lessons (Vacca et al., 2017) could be implemented in well-resourced school districts, however the extent to which they were available and had been adopted by the teachers in the Beta Schools was unknown.

Focused PD can support content area teachers' ability to effectively integrate literacy strategies into their lessons (Meschede et al., 2017; Todorova, 2017). Gaining an understanding of the Beta Schools science teachers' approaches to literacy instruction based on the PD they had received, and their current experiences with integrating literacy into their lessons, could guide the development of targeted PD for them. This research provides the school leadership with insight into possible areas for development with regard to the integration of expectations for LAC. In Section 2, I discuss the methodology that I used to conduct the research project. The section includes the rationale for the choice of research design and details on the participants in the study. Data collection procedures, data analysis, and the findings are presented.

Section 2: The Methodology

Introduction

In this study, I examined science teachers' perceptions of and experiences with integrating literacy strategies into their teaching. To do so, I used a basic qualitative research approach (see Cohen et al., 2018; Merriam & Tisdell, 2016). Research suggests that content area teachers should develop their capacities to teach discipline-specific literacy (Kirsten, 2019; Vaughan et al. 2016). The LAC initiative rolled out by the Beta Schools required content area teachers to embed literacy strategies into their lessons, according to the schools' director. A school audit showed that the teachers' instruction of science had not yielded the expected results with regard to literacy strategies in the science lessons (see the literacy audit in Appendix C). In this study I sought to gain insight into the science teachers' perceptions of the requirement to embed literacy into their lessons (RQ1), to understand the current instructional strategies that the teachers viewed as adequate to meet this requirement (RQ2), and to understand their perceptions of ways by which they could better embed recommended literacy strategies into their lessons (RQ3).

Qualitative Research Design and Approach

I conducted a basic qualitative research study because it allowed me to understand "how people make sense of their lives and their experiences" (Merriam & Tisdell, 2016, p. 24). The basic qualitative research design was broadly based on a social constructivism perspective. As such, the research problems become the RQs to be studied, providing insight into the experiences of a group of people (see Creswell, 2018). The insight gained

into the teachers' perceptions and experiences may inform more targeted interventions for improving literacy in science subjects and could be extended to other content area subjects across the Beta Schools.

I selected a qualitative research approach, not a quantitative one, because I would not be conducting an experiment with treatment conditions assigned to randomly selected subjects (Creswell, 2018). The participants' perceptions were the focus of the research, and these could not be freely explored within a quantitative design, meaning that the RQs would not be addressed. The RQs suggest an exploration of the science teachers' perceptions using open-ended interview questions, where rich data would be gathered and analyzed. Other data collation options considered were lesson observations and documentation review, the use of which would have supported data triangulation (see Merriam & Tisdell, 2016). Only one data source is required for a basic qualitative research design, however, so I opted for interviews as they allow researchers to gain insight into the participants' perspectives and learn about things that cannot be directly observed (Merriam & Tisdell, 2016). An alternative research design that was considered was the mixed-methods approach, which includes both qualitative and quantitative data (Creswell, 2018); however, this was discounted as only one data source would be required in this study. I asked participants to answer open-ended interview questions to freely share their perceptions of their experiences (see Cohen et al., 2018).

I considered other qualitative research design options, specifically the phenomenological and case study approaches. The phenomenological approach assumes that there are essences to shared experiences, which are the core meanings understood

through commonly experienced phenomena (Merriam & Tisdell, 2016). Studying these essences leads researchers to a composite description that represents the structure of the experiences (Creswell, 2018). The RQs in the study were developed to provide insight into the varied experiences of the participants, based on different events they would have experienced and not necessarily insight into the structure of those experiences. As such the phenomenological approach would not be best suited for this study.

The case study approach initially seemed well suited to this study, as the focus was on the science teachers' perspectives in a specific school district. Upon further research, however, I gained a deeper understanding of the case study research design as being limited to a bounded system, with a clear limit to the number of participants or a finite time for observations (Merriam & Tisdell, 2016). The unit of analysis is very specific in the case study approach, and in this study, the exploration is not of a specific experience but of varied undefined experiences and the meanings that the participants attribute to them. This lends itself more to a basic qualitative approach where researchers explore how people construct their worlds, and how they interpret and attribute meaning to their experiences. I developed the RQs to explore the participating science teachers' experiences and their perceptions of their teaching based on prior and current experiences.

Participants

Participants in the study included a purposeful sampling of nine science teachers from across the Beta Schools within one school district; the participants selected from those secondary science teachers who agreed to participate in the study. Purposeful

sampling allows the researcher to “discover, understand, and gain insight” into a group of individuals from whom “the most can be learned’ (Merriam & Tisdell, 2016, p. 96). Sim et al. (2018) reviewed research on approaches to sample sizes in qualitative research as including rules of thumb, conceptual models, numerical guidelines, and statistical formulae. In this study, I have opted for the rules of thumb approach which includes a sliding scale of at least three participants (Sim et al., 2018).

At the time of the study, there were 22 science teachers in the Beta Schools; and the teachers were varied and were a mix of older, younger, more experienced, newer male and female teachers. I purposefully selected nine participants from the 17 volunteers, to achieve variation in the sample in terms of age, years of experience in education, and gender. Table 1 includes the demographics of the participants.

Table 1

Demographics of Participants

Participant	Years of experience teaching science	Years of experience at current school	Age range	Gender
Teacher 1	10+	10+	36-40	Female
Teacher 2	10+	7-9	41+	Male
Teacher 3	10+	7-9	41+	Male
Teacher 4	10+	4-6	41+	Male
Teacher 5	10+	1-3	41+	Female
Teacher 6	10+	1-3	36-40	Male
Teacher 7	7-9	4-6	36-40	Female
Teacher 8	4-6	1-3	26-30	Male
Teacher 9	4-6	Less than a year	26-30	Male

Upon approval from Walden University's Institutional Review Board (approval no. 08-10-21-0584843), I sent an application to the Beta Schools administration, to conduct the research study. The application to the administration included a link to a video recording of my research pitch and a link to the consent form for onward transmission to all high school science teachers. I opted for a video recording in place of a face-to-face meeting, due to COVID social distancing restrictions on the number of persons who can gather in a meeting room. I shared the informed consent form with them as all participants were required to sign it before joining the research process. The form specified that participation was voluntary, and no form of remuneration, honorarium, or gifts would be offered. The form was restricted such that others were not able to access the data on them.

I examined the demographic data of the volunteers and selected a purposeful sample of nine science teachers, using the selection criteria outlined above, thereby ensuring that the specific context of the study was well represented in the RQs to be examined (Merriam & Tisdell, 2016). The final list of participants selected was not shared with the administration as participants' identities must be protected (Merriam & Tisdell, 2016). I then reached out to the volunteers in an email, introducing myself again and thanking them for volunteering. My original intent to reach out to them directly on the phone to agree on the interview dates and time, to afford me the opportunity to establish a working relationship before the actual interview; however, as I was resident outside of the country at that time, phone calls were expensive, so I resorted to email exchanges instead.

Using Zoom, as previously agreed, I conducted interviews with the purposeful sample of science teachers. All interviews were recorded so that any researcher bias was eliminated during transcription (Creswell, 2018). All of the interview data from the participants were recorded and stored in password-protected files in line with IRB requirements. All data remained confidential, and participants were assigned pseudonyms as the data were analyzed.

Data Collection

I developed an interview protocol for open-ended interviews (see Cohen et al., 2018) to question the participants about their perceptions of and experiences with integrating literacy into their teaching (see Appendix D). Open-ended questions are considered unstructured and allow for researcher flexibility and in-depth exploration of the phenomenon (Merriam & Tisdell, 2016). The RQs, the conceptual framework, and the themes from the literature review guided the phrasing of the interview questions. I emailed the participants the questions beforehand, so they would be more comfortable during the interview; they appreciated receiving the interview questions beforehand as this helped them reflect on their practices. While all participants were asked the same questions, some questions were paraphrased based on the participants' responses and requests for clarification. The order of the questions was flexible to allow for authentic exploratory flow and researcher response to the participants' feedback.

I initially planned for the participants to have the option of face-to-face interviews or video interviews; however, only online interviews were possible because of the COVID 19 pandemic. For the recordings, I used Zoom based on the participants'

preferences and ensured that meeting invites had passwords sent separately, to address the possibility of the "confidentiality being compromised" over the internet (Merriam & Tisdell, 2016, p. 117). I also took notes during the interviews such that I was able to record observations of non-verbal communication from the participants as well as my "reactions to something the informant says" or "to pace the interview" (Merriam & Tisdell, 2016, p. 131).

Participants who were unwilling to have their interviews videotaped were permitted to turn off their video cameras during the Zoom calls. The interviews lasted between 25 and 45 minutes. The interview recordings were transcribed verbatim as this provided rich data for analysis. Identified codes were recorded and reviewed as the data analysis progressed; they were grouped into categories and finally themes were identified; sample interview transcript with codes included in Appendix E. The recordings were stored in password-protected files on my personal computer and will be deleted upon completion of the research study as recommended.

The Role of the Researcher

I was previously employed in the target school district, and I worked as head of Elementary in one of the Beta Schools, although my employment ended in July 2021. I have not worked directly with any of the participants in this study, as they work in middle and high schools. I assumed that some teachers could feel uncomfortable answering questions about their instructional practices, as I could still be considered a colleague. Therefore, I emailed the interview questions beforehand and assured them that the data would be confidential and used solely for research purposes.

To help reduce bias and objectively conduct the study, I followed all recommended protocols for interviews including recordings and note taking (Cohen et al., 2018; Creswell, 2018). Recording my thoughts during the process enabled me to reflect on subjectivity as I reviewed the data collected from the interviews. Sample researcher notes for one participant's interview are included in Appendix F.

Data Analysis

Data in qualitative research studies are often extensive and need to be carefully analyzed (Cohen et al., 2018). Data analysis started upon completion of the first four interviews and continued as other participants were interviewed. This allowed for simultaneous data collection and analysis as recommended by Merriam and Tisdell (2016). The data were coded with themes that were distinctly relevant to the study. Codes included words and phrases that facilitated easy retrieval during data analysis (Merriam & Tisdell, 2016).

I initially adopted a deductive approach to coding, drawing a few codes, such as the use of graphic organizers, the use of digital text, and the emphasis of key vocabulary, from the conceptual framework for content area literacy (Vacca et al., 2017). These were drawn ahead of the interviews, to guide the data analysis. I also used some in vivo codes (Creswell, 2018) such as guided reading, teachers' background, flipped learning, use of summaries, big questions, and differentiation. As coding in qualitative research is also "an inductive process of data analysis that involves examining many small pieces of information and abstracting a connection between them" (Lodico et al., 2010, p. 183), it was important for me to revisit the transcripts I had completed after each new set of codes

emerged. After the first four interview transcript reviews, I had populated a list of 52 codes and began to see emerging themes such as clusters of instructional strategies, including multiple strategies for teaching reading and writing. These themes tied in with the themes identified in the review of the broader problem in the literature review which was divided into four broad areas: literacy in content area lessons, developing students' literacy using online sources, the impact of teachers on student learning, and PD for science teachers. I continued the process of coding and recoding over a four-month period and ended up with 77 codes in all. These were initially grouped into nine categories: instructional strategies, reading strategies, writing strategies, district and admin expectations, teacher motivation, PD, challenges, the classroom environment, and recommendations for improvement. These categories provided a good organizational framework for the data as I continued to reflect on the RQs and how the data provided answers to those questions.

Upon further analysis and reflection, I merged similar categories into a major theme. Instructional strategies, reading strategies, writing strategies, and learning resources became categories under the theme of teaching and learning strategies, as they all fell within recommended strategies for teaching and learning within content area lessons (Vacca et al., 2017). I removed the category district and admin expectations. I did so because the references were better captured as challenges faced by the teachers and these captured the teachers' perceptions and not those of the district and admin leaders. I rephrased "teacher motivation" as "teacher motivation to meet requirements." I did so because the research focused on the teachers' perceptions about the expectations to

integrate literacy into their lessons (RQ1), not a broad exploration of teacher motivation as a whole.

I then ended up with six themes in the final analysis: teaching and learning strategies, PD, teacher motivation to meet requirements, the classroom environment, challenges, and recommendations for improvement. The full code trees are in Appendices G and H. Table 2 provides a sample code tree for teaching and learning strategies, with the four subthemes included.

Table 2

Sample Code Tree for Theme 1: Teaching and Learning Strategies

Theme 1: Teaching and Learning Strategies				
Participant	Instructional strategy	Reading strategy	Writing strategy	Learning strategy and resource
Teacher 1	Big questions Connect to students' prior knowledge Practical/Kinesthetic activities Student peer assessment Student peer coaching	Key vocabulary Check for understanding Flipped learning Inference and decoding Reflective practice – student self-assessment Spelling focus – linked to key vocabulary	Focus on exam questions Marking for spelling and grammar Outlines and drafts	Collaborative learning Differentiation Digital texts Meaningful feedback Use of rubrics and mark schemes Use of technology in lessons
Teacher 2	Big questions Students independent research	Key vocabulary Check for understanding Guided reading (aloud) Flipped learning Read questions multiple times Silent guided reading Syllabification/etymology Reflective practice – student self-assessment	Focus on exam questions Marking for spelling and grammar Outlines and drafts Use of summaries	Differentiation Digital device Glossary/dictionary/ encyclopedia/thesaurus Meaningful feedback Use of technology in lessons
Teacher 3	Flexible grouping Practical/Kinesthetic activities Student peer coaching	Context clues Key vocabulary Check for understanding Guided reading (aloud) Inference and decoding	Focus on exam questions Outlines and drafts Use writing samples as models	Collaborative learning Differentiation Digital texts Glossary/dictionary/ encyclopedia/thesaurus Meaningful feedback Use of rubrics and mark schemes Use of technology in lessons
Teacher 4	Big questions Practical/Kinesthetic activities	Context clues Key vocabulary Check for understanding Flipped learning Images to facilitate understanding Read questions multiple times Syllabification/etymology	Focus on exam questions Outlines and drafts Use of summaries	Differentiation Use of technology in lessons

All emergent codes were tried out with all participants as the interviews progressed and additional data were collected to help focus the research findings (Merriam & Tisdell, 2016). The interviews focused extensively on the teaching strategies that the teachers used so I could gain an understanding of the reality of their experiences. There were some outlier codes identified such as the use of mnemonics by Teacher 7- "Start Reading Chemistry Every Rainy Day" is the mnemonic she uses to help her students remember the "processes for neuron, a nervous impulse to be passed from the stimulus and for the body to respond to it." Other outlier codes include direct literacy training (personal PD), and the use of flexible grouping for improved student engagement. Teacher 3 and Teacher 8 (both male teachers) described the energy that flexible grouping injected into their lessons as students explored the meanings of key vocabulary and applied their speaking and listening skills. These codes were grouped within identified themes and are included in the appendices.

During data analysis, I did not notice overtly discrepant or deviant cases which could have provided alternative explanations for emerging themes between male and female teachers. Both groups of newer and older teachers adopted a range of teaching strategies for literacy instruction within their lessons. There was insufficient evidence of more or fewer strategies used based on years of experience teaching science.

Strategies to Ensure Trustworthiness

Trustworthiness strategies ensure the credibility and dependability of the research at the doctoral-level of qualitative research. Researchers need to discuss how the data were compared through triangulation, member checks, and peer review, and the amount

of time spent in deep reflections and analysis of the meanings of the participants' experiences, thus ensuring that the readers understand the reality of the persons studied (Cohen et al., 2018; Lodico et al., 2010; Nowell et al., 2017).

After completing the interviews, I corroborated evidence of codes from different groups of participants (older and younger teachers, male and female teachers), to compare the perspectives of the different participants and support with data triangulation (see Creswell, 2018; Lodico et al., 2010). I also reviewed my personal notes and reflections while I interviewed the participants. I went over the transcripts and my notes multiple times over a four-month period, re-coding previous transcripts as new codes emerged during the data analysis process.

I shared the initial verbatim transcripts as well as the data summaries with the participants for internal data validation via member-checks (see Merriam & Tisdell, 2016). This was to enable me to confirm that the transcripts were correct and to uncover any assumptions or misconceptions and possible biases I might have taken for granted as I summarized my findings. I asked the participants for feedback as soon as possible and they all responded promptly and positively. This helped me ensure that my possible biases (as a female researcher) did not have an impact on my interpretation of the data; a sample participant response is included as Appendix I.

To ensure that the methods of data collection were consistent, I used Zoom for all the interviews. This made it possible for me to listen to the recordings repeatedly and continue the process of coding, re-coding, and retrieving themes until I reach data saturation (see Merriam & Tisdell, 2016; Nowell et al., 2017); it took four months to

complete the process. I initially used YouTube transcripts, for some transcriptions, with my setting on private so they could not be accessed by any other persons. While this seemed initially convenient, it took hours to group the conversation by speakers, and some of the words were incorrectly transcribed. In the case of Teacher 2, for example, his transcript was labeled as Dutch, due to his heavy accent. I had to subscribe to a paid online program – otter.ai – which expedited the process and published the transcripts with different speakers clearly identified. I listened to the audio recordings again to correct a few errors in the sentences that were from the teachers' unique accents and grammatical errors. I used an online computer software program, ATLAS.ti, to facilitate the data analysis process. Of the options considered (ATLAS.ti., NVivi, and Quirkos), I selected ATLAS.ti. as it had more favorable online reviews and was more affordable for student researchers. The software enabled me to track codes across documents, review reports of the number of codes in each document and the corresponding quotes, compare similarities, and frequency of occurrence of codes across the documents.

Data Analysis Results

The purpose of this basic qualitative study was to understand the teachers experiences and perceptions of literacy integration in science lessons, within this context. I interviewed nine science teachers from the Beta Schools to explore their perceptions of and experiences with integrating literacy strategies into their lessons. I collected data to gain some insight into their unique experiences and perceptions and conducted a thematic analysis.

Theme 1: Instructional Strategies for Literacy in Science Lessons

Key Vocabulary

Vacca et al., (2017) advocated the need to develop students' vocabulary knowledge in content area lessons as that would help to develop their understanding of how words are conceptually linked and to activate prior knowledge and interest. It was interesting to see that all the participants had a major focus on key vocabulary, emphasizing the spellings and meanings within lessons. Seven out of the nine participants extended the focus to using context clues within reading texts to decode meanings. Teacher 1 and Teacher 5 (both female teachers) highlighted the need to activate prior knowledge about words. Teacher 5 stressed the importance of this with students who have English as an additional language; stating "… I see how I can use examples from their own part of the world in my class; that way the child sees something familiar". Three participants shared the need to breakdown words using syllabification and reference to the etymology of the words to deepen the students' understanding and help them to remember the spellings of the keywords linked to specific topics. Vacca et al. (2017) recommend the use of dictionaries as a strategic resource to "give struggling readers insight into the meanings of unknown words" (p. 237) and five participants highlighted this practice in their lessons. Five out of the nine participants flipped the learning by including digital texts as reading material for homework; this was to again support vocabulary development before discussions in class. Teacher 4, specifically, shared the importance of building deeper levels of understanding and "time management in lessons" so that the students would be able to contribute to discussions in class.

Reading Strategies

Some research studies highlight the need for students to read and understand a variety of texts in content areas and to communicate their understanding meaningfully (Gelfuso, 2018; Green & Lambert, 2018; McMillen et al., 2018; Wexler et al., 2018). Six of the nine participants shared their use of guided reading as an important strategy to develop good speaking and listening skills in their lessons. Students were required to take turns reading aloud and then responding to discussion questions or making individual notes summarizing what they had understood from the reading session. Teacher 5 stressed the importance of including reading tasks in her lessons stating the need "to create room, no matter – five, ten minutes, so that children can read out a portion…" and talk about their understanding; this aligns in part with the think-aloud strategies recommended by Vacca et al. (2017). Eight out of nine participants used comprehension-style questions to check for understanding, with five of them phrasing questions to promote inference and decoding as opposed to simple literal retrieval. Teacher 4 (male) and Teacher 5 (female) both differentiated the texts by including images to facilitate students' understanding – especially students who had English as an additional language and required differentiated support. Three participants promoted the need for students to read questions and accompanying narratives multiple times, in order to gain deeper levels of understanding.

Writing Strategies

Vacca et al. (2017) suggest the use of short and informal writing tasks to promote writing to learn. Eight out of nine participants shared their use of different questions, that

would elicit narratives, such as short paragraphs and essays, as responses. Teacher 7 used big questions to check for understanding during her lessons. As she stated, she wanted "… to know when I've taught, maybe I've explained a concept, I ask – can you in your own words explain how the body is able to excrete urine? Can you in your own words explain how the heart works?" This seemed more prevalent in biology lessons as the subject includes extensive reading and writing. These provided opportunities for students to summarize their learning and the teachers marked these summaries, providing feedback to the students. Seven participants provided clear writing samples for their students and required students to draft and revise their writing, based on meaningful feedback from the teacher and their peers. They promoted oral presentations in class to review written work. Four participants highlighted the need to include key vocabulary in all written responses, including essays, in order for students to earn full marks in internal and external examinations.

Meaningful Feedback

Six out of the nine participants marked the students' writing for SPAG (Spellings and Grammar). In line with the recommendation by Vacca et al. (2017) for meaningful feedback to include opportunities for peer review of writing drafts, five of those participants also provided opportunities for students to work in collaborative groups and to share feedback using rubrics and mark schemes. All three female teachers shared their experiences giving meaningful feedback based on rubrics and success criteria they had identified. Three male teachers focused on the mark schemes published by the examination board as opposed to developing unique rubrics. Providing feedback to

individual students and to small groups of students, based on their unique experiences, linguistic and cultural differences, and the challenges they encounter is recommended in the research (Gunawardena et al., 2017; Hadjioannou et al., 2016; Leonard 2018). Teacher 6 (male) and Teacher 7 (female) both encouraged their students to also give them feedback; Teacher 7 referenced the need to confirm whether "they were able to actually comprehend, or have I been talking to myself?"

Additional Strategies

Teacher 7 (female) used mnemonics to help her students remember the spellings of key vocabulary, breaking polysyllabic words into familiar tunes and rhymes for the students "to learn some parts of a structure…urine contains urea, salts, and water… so U.S.W, like U.S.A helps them remember the composition of urine". Teacher 3 (male) and Teacher 8 (male) both used flexible groupings to increase levels of student engagement during guided reading and discussion sessions. Teacher 8 specifically highlighted this as promoting "collaborative learning…someone will write, there will be a presentation and they all have to contribute to the discussion".

Theme 2: Professional Development

District-Level and School-Level Professional Development

Some research suggest that content area teachers should receive inquiry-based PD to improve their capabilities with literacy instruction within their disciplines (Greenleaf et al., 2018; Harper et al., 2018; Kennedy et al., 2017). All participants said within their schools, they had not received specific training for science teachers to integrate or embed literacy into their lessons, even though they were expected to be able to do that. Only

three of the nine participants had received some form of literacy training in staff meetings and inset sessions – training for improved diction, report writing, guided reading; none of the sessions were for science teachers specifically, they were generic to all staff. These participants had worked within the same Beta Schools for more than six years. Teacher 6 was the only participant who gave a direct reference to the LAC initiative by name.

Considering the promotion of the LAC initiative in the 2018/2019 academic session, it would be useful to further explore the reason for this feedback on literacy training within the schools. Teacher 5 said the communication from the admin was "unclear and inconsistent"; on the one hand, the expectations were clearly stated in the WAEC and IGCSE examiners' reports, but the school administration had only briefly mentioned it in a staff meeting. She embedded literacy out of her personal background knowledge of English and based on feedback in the mark schemes for the external assessments. It is important to note, however, that one of the aims of the initiative which was to improve the use of scientific vocabulary seems to have been achieved as all the participants reinforced a focus on key vocabulary in their lessons. That said, Teacher 1 mentioned that in her context, the focus had faded away and was not being required or monitored by the new administration.

Teachers' Personal Professional Development

Six of the participants had directly invested in personal PD to improve their personal use of English, including diction, reading, essay marking (examiner's course) and they cite this as a recommendation for improvement for all science teachers. Five of these participants attributed their solid foundation in the use of English to their prior

learning from secondary school and from the universities. Teacher 2 cited poor background as one of the factors negatively impacting science teachers' ability to meet the examiners' requirements; he did mention that this was observed when he worked in a rural district out of state.

Theme 3: Teacher Motivation to Meet the Requirements

Swanson et al., (2017) posited that when teachers lack the pedagogical practices required to provide literacy instruction within their content areas, students who struggle with reading may have challenges with accessing the learning as these teachers might not be equipped to provide the reading strategies to facilitate their learning. Eight of the participants attributed their knowledge to their learning experiences from secondary school (high school) and university as they had not received any training in this regard. Teacher 9 was the only participant who had received specific PD in teaching English as part of the Cambridge International Certificate in teaching and learning; this was his personal PD.

Savitz et al. (2019) posited that up to 75% of content area subject teachers lack the professional knowledge necessary to teach literacy strategies in High school. While all participants initially agreed with the expectation that all teachers were expected to be teachers of English, their understanding of the practical application of this expectation and their ability to meet this expectation varied. Six participants stated that while they could teach in the English language and review basic expectations for reading and writing, they were not English language teachers, and it was the responsibility of the English language teachers to teach the literacy skills that the students would then transfer

to their science lessons. Teacher 2 was the only participant who mentioned the use of collaborative planning opportunities so that veteran teachers supported the newer teachers by including specific learning activities linked to literacy. This, he claims, supports standardization across the different campuses "because we don't want any student to be disadvantaged because he's not with a teacher." Four participants recommended extending collaborative planning and PD sessions to include members of the English department for support so that they would be empowered to meet the expectations.

Some research suggests that teachers need to be reflective practitioners who continuously review their content knowledge, pedagogical knowledge, and technical knowledge, and strive to adopt the most current strategies to improve students' levels of reading and writing in content areas (Eaton et al., 2018; Greenleaf et al., 2018; Spires et al., 2018). Seven out of the nine participants mentioned the importance of these reflective practices where teachers evaluate their lessons and their students' performances; this would afford them the opportunity to review their practices and identify areas of improvement with regard to the inclusion of literacy skills that can support their students. That said, there was no evidence that they consistently engaged in these reflective practices or that they reflected in PLCs.

Barnes et al. (2019) posited that teacher effectiveness depends a great deal on professional learning experiences that help them build competencies in their attitudes to students and the learning process. Five participants who had been teaching for over 10 years reiterated a strong focus on the requirements for exam questions. Their experiences helped them identify the key skills that their students needed and that was what they

focused on, skills such as using key vocabulary, reading writing prompts in exam questions multiple times, paying attention to the spellings of the keywords, and the organization of essays. These strategies enabled their students to attain higher scores.

Three of the participants mentioned the need for teachers to motivate their students to learn and not simply to teach them. They claimed that teachers need aware of their students' moods and to vary their lessons to improve levels of engagement in all lessons. Paying attention to the learning environment and to classroom management were also mentioned as factors that improved students' ability to learn. Five of the participants highlighted the use of resources such as dictionaries, glossaries, thesauruses, and encyclopedias (physical and digital) to support student learning as they help students to learn independently.

Three of the participants used peer observations to review and improve their practices. The observations were required within their specific Beta Schools; however, these participants specifically improved their learning activities and approaches based on what they had observed from their peers. Teacher 8 (who has only taught science for four years) observed how an older science teacher encouraged the use of a digital device (a translator) for an Asian student who had very little English. He observed how that teacher differentiated the learning by breaking down complex, polysyllabic words into accessible words linked to the student's prior learning. This, he claims, has prepared him to support EAL students in the future.

Although all the participants claimed to have a strong command of English, with only Teacher 2 stating he was functioning 'at 60%', the process of transcription revealed

concerns about the teachers' use of English. Teacher 2's audio recording was transcribed as Dutch and not English, using YouTube auto-transcribe. I then purchased software (Otter.ai) to transcribe it and had to spend about two hours replaying and editing the document because of his diction and poor sentence construction. I used the software for the rest of the transcriptions and had difficulty with two other participant recordings with similar challenges. Requiring these teachers to provide literacy instruction to students within their content area would be a challenge.

Theme 4: The Classroom Environment

Development of Students' Literacy Using Online Resources

There is strong advocacy for incorporating technology into educational settings in Nigeria (Opeyemi et al., 2019; Samuel et al., 2019; Yusuf & El-Yakub 2020), in order to align with global standards. Standard 8 of the NGSS states that all education in science should empower students to read scientific and technological reports in print and online (NGSS, 2013). All nine participants included technology in their lessons for presentations, experiments, and research. They all encouraged their students to use online dictionaries and online databases during lessons and for homework to help them explore the meanings of the key terminology in their lessons and to help them conduct personal research. Four participants included digital texts for reading material during guided reading sessions; however, only Teacher 3 used a specific online source (KOGNITY) dedicated to improving his students' literacy skills using science topics – he assigned and monitored their reading using this source. While all the participants promoted the use of technology and referenced the use of computers by both teachers and students, Teacher 2

and Teacher 8 were the only ones who had specific digital devices (translators) that the students used. The devices were owned by the families and not the schools.

Classroom Management

Four participants established routines to manage student engagement such that discussions would be robust and not rowdy, differentiation could happen during lessons, and they could have time for one-on-one interventions with groups of students. Teacher 2 highlighted the importance of this as a teacher whose English accent is sometimes distracting for the students. Teacher 3 and Teacher 8 both used flexible groupings to improve team dynamics and ensure that more able students supported less able students during discussions and projects. Teacher 8 assigned different roles for research projects, highlighting the need to "share the tasks among the children so everyone will be involved…that is how we go about collaborative learning".

Differentiation

Seven participants highlighted the need for differentiated tasks or learning activities, especially when there were students with additional learning needs in the classroom. They referenced different learning support systems including peer coaching, specialist teacher involvement in the lessons, and more effective communication skills, including using a digital translator in one instance. Teacher 5 mentioned the need to "pay attention to the lighting in the room and the temperature as well" so that students would be comfortable and able to learn. In reference to a student in his class who had very little English, Teacher 6 mentioned his need to "take a little time to listen to what he has to say then provide explanations when necessary," to promote a more inclusive classroom. A

number of teachers cited the time required to differentiate the learning as a challenge, even though they acknowledged its usefulness for students.

Theme 5: Current Challenges Faced by Teachers

Planning of Learning Activities

Some research studies recommend that content area teachers should develop well-planned cross-curricular lessons such that reading and writing skills are integrated into their lessons (Cunningham & Allington, 2016; Gelfuso, 2018; Greenleaf et al., 2018; McMillen et al., 2018; Wexler et al., 2018). Some other research suggests that teachers' ability to plan effective lessons, thereby engaging in quality instruction, has the greatest impact on student learning (Alade et al., 2017; Flores, 2016). Only four of the participants specifically planned practical, kinaesthetic activities to stimulate students' interest in reading texts. Several participants cited planning time as a challenge they faced when it came to including opportunities for literacy instruction into their lessons. Teacher 6 mentioned the enormous amount of "time to get everybody in class included in the activities, so things like making posters, they have a role to play. So those that are a kinesthetic learner, they have molding clay to work with…". Teacher 9 mentioned that "as a teacher, you don't have all the time to do all this" in reference to barriers to planning literacy activities in lessons. It is interesting to note that all three female participants in the study planned for differentiated learning activities.

Time Management

All the participants referred to some challenges with managing time. Three participants stressed the desire to reinforce literacy skills such as reading (inference) and

meaningful feedback (comments-based marking) but they lacked the time during lessons. They were side-tracked from the science content by the need to do so much literacy instruction and it took too much time for the students to learn literacy skills. Teacher 1 and Teacher 5 (both female teachers) wondered why it was such a challenge for the students to transfer the skills they applied readily in English lessons. That would be an interesting topic for further research. Teacher 6 and Teacher 9 specifically stated that the amount of time required to plan the lessons where literacy skills were embedded was "too much." They were spending so much time trying to include them and so they were no longer as invested in planning those differentiated lessons.

Direct Teacher Input

Teacher 5 identified a challenge with teacher talk time, stating that she often spent so much time explaining the key terminology and key concepts that there was not enough time for the students to apply their literacy skills in the lessons. Teacher 1 and Teacher 7 also referenced the need to allow more time for student discussions because they often spent a lot of time explaining the concepts over and over. They both did say that based on the interview questions, they reflected on the need for more literacy within their lessons and they would try to manage their time better.

Identification of Students' Abilities and Prior Learning

Teacher 3 mentioned challenges with identifying the varied abilities of the students in his classes and that affected his ability to plan different learning activities for them. He had students transfer into their classes from different schools and had a challenge with helping them catch up with the others within their classes. Teacher 2

mentioned challenges with determining their ability levels, again because of the transient nature of the students within the school and so students joined the classes at different points throughout the school year. I observed missed opportunities for differentiation, especially with regard to literacy instruction in these teachers' interviews. The need for improved teacher competencies in this regard was also evident and could be the topic of further research.

Focus on Exam Questions

Eight out of the nine participants indicated a strong focus on their students' ability to answer exam questions, resulting in limited time to address any gaps in their literacy skills. As the curricula for the sciences were vast, there was pressure to cover the syllabi on time and allow some time for students to practice exam questions repeatedly since that was the bottom line for parents and administration. Taking out time to teach literacy skills was therefore not on the front burner.

Theme 6: Teachers' Recommendations for Improvement

Continuous Professional Development

In reviewing the literature, Smiley et al. (2020) found that in highly resourced international contexts, PD often includes specific literacy coaching facilitated by master instructors and this support needs to be scaled though, in low-income countries, in order for the content of the PD to be accessible to the teachers. All the participants reiterated the need for more targeted, continuous PD to enable them, as science teachers, to improve their pedagogical knowledge of teaching English. Some of the suggested training topics include marking for literacy, teaching inference and decoding skills, and

how to support EAL students in science lessons. Teacher 4 referenced the need for "special literacy training…in the context of science itself…". They recommended the inclusion of collaborative learning opportunities within the schools, such that they could always refer the peers in the English department especially when they had challenges.

Job-alike sessions where more experienced science teachers could share their expertise, especially in the area of time management for planning these differentiated lessons, were also recommended. Greenleaf et al. (2018) posited that including inquiry-based or reflective PD provides teachers with opportunities to integrate reform strategies into their lessons. Teacher 2 reiterated the need for collaborative planning where one teacher could plan the weekly focused lesson, and then the teaching team would discuss the lesson plan, which could ensure that the expectations to include literacy strategies would be met and best practices would be used across the schools.

Clear Admin Expectations

All the participants noted the inconsistency in communication from the administration about the expectation to embed literacy skills into science lessons. In one instance, Teacher 7 noted that changes in school leadership seemed to have eroded the drive to promote LAC. A joint focus on the reports for the examination boards would also support consistency of practice across the schools.

Some research highlights the need for regular monitoring of teachers who have multicultural and linguistically diverse learners, such that the quality of instruction is consistent over time (Gunawardena et al., 2017; Hadjioannou et al., 2016; Leonard, 2018). Teacher 5 highlighted the need for school leaders to have "checklists for them to

monitor how people are doing it in class and not just necessarily to say – oh, you're not doing it well…"

Key Findings

This basic qualitative study focused on gaining insight into the teachers' perceptions of and experiences with integrating literacy strategies into their science lessons. Three RQs framed the inquiry into the problem. RQ1 explored the science teachers' perceptions of the requirement to embed literacy instruction in their pedagogy. From the findings, this expectation was not clearly and consistently communicated across the schools, as such the teachers were not consistently motivated to meet it (Theme 3: Teacher Motivation). Very little PD with regard to literacy instruction was provided, and where it was available, it was not specific to science teachers (Theme 2: Professional Development). Although the participants agreed with the importance of meeting the expectations and some of them specifically referred to the reports from exam boards that articulated gaps in this area, there was no evidence of measures for monitoring the implementation across the schools.

The International Literacy Association (2017) posited that students should use discipline-specific frameworks to learn common literacy strategies, therefore, content area reading should be integrated with discipline literacy. From the data collated in this study, the teachers had challenges meeting this expectation for reasons ranging from poor background knowledge of and use of English, teachers' poor pedagogical content knowledge, unclear expectations from the school administration, and inadequate PD (Theme 5: Challenges).

RQ2 explored the instructional strategies that the science teachers were currently using to teach literacy within their lessons. A range of strategies for teaching reading and writing was shared by most of the participants including, focusing on key vocabulary, using context clues, guided reading and discussion sessions that promote inference and decoding, big questions requiring narratives as responses, writing summaries, and flipped learning where students could continue their independent research at home (Theme 1: Teaching and Learning Strategies and Theme 4: The Classroom Environment). Although they used these strategies, some of them were not aware that they were using literacy strategies. Teacher 4 (male) and Teacher 7 (female) mentioned that this study highlighted this gap in their practices. The teachers used meaningful feedback, including teacher-to-student feedback and peer-to-peer feedback, to help their students gain deeper levels of understanding of texts read in class. They included technology in their lessons, using online sources for digital texts, with one participant (Teacher 3) using specific online resources to improve students' reading using science texts. Some teachers paid attention to the learning environment, ensuring that the classroom was well managed, a variety of multimedia texts were available and that students had opportunities to engage with others in small groups and to receive support from their peers as well as their teachers. A number of the participants highlighted the use of resources such as dictionaries, glossaries, thesauruses, and encyclopedias (physical and digital) to support student learning.

RQ3 explored the science teachers' perceptions of ways by which they could improve their adoption and implementation of recommended literacy strategies in their

lessons. The teachers shared strategies from their different experiences and from the recommendations from exam board reports (Theme 1: Teaching and Learning Strategies). They listed several challenges limiting their ability to consistently integrate the few strategies they knew into their lessons; challenges such as time for planning the lessons, their limited pedagogical knowledge of teaching literacy, and the focus on exams (Theme 5: Challenges). They highlighted the need for clearer communication from the admin with regard to the expectations and all requested for PD in the area of literacy instruction to enable them to learn about appropriate strategies they could use to embed literacy skills into their lessons (Theme 6: Recommendations for Improvement). This aligns with the conceptual framework that suggests the development of programs and strategies that will promote ongoing PD for content area teachers (Vacca et al., 2017). Some suggested programs and strategies include PD schools, establishing PLCs, having state agency and professional association partnerships, and having literacy coaches; all of which will promote professional inquiry and growth among the teachers (Vacca et al., 2017). They also suggested collaborative learning opportunities where they could plan lessons collaboratively and improve their time management whilst learning from their peers.

During the interviews, I noted that there were several missed opportunities to overtly reinforce or teach literacy skills. Those participants who had a stronger background in the use of English paid attention to their students' use of written and verbal English (Theme 3: Teacher Motivation). They were perceived as being overly particular by their students and, in the case of Teacher 7, her peers also considered her overly attentive to English skills in her planning and lesson delivery.

Teachers' dispositions towards literacy instruction would need to change for them to make a marked impact as suggested by Savitz et al. (2019), who found that, upon completion of specific training in content area literacy, the teachers experienced a shift in perspectives regarding integrating literacy into their lessons. The data analysis in this study showed that the teachers who did not have as strong a background were unaware of the literacy skills that could be taught in the lessons. Teacher 7 mentioned that, although she had taught science for six years, doing this interview made her know that she was teaching some literacy skills in her lessons; before now, she believe that she was simply helping her students to write good responses to exams questions. There were no distinctly identifiable differences between the perceptions and experiences of the three female and the six male teachers interviewed. Teacher 9 was the only participant who had spent less than three months within his current school and had taught for about four years.

The findings from this study highlighted varied challenges and multiple recommendations for development that needed to be carefully considered by the leaders across the Beta Schools and across the district. This would help them design targeted interventions that could result in more positive adoption of the requirement to embed literacy instruction into science lessons. As I no longer worked within the district, I opted to present the research findings in a position paper that included details of the participating teachers' perceptions and experiences and all the recommendations. This would provide the school leaders with some flexibility as they considered possible action points and implementation strategies within their unique contexts.

Section 3: The Project

Introduction

The project that emerged from this qualitative study is a position paper. The position paper includes the background of the problem, a brief review of evidence from the literature, a summary of the findings from the study, and recommendations. The findings from Section 2 are clustered into six themes: (a) instructional strategies for literacy in science lessons, (b) PD, (c) teacher motivation to meet the requirements, (d) the classroom environment, (e) current challenges faced by teachers, and (f) teachers' recommendations for improvement. The data analysis highlighted the teachers' need for support to enable them to meet the expectation to integrate literacy into their lessons more consistently. The recommendations from the findings include training aimed at improving teachers' pedagogical content knowledge, training for heads of science departments, coordinators and science coaches, the establishment of PLCs, partnerships with external organizations, and scheduled peer observations. These were in line with recommendations from the literature for supporting science teachers (Greenleaf et al., 2018; Savitz et al., 2019; Smiley et al., 2020; Vacca et al., 2017).

With the approval of my committee, I opted to complete a position paper for my project. The goal of a position paper is to present and explain a gap in practice, gather evidence on options, review them, and present a position to stakeholders (Bala et al., 2018). The primary goal of this position paper is to present the findings on teachers' perceptions and experiences with integrating literacy into their science lessons to school leaders and district administrators. The secondary goal is to provide recommendations

from the study and from the literature that can be adopted by policy makers and other stakeholders at the local school and district levels, as well as the state and national levels. Empowering science teachers to more consistently integrate literacy strategies into their lessons would support the drive for improved attainment in science subjects across The WAEC examinations and could result in improved literacy levels of students nationwide. In this section, I present the rationale, a brief literature review, the project description, the project evaluation plan, and the project implications.

Rationale

I developed the position paper presented in this capstone by integrating emergent themes from the data analysis and recommendations from the literature. The literature review revealed concerns about the limited access science teachers have to learn how to teach literacy skills in their lessons. All the participants in the study shared similar concerns in their different contexts. I initially considered designing a PD program for this study and opted for a position paper instead, as it would provide school leaders and administrators with more flexible action points to consider and implement within their varied contexts.

The need for flexibility and contextualization in the development of PD programs came through based on participants' responses to the RQs. In response to RQ1, the data showed inconsistent levels of communication from different school leaders about the expectation that literacy should be embedded in science lessons. Very little training was provided in the area of literacy skills, and where available, it was not articulated to science teachers. The data from RQ2 showed that although a range of literacy strategies

was being used sporadically by different teachers, some were unaware of the pedagogy behind them and therefore did not use them. The teachers' perceptions of ways forward were explored in RQ3, and the need for improved time management, targeted training, and clear communication from the administration were presented.

The position paper includes details of the participating teachers' perceptions and experiences and all the recommendations. This could enable school leaders and administrators to make more informed decisions as they review their provision for PD within their local contexts. Targeting the PD offerings to the teachers within their unique contexts could upskill them more quickly and ultimately support their students with developing the literacy skills they need for the world of work.

Review of the Literature

This literature review is an examination of scholarly articles and academic publications related to my position paper and the recommendations from the research findings. The findings highlighted the need for PD to support science teachers as they strive to integrate literacy strategies into their lessons. Vacca et al.'s (2017) conceptual framework on content area reading affirms this need for focused PD such that content area teachers can build a repertoire of skills and strategies required for integrating literacy into their lessons.

I searched for peer-reviewed scholarly articles and academic publications via Google Scholar and Walden University Library databases. I accessed ERIC, Sage Journals, Education Source, Taylor and Francis, Springer, Emerald Insight, Science Direct, and Wiley Online Library resources. The keywords and phrases I used included

position paper, *white paper*, *K-12 science education, professional learning communities*, *professional development for science teachers*, *pre-service science teachers training*, *literacy training for science teachers*, and *integrating writing into science lessons*.

Position Paper

A position paper is "a detailed report that recommends a course of action on a particular issue" (Merriam-Webster, n.d.). Position papers are also referred to as opinion papers or white papers that are used in various disciplines to present a position on a well-reasoned topic or argument (McGregor, 2018). Position papers can take different formats, but they generally include an introduction to the topic, evidence gathered and evaluated to provide a clearly established position based on the evidence, and a conclusion (Bala et al., 2018; McGregor, 2018). Presenting the position in a succinct manner that can engage stakeholders and policy makers may facilitate the possible adoption of and implementation of any recommendations (Brown, 2017; Dagenais & Ridde, 2018).

Relevance of Position Papers

Researchers sometimes use position papers to communicate their findings to a non-academic audience (Brown, 2017). Purzer and Quintana-Cifuentes (2019) presented a paper on the need to consider STEM integration into school science from epistemological, pedagogical, and methodological perspectives. They argued the importance of collaboration among science and engineering educators to develop shared terminology, whilst still focusing on the NGSS and allowing for diversity in instructional models. Presenting their detailed research in a succinct manner makes it more accessible to non-academic stakeholders who can influence changes in teachers' classroom

practices. Egbert and Shahrokni (2019) advocated a position that PD providers and teacher educators should not only focus on the inclusion of computer-assisted language learning in classrooms but base their PD on competency-based learning outcomes. In this way, English Language Learners can attain mastery of language, content, and technology, they concluded. The steps they share can be easily implemented by PD providers in different contexts, supporting English Language Learners as they acquire the vocabulary they need for improved academic attainment.

Leaders and administrators often make informed decisions guided by research and they benefit from concise information in position papers (Bala et al., 2018; Brown, 2017; Dagenais & Ridde, 2018; McGregor, 2018). The school leaders, district administrators, and policy makers who oversee the locale where this study was conducted will have access to the data, evidence, and recommendations in a succinct format. This should enable them to make informed decisions about designing targeted PD for science teachers.

Professional Development for Teachers

A major challenge that emerged from the findings was inadequate PD for the science teachers in the area of literacy skills. There is very limited training in the area of early grade reading skills, available for Nigerian teachers, and less so for science teachers seeking to enhance their literacy skills (Barnes et al., 2019). Promoting LAC enables students to begin to write and speak like scientists, literary critics and historians, and teachers should be prepared to facilitate this process before they come into the classrooms (Mendoza, 2018). Unfortunately, the reverse is the case and some of the

negative dispositions that science students have towards writing have been attributed to their teachers' similarly negative dispositions (Emerson, 2019; Thibaut et al., 2018). This is more so for students with extensive support needs who require help to develop effective reading and writing skills (Walker et al., 2022). Their teachers, therefore, need to be trained to better support them within inclusive classrooms.

Pre-Service Teacher Training

Science teachers often have limited opportunities to acquire science content knowledge in their pre-service training (Bancroft, 2020). Academic coursework in higher education programs should include specific content knowledge, including the literacy skills required to apply the content knowledge, to improve the teachers' sense of self-efficacy in their subject specialisms (Sithole, 2017). High school teachers, in particular, need inquiry-based experiences that equip them with strategies they need, including literacy strategies, to address the students in their unique contexts (Sithole, 2017).

In one particular study, Hayes et al. (2021) showed that collaboration between science coaches (subject specialists) and faculty in designing K-12 teachers' learning activities helped create a balance between the need for teachers to gain deep content knowledge and to design engaging lessons for their students. Literacy skills are required to design these engaging lessons and where the teachers themselves have English as an Additional Language, it becomes essential to teach them the literacy skills they will require in their classrooms as part of their pre-service coursework. It will be useful for higher education science faculty to review their instructional practices and possibly

include more active learning pedagogies and the literacy strategies required to apply them (Hayes et al., 2021).

Targeted PD for Science Teachers

Teachers' classroom practices are still considered a high predictor of student learning and PD interventions can improve them by increasing the teachers' pedagogical content knowledge and enabling them to implement reforms in science education (Yang & Gardella, 2020). One of such reforms is the need to address linguistic differences and dialects within culturally responsive classrooms (Vacca et al., 2017). Content area teachers need to be trained to build classroom environments that include opportunities for building literacy skills, including building discipline-specific vocabulary or academic language (Kalinowski et al., 2019; Lachance et al., 2019; Vacca et al., 2017).

Dubinsky et al. (2019) shared their study on targeted PD in neuroscience that helped science and nonscience teachers learn new pedagogies that helped them improve their lesson plans, learning activities, and student cognitive engagement. Although their study proved effective in improving science teachers' aptitudes, there is still a concerning lack of high-quality science PD that is adaptable across various contexts so preparing teachers to implement recommended reforms and new pedagogies in science education has been challenging (Pringle et al, 2020). Integrating such new pedagogies into teachers' classroom practices, for example, takes time and ongoing PD so stakeholders such as school administrators, literacy coaches, science coordinators and science coaches need to create opportunities for teachers to reflect on their practices as they learn the new curriculum or new approaches to instruction, and share those practices with others in

meaningful conversations (Dolfing et al., 2021; Piliouras et al., 2018; Ufnar & Shepherd, 2019). This will enhance teacher learning and development, making it easier for them to support their students as they learn new skills, including literacy skills, collaboratively (Dolfing et al., 2021). Science coaches, who work with the science teachers more frequently, would also benefit from targeted PD so they can improve their modelling of expectations as they work reflectively and collaboratively with their teachers (Whitworth et al., 2018). Part of this targeted PD would include literacy strategies for science instruction.

Bancroft (2020) recommended that PD for teachers should include discipline-specific content that is directly relevant to the teachers' varied classroom contexts. Teachers should learn to research and communicate new knowledge in science, thus learning to value the process of inquiry and the struggles that emanate from that process; when they experience this, they can better model this to the students in their classrooms (Davidson & Hughes, 2018). This way, the students also learn to research and communicate their new knowledge in science.

Some research suggests that online learning activities should be included in teachers' professional learning experiences so that they can access the learning at their own pace (Powell & Bodur 2019; Sithole, 2017). That way, they will be better prepared to engage their current and future students as these students are first generation technology users (Powell & Bodur 2019; Sithole, 2017; Vacca et al., 2017). Science coaches, in collaboration with literacy coaches, are encouraged to design PD sessions that can be remotely accessed by all teachers in their different contexts.

Lederman and Lederman (2019) shared research on a five-year PD program showing that teachers' content knowledge and pedagogical knowledge, and the students' attainment improved over time. The importance of ongoing and extended PD is emphasized repeatedly in the literature and this has been cited as a major challenge by the participants in this study (Babinski et al., 2018; Davidson & Hughes, 2018; Lederman & Lederman, 2019; Longhurst et al., 2017; Whitworth et al., 2018). Educators often find the time to invest in PD programs that are "authentic professional growth opportunities" (Vacca et al., 2017, p. 350). It is therefore important for the relevant stakeholders to collaborate in designing these targeted learning opportunities that will help the teachers embed literacy skills in their lessons.

Students Support Needs

All teachers need to have specific PD so they can adopt more inclusive practices in their classrooms where they can deliver immersive learning experiences to students who have English as an additional language or other extensive support needs, and not simply continue with the traditional pull-out method with specialists (Babinski et al., 2018; Byrd & Alexander, 2020; Walker et al., 2022). To be able to drive this change in teachers' mindset and practice, facilitators of this PD need to understand both adult learning methods and language acquisition methods (Slack, 2019). Skillfully facilitated PD builds shared efficacy within the group of teachers and promotes good cultures of learning, resulting in more equitable access for linguistically diverse students (Slack, 2019; Lee, 2020). PD that includes the literacy skills required by content area teachers empowers them to differentiate the learning and provide access to diverse groups of

learners. With this improved sense of self-efficacy, they have enhanced motivation to improve their performance and support their students as they in turn build higher levels of self-efficacy, resulting in higher levels of performance and attainment (Bandura, 1978). One high school adopted a co-teaching model to support inclusion in their classrooms, where pairs of teachers worked collaboratively to support all the students, and it resulted in overall school improvement (Vostal et al., 2019).

Professional Learning Communities

Establishing a collaborative PLC with well-defined roles and group norms, respectful interactions among group members that build trust, and mutual leadership often results in the teachers' creative and consistent appropriation of pedagogies and improved students' performance (Babinski et al., 2018; Davidson & Hughes, 2018; Dolfing et al., 2021; Longhurst et al., 2017). Attention is paid to the communication norms within these groups, and this facilitates productive learning opportunities (Finkelstein et al., 2019). These communities are task focused and also include specialists such as literacy coaches to facilitate the teachers' learning experiences (Babinski et al., 2018; Vacca et al., 2017).

PLCs have a positive effect on teachers' sense of self-efficacy with teachers leveraging the expertise and cross-disciplinary collaboration within these communities (Donohoo et al., 2018; Lee, 2020). They provide opportunities for experienced teachers to receive the coaching and mentoring they find useful as they improve their practices (Bressman et al., 2018). They are better able to help their students transfer skills they learn and improve their application of STEM literacy goals (Falloon et al., 2020). Kelley

et al. (2021) promoted collaborative teaching models within communities of practice as effective for improving students' STEM knowledge. This STEM knowledge is learned using strategies for reading, writing, listening and reviewing, and these strategies need to be embedded into the teaching models (Vacca et al., 2017). Collaboration between science teachers and literacy teachers would support improved acquisition and application of literacy strategies within the science lessons.

Riggins and Knowles (2020) noted that PLCs could be ineffective when they do not follow the recommended model and there is no culture of collaboration and collective responsibility within the school. Administrators must therefore invest time into clarifying the focus of the collaboration, providing systematic support for the teachers, and calling for the teachers' continued reflection on the students' learning by evaluating their responses to students' successes and failures. Riggins and Knowles affirm that doing these is essential to promoting effective PLCs.

Gunning et al. (2020) suggested that PLCs can be vertically articulated across K-12 schools such that teachers learn from their different experiences and prepare their students to make good progress across grade levels. They also suggested that participation in these science-focused PLCs can improve the teachers' understanding of science pedagogical content knowledge, which includes the literacy skills required to apply this knowledge (Gunning et al., 2020). Establishing PLCs within the locale where this study was conducted becomes pivotal to addressing the needs highlighted in the research.

Project Description

I will present this position paper to stakeholders at the Beta Schools and the district. The stakeholders include the school leaders, the district administrators, and the state commissioner for education, and extends to the AISEN leaders (Association of International School Educators of Nigeria) and APEN leaders (Association of Private Educators in Nigeria). I will share the position paper with these stakeholders for review, and I will also apply to present it at the annual APEN conference scheduled for November 2022.

Implementation

The recommendations in the position paper include ongoing PD that spans each academic year. PLCs will need to be established at the beginning of the school year (September) and run all through the year, with online discussions, peer observations, training workshops and coaching sessions scheduled, to allow time for teachers to independently and collaboratively reflect on their practices (Dolfing et al., 2021; Piliouras et al., 2018). I will submit an electronic request to meet with the school leaders and share the research findings from this study; the position paper will be attached to this request. I will also request the opportunity to support them as they decide on which recommendations to implement in the coming academic year. I will submit a request to meet with the APEN secretariat to present the research findings and request an opportunity to present the paper at the upcoming annual conference in November 2022. I will also submit the position paper to the state commissioner for education and request an

audience to discuss the findings with other stakeholders in the ministry of education; this could facilitate access to the district leaders across the state.

Resources, Barriers, and Solutions

The resources I need for this project include my computer, an executive summary for the state commissioner for education, and electronic copies of the position paper. The existing supports for this project include the leaders at the Beta Schools who authorized the research at their sites. I have access to the APEN and AISEN secretariat, as a former leader within a district under their jurisdiction. In the larger context, I have access to the state commissioner for education who is part of the AISEN group, and she has direct responsibility for all the school districts within the state.

It is possible that my requests to discuss the study findings with the key stakeholders could be rejected and that would be a potential barrier to implementation. I would appeal any rejections I receive and offer to collaborate directly with the school leaders on designing their PD program for one academic session at no cost to them. I would also offer to lead a session at the APEN and AISEN conference, pro bono, in exchange for the opportunity to present the position paper as a plenary session. As I have presented at both conferences repeatedly over the years, I should be able to secure a place on the agenda when I submit a proposal.

Roles and Responsibilities

Being the main researcher in this study, my role is to organize all logistics required to access the stakeholders as I implement the project. I will need to write an executive summary of the research and share that electronically, as I make a formal

request for face-to-face meetings with the school leaders, APEN and AISEN leaders, and the state commissioner for education. I will attach the position paper to the electronic requests. I will have paper copies of the executive summary and the position paper available for all face-to-face meetings. I will have to be flexible with the timings of the meetings and the outcomes as they are all dependent on the availability of the stakeholders.

As the Beta school leaders approved research to be conducted on their sites, I will urge them to review the position paper and implement the suggestions, highlighting the need to improve students' attainment in the standardized science examinations. This would possibly motivate them to take ownership of the implementation within their schools. Promoting this across the district would then be facilitated as the school leaders meet with district leaders and the state commissioner for education. I will be available to support with structuring PLCs and designing PD sessions across the state, as required.

Project Evaluation Plan

The goals of this position paper are to provide the findings from the study of Nigerian teachers' perceptions of and experiences with integrating literacy strategies into science instruction and to present recommendations to district leaders and school administrators, as they work towards addressing the gaps identified. A goals-based evaluation plan will be used in this project, as it will enable me to evaluate the overarching purpose of the project (see Lodico et al., 2010), suggest further recommendations for refinement across the schools and extend those to the district. The evaluation goals will be to review the training sessions in the schools, the peer

observations, the PLCs and the students' attainment results for WAEC and IGCSE science exams, post-implementation.

Formative evaluation will be elicited through qualitative and quantitative data collection, ensuring that any unanticipated project outcomes can also be recorded (see Lodico et al., 2010). Open-ended questions linked to the themes identified in the findings of this research study will be administered to the teachers and school leaders. Students' attainment scores will be reviewed to check for improvements after the recommendations have been implemented.

Eliciting feedback from the students, teachers and school leaders is important as they are key stakeholders. The school leaders will get formative feedback from the students on essential components of the project, such as changes they may have noted in their science lessons, additional support systems the teachers may have put in place, and suggestions for improvements. The school leaders can also collect similar feedback from the teachers; however, it is important for the teachers to reflect on their learning from the training sessions and their progress in terms of reviewed practices for integrating literacy strategies into their lessons. I will provide the data collection tools and present them to the stakeholders for ease of dissemination. The district administrators and education association leaders (APEN and AISEN) are also key stakeholders who can influence change on a larger scale. I will share the results of the evaluation with these groups of stakeholders as this will provide useful information to guide their decision making about PD opportunities and policy reforms in the state and nationally.

Project Implications

This project will influence positive social change at the local level, and it could potentially extend to the state and national levels. The teachers at the local level could be empowered with the tools and systems they need to improve their practices with regard to integrating literacy skills into their lessons, and they could improve their pedagogical content knowledge for teaching literacy which would improve their sense of self-efficacy and motivation. In conjunction with the school leaders, they could build collaborative PLCs where they reflect on their practices and update them unobtrusively. Novice educators can learn from more experienced teachers, and science coaches and department heads could provide targeted training leveraging the expertise in the community.

The teachers would also be able to reflect on their students' attainment in standardized examinations and redesign lessons and programs of study where necessary. These reflective exercises would extend to the students as well, during lesson reviews and exam preparation sessions, where the students will also reflect collaboratively on their learning and ways for improvement. Getting students to take ownership of this process also improves their sense of self-efficacy and that confidence will empower them to embed the learning into their daily lives. This will prove useful as they progress into higher education and the world of work.

At the state and national levels, the district leaders, commissioner for education and association leaders will be able to influence policy changes in school systems to include recommended practices for continuous PD. They would also be able to

disseminate the recommendations to a wider audience with contextualized stories and not general principles or theories.

Section 4: Reflections and Conclusions

Introduction

In this basic qualitative study, I explored science teachers' perceptions of and experiences with integrating literacy strategies into their science instruction at Beta Schools. In reviewing the literature, I found varied possible reasons for the gaps in science teachers' practices that informed my exploration of the unique perceptions and experiences of the teachers within the context of the study. I interviewed nine purposefully selected teachers individually, using open-ended questions that were framed around three RQs. The interviews were open-ended as the participants' responses guided the order in which I asked the questions. I transcribed the interviews verbatim and coded the data, clustering the codes into categories and finding emergent themes. Reviewing the data repeatedly as I progressed enabled me to apply new codes and categories to all the data sets throughout the data analysis process. I used a thematic analysis to connect themes that addressed the RQs and summarize the findings and recommendations. The final recommendations included recommendations from the literature and from the research data analysis, which I then articulated in a position paper. I determined that a position paper would best communicate the study findings and recommendations to the stakeholders in a succinct manner. The stakeholders include school leaders, literacy coaches, science coaches, district leaders, and education association leaders.

In this section, I discuss and reflect on the projects' strengths and limitations, offer recommendations for alternative approaches, consider the project's implications for social change, and discuss directions for further research. I also reflect on my personal

growth as a scholar-practitioner. I conclude with a message that captures the essence of the research study.

Project Strengths and Limitations

Project Strengths

One of the strengths of this position paper is the data source. The teachers interviewed in this context represent a sample of older, more experienced teachers and younger, less experienced teachers, representing about 40% of the science teachers within the Beta Schools at the time of the study. Their insights provide current information that the stakeholders could use to make informed decisions concerning science reform in the area of literacy integration.

Another strength of the position paper is the presentation of the findings from the data in a succinct manner. The results indicate the current strategies that the teachers used to integrate literacy into science lessons. These practices were not used by all the teachers consistently; however, they are now available as a resource bank for all the teachers to access as they implement the directive to embed literacy into their science lessons. The school and district leaders may be able to share these practices across the board and promote the more consistent implementation of the strategies, thus meeting the expectations to improve literacy levels in standardized science assessments. Having access to these without having to read through an extensive research paper may facilitate easy adoption by the stakeholders.

An additional strength of the position paper is the recommendations for PD that can be implemented immediately to remediate the gaps in practice within the local

context. This recommendation emerged from the data analysis and is echoed in the literature (Greenleaf et al., 2018; Gunawardena et al., 2017; Harper et al., 2018; Kennedy et al., 2017; Savitz et al., 2019; Smiley et al., 2020; Vacca et al., 2017). If implemented, and the project evaluation shows that the project goals and objectives are met, stakeholders might be able to extend the recommendations to other districts within the state who have similar challenges and across the nation at large.

Project Limitations

Working with a purposeful participant sample could possibly limit the generalizability of the project findings to other contexts; however, focusing on this number provided an opportunity to gain in-depth insight into the local context (see Creswell, 2018). Although the sample and the data are from one district, they could provide a foundation for research into other schools and districts within the wider context. The results and recommendations shared in the position paper address concerns raised across a wider context about the need for science teachers to integrate literacy strategies into their lessons (Vacca et al., 2017). Presenting the findings in a position paper makes them more accessible to leaders who might not have the time to read through extensive research papers.

Recommendations for Alternative Approaches

Some alternative approaches could be used to address the problem in this study. One approach could be to review the problem statement to specifically address the training, including pre-service training, that the science teachers received as part of their preparation to teach within the Beta Schools. This could have provided useful insight that

preservice trainers could use to improve their programs and equip the science teachers with the knowledge and skills they would need before they get to the classrooms.

The problem in this study focused on the science teachers' perceptions of and experiences with integrating literacy into their lessons. Apart from presenting the position paper, an alternative approach could be to design a specific literacy training program that could be used as an intervention plan. This would include the training materials, timetable for training, schedule for reflection, monitoring, and evaluation of the program. An alternative approach to gaining insight into the teachers' perceptions and experiences through open-ended interviews used in the study could be to conduct direct lesson observations and document reviews (lessons plans). I could have identified the strategies the teachers planned for and those they implemented in their lessons, those that aligned with industry recommended practices and those that were suggested in the literature but were missing from the observations and the document reviews. Participants for the study could have been sourced from across districts, as an alternative, in order to expand the sample size and provide an occasion for comparative analysis. The data from this investigation could provide the school leaders with useful data in reviewing their teachers' practices; however, the teachers' direct perceptions and some of their experiences might have remained unknown.

Scholarship, Project Development, and Leadership and Change

Scholarship

This research study has been the most meaningful academic learning process I have ever engaged in. Learning more about the different approaches to research studies

broadened my perspective and helped me review my previous disposition towards scholarly articles. Understanding the rigor involved in validating claims, making data-informed decisions, and critiquing the available literature on topics of interest has been a learning journey that I have enjoyed. Having a team of experts (my committee and Walden University's Institutional Review Board) critically appraise my study was instructive for me as a practitioner; I learned to review, reflect, and review again, critiquing my work based on the meaningful feedback I received. I also learned the need for resilience as I worked on my research through multiple transitions in my career and my family.

I have become a more skilled scholar-practitioner. I value the importance of the research process and have improved my writing skills, learning how to synthesize information and analyze data including all relevant details, without flowery language. Learning to conduct thematic data analysis was enlightening. Seeing the codes, categories, and themes emerge as I repeatedly reviewed the data from the interviews was truly engaging. The literature review enabled me to learn and apply these new writing skills effectively. Searching for peer-reviewed articles via available resources, including Google Scholar and Walden University Library databases, highlighted the need for careful attention to research context and context, and the importance of updated studies. It was interesting to observe some changes in approaches to education over time; further highlighting the need for me as a scholar-practitioner to stay informed of the most recent studies and practices in education.

Project Development

In addition to learning about the possible project outcomes, it was interesting for me to review Walden University's doctoral-level checklist for qualitative project studies as it helped streamline the expectations. I appreciated the available variety as that allowed me to learn more about position papers; ultimately leading to my choice to write a position paper for my project. Learning about the need to synthesize the study findings, and to present them to a nonacademic audience in a succinct yet detailed narrative, was a steep learning curve. Position papers communicate a firm position, enabling researchers to voice their opinions that have been formed from a rigorous process. I appreciate the new knowledge and skills I have acquired through this process.

Leadership and Change

This research process has highlighted the need for data-informed decision making so that problems can be identified and articulated, and interventions can be well targeted to address the specific problems. As a leader in the education space, I have also learned the importance of collating data that are relevant to the context in question. Although it is important to know about industry-recommended practices in education, it is equally important to contextualize that knowledge and skills as educators apply them in multicultural learning communities.

Reflecting on the application of new knowledge and skills all through the implementation process is equally important and I have learned this from the process of writing and reviewing my research study. This is one practice that will stay with me as I lead change within my sphere of influence. As I have to "lead up" within my current

district, I will be better able to present my proposals and influence or possibly catalyze systemic change using position papers.

Reflection on the Importance of the Work

Through this research study, I have developed a deeper appreciation for educational research and the impact it could have on our schools and communities. Reviewing the literature on science teachers' perceptions of and experiences with integrating literacy in their lessons, and the data from the study, showed an authentic gap in practice. It is therefore important that the recommendations from this study are used to mitigate this gap.

If the project is implemented within the Beta Schools and in similar districts across the state, it has the potential to catalyze systemic change in the science teachers' lessons. An improvement in the teachers' knowledge and skills could lead to improved student engagement in lessons; that way, they could learn more. An increase in their knowledge and skills would empower the students to perform better in the high-stakes standardized assessments. This could change the narrative about student attainment across the state and contribute to the drive for improved literacy levels across the nation.

Implications, Applications, and Directions for Future Research

Implications

The implications for positive social change include possible changes in the science teachers' experiences with integrating literacy strategies into their lessons based on the data collected from the interviews. The data showed the need for knowledge of literacy strategies that the teachers could implement in their lessons more consistently as

there were gaps in their practices The results and recommendations shared in the position paper address concerns raised across a wider context about the need for science teachers to integrate literacy strategies into their lessons (Vacca et al., 2017). This study could help the participants and other science teachers contribute meaningfully to discourse within their contexts regarding integrating literacy skills into their lessons.

The findings of the study highlighted the need for PD and consistent communication from school leaders regarding integrating literacy strategies into science lessons (Greenleaf et al., 2018; McMillen et al., 2018). The recommendations from the study could catalyze lasting change within the Beta Schools and could extend to other districts with similar challenges, as such, a position paper was developed for district leaders and other stakeholders. Another implication is the possible development of systems for continuous PD for the science teachers and other content area teachers. That would promote collaboration within and across schools and safeguard the quality of teaching and learning in science across the district.

Applications

The focus of this study was on science teachers' perceptions of and experiences with integrating literacy strategies into their lessons. The insights gained in this study could also apply to other content area teachers within the Beta Schools as they integrate the highlighted literacy strategies into their unique subject areas. The insights could be extended to other districts as well, driving improvement across the state. The recommendations for PD, including recommendations for establishing PLCs, could be

applied across the state by the stakeholders, including the leaders of the education associations.

The ongoing drive for improved literacy levels across the nation has increased the expectation that teachers need to support their students as they acquire the literacy skills they need for school and the world of work (Abu-Ubaida et al., 2017; Alade et al., 2017; Obiegbu, 2018). The recommendations from this study could support science teachers and other content area teachers and leaders as they meet this expectation in their local contexts.

Directions for Future Research

This study focused on science teachers' perceptions of and experiences with integrating literacy strategies into their lessons, highlighting the challenges they faced and their suggestions for remediation of the gaps in their practices. It will be useful to extend this study to include their counterparts across the district and possibly, to explore other content area teachers' perceptions and experiences with regard to embedding literacy skills into their lessons (Vacca et al., 2017). It will also be useful to explore the content of the pre-service training available to content area teachers within the district, to determine whether it would adequately prepare them to meet the expectations to embed literacy skills in their lessons. Exploring the availability and efficacy of any systems for continuous PD is an additional area for future research (Barnes et al., 2019; Savitz et al., 2019). Critiquing these systems could highlight further gaps in practice and provide opportunities to discuss possible interventions. Another area for future research could be

to review student data after project implementation, to determine the impact of the recommended PD programs that the districts might choose to implement.

Conclusion

This basic qualitative study focused on investigating Nigerian science teachers' perceptions of and experiences with integrating literacy into their lessons. This expectation had been laid out by the school and district leaders, and had been highlighted as an area for development in feedback reports from standardized assessments. Gaining an understanding of the unique perceptions and experiences of the science teachers within the study context would enable the school and district leaders to support the teachers as they adopt effective strategies and recommended practices for integrating literacy skills into their lessons.

The literature reviewed showed the need for teachers to adopt more effective strategies, practices and theories that would help them equip their students with the skills they needed for real life (Gelfuso, 2018; Gunawardena et al., 2017; Vacca et al., 2017). Teachers' improved abilities are likely to translate into improved student engagement and learning experiences; ultimately resulting in improved student attainment (Eaton et al., 2018; Spires et al., 2018). This study was grounded in Vacca et al.'s (2017) conceptual framework of content area literacy, highlighting the need for content area teachers, such as science teachers, to actively embed literacy skills into their lessons. A purposeful sample of teachers was interviewed, and the data showed multiple gaps in practice including inconsistency in teachers' knowledge of and use of literacy skills. The results

from the study support the need for a review of practices, including practices for continuous PD, at the local level and also extend to the broader level.

The project for this study is a position paper for school and district leaders, and state-wide educational stakeholders. It addresses the local problem, details the research findings with supporting evidence from the literature, and includes recommendations for change that could be implemented immediately, within the local context. Building PLCs where content area teachers can collaborate and share strategies to effectively and consistently embed literacy skills into science curricula, was a firm recommendation in the position paper. It is anticipated that the implementation of the recommendations will lead to positive social change within the Beta Schools and the broader context if applied. Stakeholders in education have to invest all available resources into ensuring that students develop the knowledge and skills they need for real life and the world of work.

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Appendix A: The Project

Nigerian Teachers' Perceptions and Experiences of Integrating Literacy Strategies Into Science Instruction

Goals

This position paper presents an argument for the need for targeted, ongoing professional development for Nigerian Science teachers, based on a recent study of their perceptions and experiences, as they struggle to embed literacy strategies into their lessons. The recommendations could support and guide district leaders, school administrators, and education association leaders as they design well-targeted professional development programs within their schools and districts. This could possibly also improve staff competencies and motivation to meet set expectations, and improve student attainment in West African Examinations Council (WAEC) and International General Certificate of Secondary Education (IGCSE) examinations.

Background of the Existing Problem

Reading difficulties have been highlighted as being a major challenge for Nigerian students in Secondary Schools (Abu-Ubaida et al., 2017; Alade et al., 2017; Obiegbu, 2018). Concerning science, in particular, the West African Examinations Council (WAEC) which hosts the standardized assessments for the End of Grade 12 shows that poor application of literacy skills account for low attainment levels among students (WAEC, 2018, 2019). In the Beta Schools (pseudonym), a cluster of schools within a large school district, a Literacy Across the Curriculum (LAC) Initiative was rolled out by the administrator to improve students' literacy levels. An audit conducted

showed gaps in practice with embedding literacy in lessons, especially among science teachers. Because the reasons for these gaps were unknown to school leaders, the research study on which this paper is based investigated the science teachers' perceptions of and experiences with meeting the expectations to integrate literacy strategies into their lessons. The research literature on this gap in practice showed support for studying this problem and is discussed briefly below.

Evidence In Current Articles

The literature shows an overwhelming need for content area teachers, including science teachers, to pay attention to scientific literacy, showing their students how to apply literacy skills and strategies more explicitly (Cannady et al., 2019; McMillen et al., 2018; Vacca et al., 2017). Students need to be taught to communicate their understandings within their subject disciplines meaningfully and teachers need to use well-planned, engaging lessons that integrate reading and writing skills into those disciplines using reading materials that capture students' interests (Gelfuso, 2018; Green & Lambert, 2018; Greenleaf, et al., 2018; ; Lupo et al., 2019; McMillen, et al., 2018). Some research suggests that teachers' ability to plan these lessons using factors such as achievement scores, effort, and persistence has the greatest impact on students' learning (Alade, et al., 2017; Vanlommel et al., 2018) so teachers need to be equipped with the tools they need to plan effective lessons. Teachers require rich, ongoing professional development opportunities to gain the tools they need to support their students (Patterson et al., 2018; Wright et al., 2016) and it was important to investigate the teachers' experiences of professional development for integrating literacy into their lessons.

Inquiry-based professional development for science teachers would help them become more effective teachers (Harper, et al., 2018; Kennedy et al., 2017; Wright et al., 2016). This form of professional development can be framed within professional development schools, which are collaborative institutions formed between university education programs and schools to support teachers to become more knowledgeable, reflective practitioners who can meet the needs of diverse learners (Vacca et al., 2017). Some other research suggests that the teachers' limitations may stem from their knowledge of and use of science-specific literacies (Feez & Quinn, 2017; Kirsten, 2019). This inhibits their ability to support their students' learning as they require professional knowledge to teach literacy strategies (McMillen, et al., 2018; Savitz et al., 2019).

Vacca et al. (2017) recommend that content area teachers, including science teachers, need to pay attention to students' ability to understand discipline-specific material using reading, writing, listening and viewing processes, as they are central to the students' growing abilities in this regard. Teachers need to help students develop deeper levels of understanding as they make vital connections with the texts read in class as well as their unique real-life experiences (Vacca et al., 2017). Teachers can be motivated to independently improve their practices, but this can be done effectively within professional learning communities (PLCs) that provide a forum for knowledge sharing, improved creativity, the connection of policy to practice, and linking assessments to learner development (Vacca et al., 2017). The content area literacy conceptual framework, by Vacca et al. (2017), guided this research study.

Recommendations

The recommendations in this position paper originate from the research findings and the literature review. They will enable district and school leaders to provide support opportunities for science teachers so that they can integrate literacy strategies into their lessons more consistently and effectively.

Recommendations From the Literature

1. Science teachers must learn to plan engaging lessons that include opportunities for students to learn reading and writing skills.
2. Science teachers' pedagogical content knowledge for teaching literacy skills should be developed in on-site professional development sessions.
3. Schools should have access to a range of science-specific reading materials that engage students' interests such that the teachers can include these in their lessons. These materials should also include graphic novels and digital texts.
4. There should be opportunities for ongoing professional development for teachers within their contexts, via professional development schools or professional learning communities so they can reflect on and continue to improve their practices using data from student performance.

Recommendations From the Findings

1. Training for pedagogical content knowledge should be provided for the science teachers so they can learn how to teach literacy skills such as reading, writing, listening and speaking. This training has to move away from the traditional lecture or external workshop model to on-site training within the schools, and it should be delivered by literacy coaches.

2. Heads of science departments must receive specific training in monitoring the integration of literacy skills in science lessons so that they can provide support and guidance for their peers.
3. Professional learning communities (PLCs) should be established within and across schools in the district to enable science teachers to share recommended practices and learn from each other.
    a. Within these PLCs, targeted training can be provided for the science teachers in each context. Teachers from other departments, especially the English department, can be invited to join the community as resource persons. The PLCs can be hosted online as well, to promote asynchronous learning for the teachers.
    b. A list of effective strategies for integrating literacy into science lessons using practical, kinesthetic activities can be populated and easily referenced by novice science teachers. These could be included in the science departmental handbooks and updated regularly by the teachers and heads of departments within the schools.
    c. Teachers can collaboratively review writing prompts for exam questions, exam board reports, and mark schemes. They can gain deeper levels of understanding of the expectations and share best practices about meeting those expectations.
    d. Planning can become a collaborative experience where more experienced science teachers support novice teachers within and across schools. Banks

of well-differentiated lesson plans can be collaboratively developed and shared; these should be stored in shared online and physical spaces for easy access by all the teachers within the community.

4. Partnerships with organizations such as AISEN (Association of International School Educators of Nigeria) and APEN (Association of Private Educators in Nigeria) can facilitate the PLCs across schools and save on the cost of recruiting literacy coaches and master instructors.
5. Schedules for peer observations should be included in each school calendar so the science teachers can observe their peers and provide meaningful feedback on the integration of literacy skills in their lessons.

It is important to share the process of and findings from the research at this point, to provide concrete data and background context for the listed recommendations. These details can also guide school leaders and administrators as they design the PD opportunities in their locales.

Summary of Findings and Analysis

The basic qualitative research study, on which the recommendations in this paper rest, was conducted specifically to gain insight into the science teachers' perceptions of and experiences with integrating literacy strategies into their lessons (Creswell, 2018; Merriam & Tisdell, 2016). The three RQs for the inquiry centered on (a) the participating teachers' perceptions of the requirement to integrate literacy into their teaching and learning experiences, (b) the instructional strategies they currently viewed as adequate for

meeting the expectation, and (c) their perceptions of ways by which they could improve their practices.

A purposeful sample of male and female science teachers within the Beta Schools (pseudonym) was selected from a group of volunteers; nine teachers were selected and interviewed using extensive open-ended questions. The interview questions were phrased based on the conceptual framework, the RQs and broader themes from the literature review. The data were collected, and a thematic analysis was conducted. Six themes emerged during the data analysis.

Summary of Findings

Research Question 1: Summary of Themes

Research Question 1 explored the science teachers' perceptions of the requirement to embed literacy instruction in their pedagogy. The data analysis showed that this expectation was not consistently communicated across the schools, so the participants were not consistently motivated to meet it (Theme 3: Teacher motivation). The teachers' challenges in meeting this expectation also included poor pedagogical content knowledge, poor background knowledge of and use of English, unclear communication from the administration, and inadequate training (Theme 5: Challenges). Very little training was provided, and when available, it was not specific to science teachers (Theme 2: Professional development). While the participants agreed with the importance of meeting the expectations especially as the reports from examination boards articulated gaps in this area, they did not consistently meet the expectations and there was no evidence of monitoring the implementation across the schools.

Research Question 2: Summary of Themes

Research Question 2 explored the instructional strategies that the science teachers were currently using to teach literacy within their lessons. The participants used varied strategies for teaching reading and writing including, focusing on key vocabulary, using context clues to drive deeper levels of understanding, having guided reading and discussion sessions to promote inference and decoding, using big questions requiring extended responses, writing summaries, and flipped learning where students could continue their independent research at home (Theme 1: Teaching and learning strategies and Theme 4: the classroom environment). It was interesting to note that while they used some of these strategies, some of them were unaware that they were literacy strategies. Two participants mentioned that this study revealed the gaps in their practices. The participants used teacher-to-student feedback and peer-to-peer feedback to help their students understand the texts read in class at deeper levels. They included technology in their lessons, also using online sources for digital texts. One participant used specific online resources to improve students' reading using science texts. Some teachers paid attention to the learning environment, thereby making sure that the classroom was well managed. Some participants used different multimedia texts and ensured that students had chances to engage with their peers in small groups; thereby receiving support from their peers and teachers. A number of the participants supported student learning through the use of dictionaries, glossaries, thesauruses, and encyclopedias (physical and digital).

Research Question 3: Summary of Themes

Research Question 3 explored the science teachers' perceptions of ways by which they could improve their adoption and implementation of recommended literacy strategies in their lessons. The participants shared a range of strategies from their varied experiences and also from the recommendations in the examination board reports (Theme 1: Teaching and learning strategies). They listed several challenges that inhibited their ability to consistently use the limited strategies they knew in their lessons. The challenges include time for planning differentiated lessons, their limited pedagogical knowledge of teaching literacy, and the focus on examinations (Theme 5: Challenges). They emphasized the need for clearer communication of the expectations from the leadership and they all requested specific professional development in the area of literacy instruction, so they could learn about appropriate strategies to use to integrate literacy skills into their lessons (Theme 6: Recommendations for improvement). This aligns with the conceptual framework that suggests that schools and districts should develop programs and adopt strategies that will promote continuous professional development for content area teachers (Vacca et al., 2017). Some suggested programs and strategies include identifying professional development schools, establishing professional learning communities, promoting state agency and professional association partnerships, and having literacy coaches; all of which will facilitate professional inquiry and growth among teachers (Vacca et al., 2017). Some of the participants also suggested establishing collaborative learning opportunities where they could plan lessons in teams and improve their time management whilst learning from their peers.

During the interviews, I noted some missed opportunities that the participants could have used to overtly reinforce or teach literacy skills. The participants who were more confident in their use of English paid attention to their students' written and verbal English skills (Theme 3: Teacher motivation). Their students perceived them as overly particular and, in the case of one participant, other teachers also questioned the additional focus on literacy skills in science lessons. The completion of specific training in content area literacy enabled a group of teachers to shift their perspectives and Savitz et al. (2019) suggested that all teachers' dispositions towards literacy instruction must change so they can better integrate literacy into their lessons. The data from this study showed that those teachers who did not have as strong a background in the use of English were unaware of the literacy skills that could be taught in the lessons. One participant mentioned that doing this interview highlighted the literacy skills she had been covertly using, even though she had been teaching science for over six years and was simply helping her students to write good responses to exams questions.

The findings from this study point to an urgent need for continuous professional development for science teachers, so they learn the strategies for integrating literacy into their lessons and can manage their time for improved planning. There is also a need for consistency in communication and monitoring procedures from the administration.

Thematic Analysis

Theme 1: Instructional Strategies for Literacy in Science Lessons

Key Vocabulary

All the participants had a major focus on key vocabulary, emphasizing the spellings and meanings within their lessons, with seven participants using context clues within texts to decode meanings. Vacca et al., (2017) share the importance of developing students' vocabulary knowledge within content area subjects to develop their understanding of the conceptual links between words and activate prior knowledge and interest. Two participants highlighted the need to activate prior knowledge about words, especially for students who have English as an additional language. Vacca et al. (2017) recommend using dictionaries and five participants shared that they used them in their lessons. Three participants used syllabification and referenced the etymology of words to help students deepen their levels of understanding and remember the correct spellings. One teacher shared the importance of using homework time to build deeper levels of understanding and manage time during lessons so that the students would be able to contribute meaningfully in class. Five participants flipped their learning by assigning reading materials for homework, to help develop students' vocabulary before the lesson.

Reading Strategies

Six participants highlighted the use of guided reading to develop good speaking and listening skills within their lessons. Students would take turns to read aloud and then respond to discussion questions or make notes summarizing what they had understood, in line with the research that highlights the need for students to meaningfully communicate their understanding of texts read in context areas (Gelfuso, 2018; Green & Lambert, 2018; McMillen et al., 2018; Wexler et al., 2018). One participant emphasized the

inclusion of reading tasks in her lessons at all costs in alignment with Vacca et al.'s (2017) think-aloud strategies. Two other participants differentiated the texts for students who needed additional support by including images. Eight participants used comprehension-style questions to check for understanding; five of them phrased questions to promote inference and decoding, as well as simple literal retrieval. Three participants asked their students to read questions and accompanying narratives multiple times, so they could deepen their understanding.

Writing Strategies

Vacca et al. (2017) posit that using short and informal writing tasks promotes writing to learn. Eight participants shared that they used different questions that would elicit narratives, such as short paragraphs and essays, as responses. One participant used big questions to check for understanding, asking the students to explain the scientific processes in their own words, especially in Biology which involves extended reading and writing. The participants marked the summaries and gave the students feedback. Seven participants shared writing samples with the students and had them draft and revise their work based on feedback received, including feedback received from peers. They promoted the inclusion of key vocabulary in their writing in line with exam requirements for full marks. They also got their students to present their work to the class as part of the review process.

Meaningful Feedback

Six participants marked the students' work for SPAG (Spellings and Grammar) and the three female participants also used rubrics and mark schemes to give feedback,

which is in line with recommendations in the literature (Vacca et al., 2017). Three male participants focused on the mark schemes published by exam boards. Providing students with opportunities to redraft their writing and discuss them in collaborative groups is also recommended (Vacca et al., 2017) and five of the participants adopted these practices in their lessons. Some literature recommends that students should receive feedback as individuals and in small groups based on their cultural and linguistic differences and uniqueness (Gunawardena, et al., 2017; Hadjioannou, et al., 2016; Leonard, 2018). Two participants extended the feedback opportunities to receive feedback from their students so they could improve their practices.

Additional Strategies

One participant (female) used mnemonics so that her students could break polysyllabic words into rhymes and tunes, and could remember spellings of keywords in the subject area. Two participants set up flexible groups, so their lessons would be less predictable, and all students would be engaged in collaborative learning structures; they assigned roles within the groups, and required each group to present their learning to the whole class.

Theme 2: Professional Development

District-Level and School-Level Professional Development

Inquiry-based professional development has been proposed as essential for content area teachers so they can be more creative and deliberate about including literacy in their disciplines (Greenleaf et al., 2018; Harper, et al., 2018; Kennedy et al., 2017). None of the participants has received training specifically for science teachers about

integrating or embedding literacy into their lessons. Three of them had received generic literacy training in staff meetings, covering diction, report writing and guided reading. These three participants had worked with the school district for at least six years and only one of them referenced the literacy across the curriculum (LAC) initiative directly.

It would be useful to investigate this feedback on poor literacy training within the schools since the LAC initiative was promoted in the 2018/2019 academic session. One participant mentioned that communication from the leadership was "unclear and inconsistent" but the expectations were clearly stated in the WAEC and IGCSE examiners' reports. The school leadership mentioned did not reiterate these expectations, however, she integrated literacy into her lessons based on her background knowledge of English and the feedback in the mark schemes published by exam boards. One of the aims of the LAC initiative was the consistent use of scientific vocabulary in written responses; this was met by all the participants and has been sustained. One of the participants said that there was no drive from the new administration to promote the LAC initiative.

Teachers' Personal Professional Development

Six participants had personally invested in professional development to improve their literacy skills, including diction, reading, and essay marking (examiner's course), and they firmly recommend that all science teachers do the same. Five participants attributed their good foundation in the use of English to their learning from Secondary school and university. One participant mentioned that teachers who had poor

backgrounds would not have the ability to meet the examiners' requirements; he mentioned that this was observed in a rural district out of state.

Theme 3: Teacher Motivation to Meet the Requirements

Savitz et al. (2019) summate that up to 75% of content area teachers do not have the professional knowledge required to teach literacy strategies in High school. Swanson et al., (2017) posited that teachers who lack the pedagogical practices necessary to provide literacy instruction in their disciplines will not be able to support students who struggle with reading; they would not have the reading strategies to facilitate their students. This would be demotivating for them as teachers. Eight participants said they had not received any training post-university about literacy skills. Only one participant had received specific training in teaching English as part of the Cambridge International Certificate in teaching and learning; this was at his own expense.

All the participants initially agreed with the expectation that all teachers should be teachers of English; however, their understanding of the practical application and their ability to meet this expectation varied. Six participants stated they were not English teachers, but they could teach the basics of reading and writing. They expected the teachers in the English department to teach the skills and the students to transfer them to the science lessons. One participant highlighted the importance of collaborative planning opportunities so the more experienced teachers could include specific learning activities directly linked to literacy in the lessons. This would support standardization across different classes on the same grade level and across campuses. Four participants

recommended that collaborative planning and training sessions should include colleges from the English department so that they could learn the required literacy skills.

Some research studies recommend that teachers should be reflective practitioners who continuously reviewed their technical knowledge, content knowledge, and pedagogical knowledge so that they could adopt the most current practices for improving students' reading and writing in content area subjects (Eaton, et al., 2018; Greenleaf, et al., 2018; Spires et al., 2018). Seven participants also mentioned these as ways by which they evaluated their lessons and their students' learning. This enabled them to identify areas for improvement in their students' literacy skills and plan for support. None of the participants mentioned collaborative reflection within professional learning communities though, and there was insufficient evidence of the consistency of the reflective practices they mentioned.

Barnes et al. (2019) suggest that teacher effectiveness is dependent on the professional learning experiences that help them grow and improve their competencies and their attitudes to students and the learning process. Five participants, who had over 10 years of experience, highlighted the need to focus on the requirements for exam questions. Over the years, they had identified the key skills that their students needed, skills such as including key vocabulary, repeatedly reading writing prompts before reading the exam questions, learning the spellings of the keywords, and the organization of essays. These strategies helped their students attain higher scores.

Three participants highlighted the importance of motivating students to learn as opposed to simply teaching them. Teachers needed to pay attention to their students'

moods and dispositions and to be creative with their lessons so that the students would be engaged for the most part. Teachers also needed to pay attention to the learning environment and to be deliberate about classroom management as these improved the students' ability to learn. Five participants mentioned that they used resources including dictionaries, glossaries, thesauruses, and encyclopedias (physical and digital) to support their students' learning.

In personal professional development, three participants used peer observations to discuss, review and improve their practices. These lesson observations were required within their Beta Schools; however, these three participants specifically improved their lessons based on what they had observed from others. One participant (who had only taught science for four years) observed how his colleague encouraged the use of a digital device (a translator) for a foreign student who had very little English. The participant broke down complex, polysyllabic words into simpler words linked to the student's prior learning. This method of differentiation would be useful for him when he encounters EAL students in the future.

The process of transcription revealed concerns in the participants' use of English. All the participants claimed to have a good command of English, with only one participant stating he was functioning 'at 60%', but there were notable challenges with the automated transcription process. One of the participant's audio recording was automatically transcribed as Dutch, using YouTube auto-transcribe. I had to purchase software (Otter.ai) to transcribe it and spent about two hours replaying and editing the transcript because of his poor sentence construction and his diction. I had difficulty with

two other participant recordings with similar challenges. Asking these teachers to include literacy instruction within their science lessons would challenging.

Theme 4: The Classroom Environment

Development of Students' Literacy Using Online Resources

There is strong advocacy for technology to be included in educational settings in Nigeria (Opeyemi et al., 2019; Samuel et al., 2019; Yusuf & El-Yakub, 2020) so that the nation aligns with global standards. Standard 8 of the Next Generation Science Standards (NGSS) states that all education in science should empower students to read scientific and technological reports in print and online (NGSS, 2013). All the participants included presentations, experiments, and research using technology. They all promoted the use of online dictionaries and online databases during lessons and for homework, so the students could deepen their levels of understanding of key vocabulary in their lessons and guide them as they conducted personal research. Four participants used digital texts during guided reading sessions; however, only one participant used an online source (KOGNITY) specifically for improving his students' literacy skills using science topics.

Even though all the participants promoted the use of technology by both teachers and students in class, only two participants had specific digital devices (translators) that the students used. Even at that, the devices were not the schools' property; the parents bought them.

Classroom Management

Four participants used routines to organize and manage student engagement facilitating discussions that were robust but not rowdy. This enabled them to differentiate

the resources and support for the students and include one-on-one interventions. One participant highlighted his use of this for reading sessions as his English accent was sometimes distracting for the students. Two participants used flexible groupings to vary the teams and improve dynamics within the class; also ensuring that more able students supported less able students during discussions and projects. One participant promoted collaborative learning by distributing tasks and roles to the group members to improve levels of engagement.

Differentiation

Seven participants highlighted the need for teachers to use differentiated learning activities, as they helped students with additional learning needs during lessons. They mentioned different learning support systems such as peer coaching, specialist teacher involvement during the lessons, and more effective communication skills. One participant specifically highlighted the lighting and the temperature of the room as factors that could make students more comfortable and more able to learn. He also mentioned the need for active listening on the part of the teachers so that they can provide better explanations when students have questions, to promote a more inclusive classroom.

Some participants mentioned that this level of differentiation was time-consuming, even though it was important to support the students

Theme 5: Current Challenges Faced by Teachers

Planning Learning Activities

Some literature suggests that content area teachers should develop well-planned cross-curricular lessons and integrate reading and writing skills into them (Cunningham

& Allington, 2016; Gelfuso, 2018; Greenleaf, et al., 2018; McMillen, et al., 2018; Wexler et al., 2018). Some other literature suggests that teachers' ability to engage in quality instruction by planning effective lessons has the biggest impact on student learning (Alade, et al., 2017; Flores, 2016). Only four participants deliberately planned practical, kinaesthetic activities to increase students' interest in reading texts. Several participants mentioned planning time for including opportunities for literacy instruction in their lessons as a major challenge. One participant mentioned that it took too long to get all the students to participate in activities such as role-plays and poster making, or using moulding clay. One participant mentioned the limitations of school timetables and life outside of school so there was not enough time to plan for literacy activities. It is important to point out that all three female participants in the study deliberately planned for differentiated learning activities.

Time Management

All the participants referenced challenges with managing time. Three participants stated a willingness to reinforce literacy skills including reading (inference) and meaningful feedback (comments-based marking) but they simply did not have the time during lessons. The literacy instruction took too much time away from the main science content. Two participants wondered why the students had such difficulty with transferring the literacy skills they learned in their English lessons into their science lessons. Exploring this would be an informative research study. Two other participants mentioned that they were no longer as invested in including literacy activities in their

lessons as it took too long to plan and execute them with the available time slots they had.

Direct Teacher Input

One participant mentioned that she often caught herself spending too much time explaining the key vocabulary and concepts during lessons, and ended up not having enough time to get the students to apply their literacy skills. Two other participants also referenced this as a pitfall; stating that it took up time for students to have their discussions that could probably improve their levels of understanding. They both reflected on the need for more literacy in their lessons, based on the interview questions, and pledged to manage their time better.

Identification of Students' Abilities and Prior Learning

One participant mentioned challenges with determining students' ability levels, because of the transient nature of the students within the school; students were able to join the classes at different points throughout the academic year. Another participant mentioned his challenges with identifying the varied abilities of the students in his classes, due to numbers, so he could not plan different learning activities for them. He also had students transfer into his classes from different schools and it was difficult to help them catch up with the others. I observed missed opportunities for differentiation, and literacy instruction during the interviews with these teachers. The need for improved competencies was also evident and could be the topic of further research.

Focus on Exam Questions

Eight participants focused on improving their students' ability to answer exam questions, and this resulted in limited time for addressing any gaps in their literacy skills. They were under pressure to cover the vast science syllabi in time to allow some time for students to practice responding to exam questions. This pressure was intense as exam success was the bottom line for parents and administration. Taking out precious time to teach literacy skills was on the back burner.

Theme 6: Teachers' Recommendations for Improvement

Continuous Professional Development

In reviewing the literature, Smiley et al. (2020) found that in well-resourced contexts, especially international contexts, professional development often includes literacy coaching facilitated by master instructors. They suggested that this level of support has to be scaled though, for teachers in low-income countries to access the content of the PD. All the participants emphasized the need for more targeted, continuous training to support them, as science teachers, as they improve their pedagogical knowledge of teaching English. Some of the participants highlighted training topics that include teaching inference and decoding skills, marking for literacy, and supporting EAL students in science lessons. They suggested that collaborative learning opportunities be included within the schools so that they could always consult with their peers in the English department when they had difficulties.

The participants also recommended job-alike sessions where the more experienced science teachers could share their experiences. Greenleaf et al. (2018)

summated that including reflective, inquiry-based training provides teachers with opportunities to embed varied strategies into their lessons and reform their practices. One participant emphasized the importance of collaborative planning; one teacher could plan the weekly lesson with literacy strategies well integrated, and then the teaching team would discuss that lesson plan so that best practices would be used across the schools.

Clear Admin Expectations

All the participants commented on the inconsistent communication from the administration about this expectation to integrate literacy skills into science lessons. One teacher noted that changes in school leadership had diminished the drive to promote LAC . Having a joint review of the reports for the examination boards would help to improve the consistency of practice across the schools.

Some research studies highlight the importance of regular monitoring of teachers who have multicultural and linguistically diverse learners, to safeguard the quality of instruction and maintain consistency over time (see Gunawardena, et al., 2017; Hadjioannou, et al., 2016; Leonard, 2018). One participant highlighted the need for school leaders to develop and use checklists to monitor the implementation of recommended practices as it was not enough to simply mention that some teachers were not doing a good job.

Conclusion

This position paper argues for urgent attention to be paid to PD opportunities in schools to address the gaps in practice concerning science teachers' integration of literacy strategies into their lessons, within the Beta Schools context. The findings have been

collated from the science teachers' current experiences regarding their strategies and challenges and clear gaps have been identified. Addressing these gaps in practice is significant for schools and district leaders in this context and the nation at large, to contribute to improving students' literacy skills which they need as they prepare for the world of work.

The findings and the recommendations will facilitate discourse on designing targeted interventions and professional development programs such that available resources with the schools, as limited as they may be, can be effectively deployed for maximum results. Improved teacher competencies would result in improved student abilities, ultimately improving attainment scores in science subjects. This will encourage the students to move on to explore science-related disciplines in higher education.

Policymakers and education associations across the nation could potentially improve current and future professional development opportunities in practical ways that are responsive to the actual experiences and challenges shared by the science teachers in this local district.

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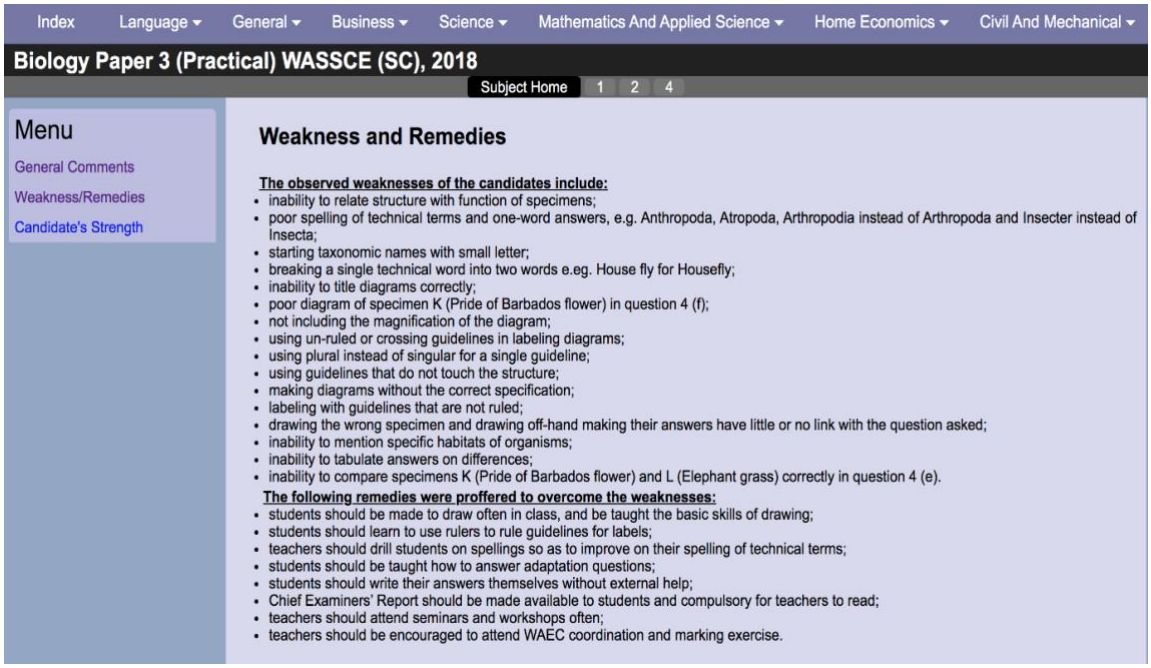
Appendix B: West African Examinations Council Results Summaries

This appendix contains screenshots of weaknesses and remedies as published online.



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Biology Paper 3 (Practical) WASSCE (SC), 2018

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Menu

General Comments
Weakness/Remedies
Candidate's Strength

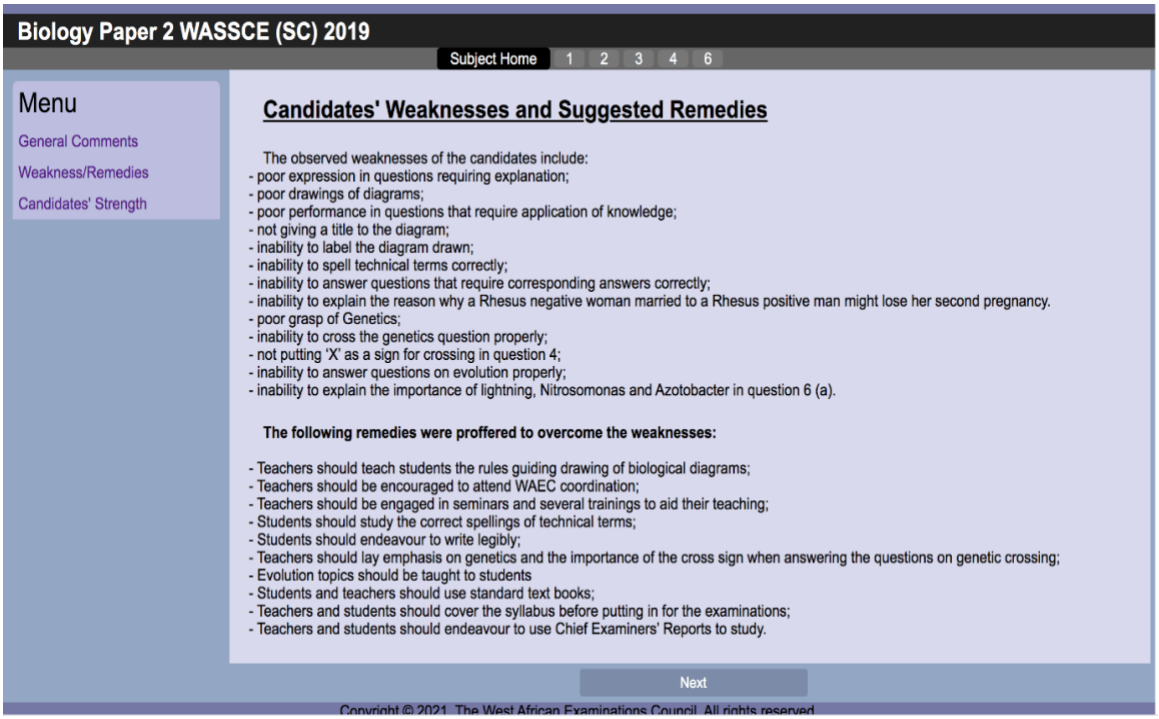
Weakness and Remedies

The observed weaknesses of the candidates include:

- inability to relate structure with function of specimens;
- poor spelling of technical terms and one-word answers, e.g. Anthropoda, Atropoda, Arthropodia instead of Arthropoda and Insecter instead of Insecta;
- starting taxonomic names with small letter;
- breaking a single technical word into two words e.eg. House fly for Housefly;
- inability to title diagrams correctly;
- poor diagram of specimen K (Pride of Barbados flower) in question 4 (f);
- not including the magnification of the diagram;
- using un-ruled or crossing guidelines in labeling diagrams;
- using plural instead of singular for a single guideline;
- using guidelines that do not touch the structure;
- making diagrams without the correct specification;
- labeling with guidelines that are not ruled;
- drawing the wrong specimen and drawing off-hand making their answers have little or no link with the question asked;
- inability to mention specific habitats of organisms;
- inability to tabulate answers on differences;
- inability to compare specimens K (Pride of Barbados flower) and L (Elephant grass) correctly in question 4 (e).

The following remedies were proffered to overcome the weaknesses:

- students should be made to draw often in class, and be taught the basic skills of drawing;
- students should learn to use rulers to rule guidelines for labels;
- teachers should drill students on spellings so as to improve on their spelling of technical terms;
- students should be taught how to answer adaptation questions;
- students should write their answers themselves without external help;
- Chief Examiners' Report should be made available to students and compulsory for teachers to read;
- teachers should attend seminars and workshops often;
- teachers should be encouraged to attend WAEC coordination and marking exercise.



Biology Paper 2 WASSCE (SC) 2019

Subject Home 1 2 3 4 6

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General Comments
Weakness/Remedies
Candidates' Strength

Candidates' Weaknesses and Suggested Remedies

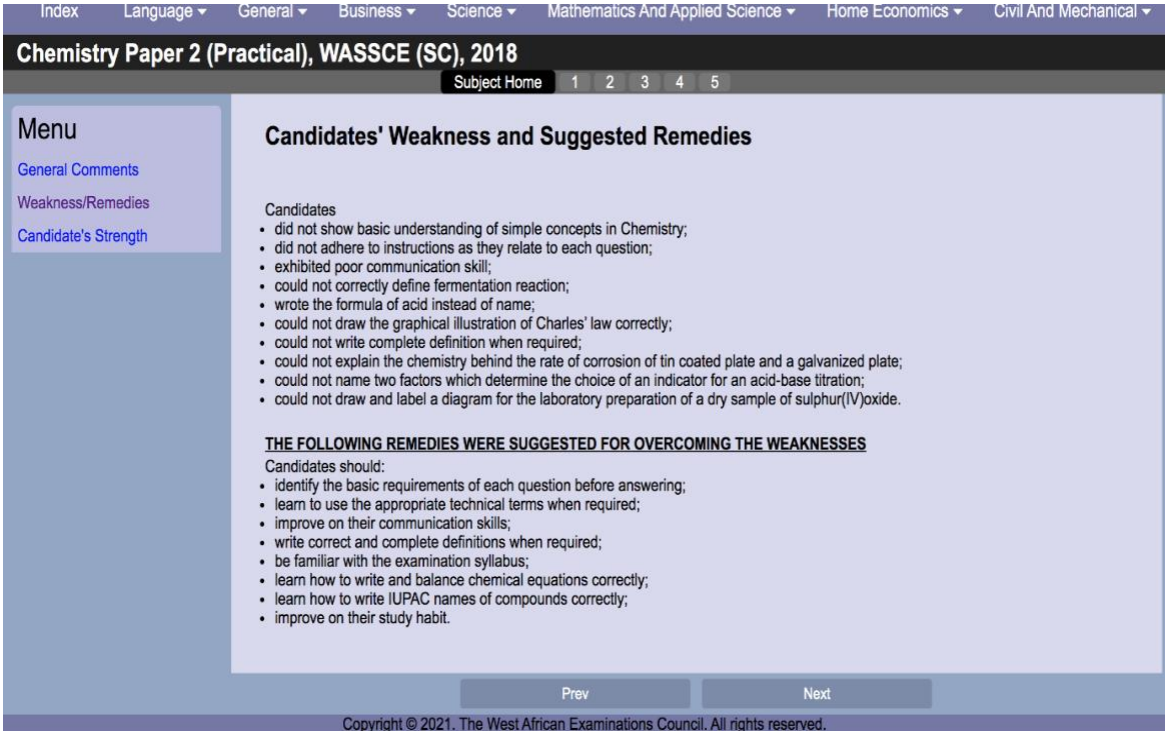
The observed weaknesses of the candidates include:

- poor expression in questions requiring explanation;
- poor drawings of diagrams;
- poor performance in questions that require application of knowledge;
- not giving a title to the diagram;
- inability to label the diagram drawn;
- inability to spell technical terms correctly;
- inability to answer questions that require corresponding answers correctly;
- inability to explain the reason why a Rhesus negative woman married to a Rhesus positive man might lose her second pregnancy.
- poor grasp of Genetics;
- inability to cross the genetics question properly;
- not putting 'X' as a sign for crossing in question 4;
- inability to answer questions on evolution properly;
- inability to explain the importance of lightning, Nitrosomonas and Azotobacter in question 6 (a).

The following remedies were proffered to overcome the weaknesses:

- Teachers should teach students the rules guiding drawing of biological diagrams;
- Teachers should be encouraged to attend WAEC coordination;
- Teachers should be engaged in seminars and several trainings to aid their teaching;
- Students should study the correct spellings of technical terms;
- Students should endeavour to write legibly;
- Teachers should lay emphasis on genetics and the importance of the cross sign when answering the questions on genetic crossing;
- Evolution topics should be taught to students
- Students and teachers should use standard text books;
- Teachers and students should cover the syllabus before putting in for the examinations;
- Teachers and students should endeavour to use Chief Examiners' Reports to study.

Next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General Comments
Weakness/Remedies
Candidate's Strength
Candidates' Weakness and Suggested Remedies
Candidates
did not show basic understanding of simple concepts in Chemistry;
did not adhere to instructions as they relate to each question;
exhibited poor communication skill;
could not correctly define fermentation reaction;
wrote the formula of acid instead of name;
could not draw the graphical illustration of Charles' law correctly;
could not write complete definition when required;
could not explain the chemistry behind the rate of corrosion of tin coated plate and a galvanized plate;
could not name two factors which determine the choice of an indicator for an acid-base titration;
could not draw and label a diagram for the laboratory preparation of a dry sample of sulphur(IV)oxide.
THE FOLLOWING REMEDIES WERE SUGGESTED FOR OVERCOMING THE WEAKNESSES
Candidates should:
identify the basic requirements of each question before answering;
learn to use the appropriate technical terms when required;
improve on their communication skills;
write correct and complete definitions when required;
be familiar with the examination syllabus;
learn how to write and balance chemical equations correctly;
learn how to write IUPAC names of compounds correctly;
improve on their study habit.
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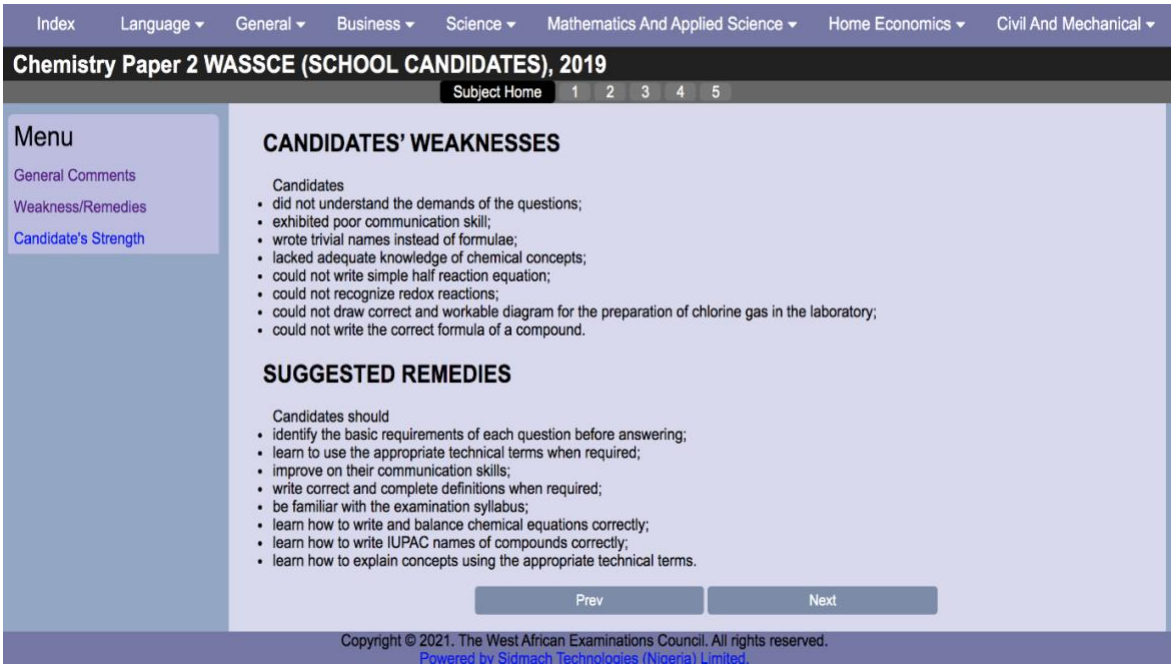
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Chemistry Paper 2 WASSCE (SCHOOL CANDIDATES), 2019
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General Comments
Weakness/Remedies
Candidate's Strength
CANDIDATES' WEAKNESSES
Candidates
did not understand the demands of the questions;
exhibited poor communication skill;
wrote trivial names instead of formulae;
lacked adequate knowledge of chemical concepts;
could not write simple half reaction equation;
could not recognize redox reactions;
could not draw correct and workable diagram for the preparation of chlorine gas in the laboratory;
could not write the correct formula of a compound.
SUGGESTED REMEDIES
Candidates should
identify the basic requirements of each question before answering;
learn to use the appropriate technical terms when required;
improve on their communication skills;
write correct and complete definitions when required;
be familiar with the examination syllabus;
learn how to write and balance chemical equations correctly;
learn how to write IUPAC names of compounds correctly;
learn how to explain concepts using the appropriate technical terms.
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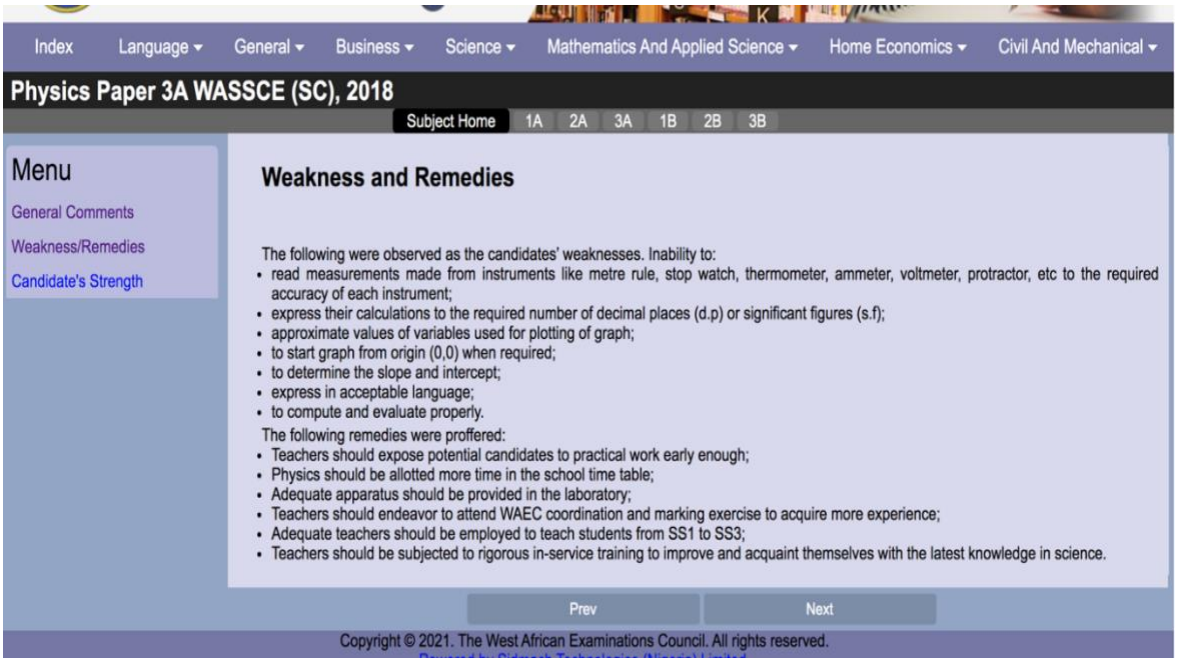
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General Comments
Weakness/Remedies
Candidate's Strength
Weakness and Remedies
The following were observed as the candidates' weaknesses. Inability to:
read measurements made from instruments like metre rule, stop watch, thermometer, ammeter, voltmeter, protractor, etc to the required accuracy of each instrument;
express their calculations to the required number of decimal places (d.p) or significant figures (s.f);
approximate values of variables used for plotting of graph;
to start graph from origin (0,0) when required;
to determine the slope and intercept;
express in acceptable language;
to compute and evaluate properly.
The following remedies were proffered:
Teachers should expose potential candidates to practical work early enough;
Physics should be allotted more time in the school time table;
Adequate apparatus should be provided in the laboratory;
Teachers should endeavor to attend WAEC coordination and marking exercise to acquire more experience;
Adequate teachers should be employed to teach students from SS1 to SS3;
Teachers should be subjected to rigorous in-service training to improve and acquaint themselves with the latest knowledge in science.
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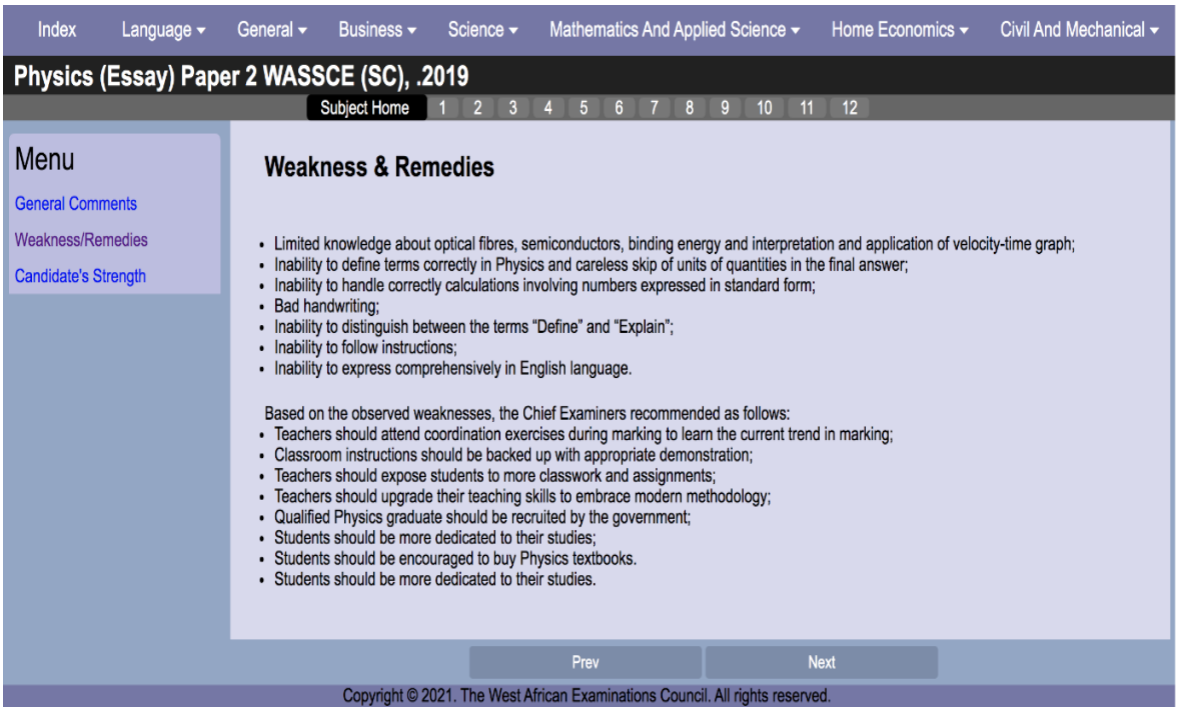
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Limited knowledge about optical fibres, semiconductors, binding energy and interpretation and application of velocity-time graph;
Inability to define terms correctly in Physics and careless skip of units of quantities in the final answer;
Inability to handle correctly calculations involving numbers expressed in standard form;
Bad handwriting;
Inability to distinguish between the terms "Define" and "Explain";
Inability to follow instructions;
Inability to express comprehensively in English language.
Based on the observed weaknesses, the Chief Examiners recommended as follows:
Teachers should attend coordination exercises during marking to learn the current trend in marking;
Classroom instructions should be backed up with appropriate demonstration;
Teachers should expose students to more classwork and assignments;
Teachers should upgrade their teaching skills to embrace modern methodology;
Qualified Physics graduate should be recruited by the government;
Students should be more dedicated to their studies;
Students should be encouraged to buy Physics textbooks.
Students should be more dedicated to their studies.
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Appendix C: The Literacy Audit

[redacted] SCHOOLS LITERACY AUDIT
2018/2019 SESSION

Executive Summary

Overview
A committee was set up to conduct the Literacy Audit across the schools, with selected teacher leaders from the Junior School auditing the Senior School and selected teacher leaders from the Senior School auditing the Junior School. A six-week time line was set in Term 1, however, the audit did not begin until Week 2, Term 2.

Limitations
The audit was conducted primarily in KS2 and KS3, with lessons and notebooks in KS4 reviewed as well. In KS2, lessons and books were reviewed across year groups and departments via random sampling, to ensure that all subjects areas were covered. In KS3, the departments with the Core Subjects were reviewed: English, Mathematics, Science and Humanities.
Unfortunately, the committee was unable to review the whole school within that time frame due to timetable limitations and competing deadlines.

Findings
The data were codified and common trends have been listed in this summary to provide feedback, guidance and targets for improvement across the school.

Senior School Trends

1. Visible evidence of expectations
   - Evidence of subject specific vocabulary was visible and audible; Key vocabulary was displayed on PPT.
   - Some students and teachers used key vocabulary in their commentary; Most interactions were respectful and comments were thoughtful.
   - Examples of good questioning which facilitated good discussion amongst the students seen in some cases.
   - Mark schemes/paragraphing structure visible in some cases and were used by the students for peer assessment.
   - Available texts (including word problems) were read and discussed.
   - Some students were asked to read paragraphs/texts/problems/own writing aloud.
   - Students also read texts and researched (from books and computers) independently; some texts were differentiated.
   - Minimal evidence of teacher assessment (TA), peer assessment (PA) and self-assessment (SA) which included WWW/EBI.

2. Areas for improvement
   - Students consistent use of subject specific key vocabulary in discussions, responses to questions (verbally and in writing); teachers need to model how to use this effectively.
   - Reading for inference (especially in all subjects other than English) – consistently phrase questions to promote high order thinking in discussions; consistently provide differentiated texts and discuss them during lessons (small group/whole group session).
   - Extended writing not visible in the Sciences; for improved IGSCE essays. This is an urgent area for improvement.
   - Neat and legible handwriting – must be consistently required and reinforced; this includes the teachers' handwriting.
   - Marking and target setting using WWW/EBI – for TA, PA and SA. This was highly inconsistent and is another urgent area for improvement.
   - Consistently include SPAG expectations in targets set in all subject areas such that these are in place before KS4 external examinations.

- Cross-curricular links – consistently maximize opportunities to promote this in discussions and in written responses.
- Consistently phrase verbal feedback to students positively; this models the expectations such that PA is also phrased positively and interactions remain respectful.

Junior School Trends

1. Visible evidence of expectations
   - Evidence of subject specific vocabulary was visible and audible; Key vocabulary was displayed on board, walls.
   - Most students and teachers used key vocabulary in their commentary; Most interactions were respectful and comments were thoughtful.
   - Examples of good questioning which facilitated good discussion amongst the students seen in some cases; some questions promoted cross-curricular links.
   - Success criteria visible on the board; also discussed with students in most cases.
   - Available texts (including word problems) were read and discussed; differentiated tests (questions) visible in most cases. Students also read texts and researched (from books and computers) independently.
   - Some students were asked to read paragraphs/texts/problems/own writing aloud.
   - Extended writing was visible in Topic lessons.
   - Strong evidence of teacher assessment (TA), peer assessment (PA) and self-assessment (SA) which included WWW/EBI.

2. Areas for improvement
   - LA students consistent use of key vocabulary in discussions, responses to questions (verbally and in writing); teachers and assistants need to reinforce this.
   - Reading for inference (especially in subjects other than English) – consistently phrase questions to promote high order thinking in discussions.
   - Short writing not very effective in Science; strategies taught in Topic need to be connected to Science lessons more deliberately.
   - Neat and legible handwriting – must be consistently required and reinforced; this includes the teachers' handwriting.
   - Consistent reference to cross-curricular links – maximizing opportunities to promote this.
   - Consistently include SPAG expectations in targets set in all subject areas.

Recommendations

It is the recommendation of the committee that:

- Expectations for Literacy levels across the school should be reinforced on a termly basis. These should form part of consistent peer observations.
- Teachers should be supported to develop improved Literacy skills (short writing, extended writing and reading for inference) such that they can promote these easily during lessons.
- An annual Literacy audit should be done within Year Groups and departments, by Middle Leaders, in Autumn Term II.

Available Supporting Documentation

- All audit pro formas used by teachers
- Pictures/print outs from student notebooks and textbooks

Report Prepared by: M[redacted]
18/01/2019 [redacted]

Appendix D: Interview Protocol

Introduction

Thank you very much for your time and for agreeing to be a part of my research study. I appreciate your expertise as you are the professional in your classroom and your perspectives will be valuable contributions to the study. So thank you so, so much.

I have to state, as a reminder, that all the information you provide is confidential. It is in no way connected to your school district. I need to record this interview so that I can transcribe it later; I hope that is okay? I will save the transcript in a password protected folder which I alone will have access to. I'm transcribing all the interviews, so I can identify any commonalities and trends and see what I can learn from you.

So, before we start the interview, I would like to know a little more about you, if that okay? Tell me a little bit about yourself, whatever you are comfortable sharing.

Thank you for sharing. Our interview today is focused so we will be taking about literacy strategies that are integrated into science lessons. I understand that you might or might not have had any specific training regarding embedding literacy across the curriculum. The literacy strategies we will discuss are based on the research I have done as part of my literature review but, please feel free to interrupt, add more information to a question or a previous question as we go through the interview.

Opening Questions

1. How long have you been teaching?
2. What are your thoughts about the expectation that every teacher is a teacher of English?
3. How would you describe your personal comfort level with using English for academic purposes?

Part I – Content Area Literacy

4. What reading are students expected to do in your science lessons?
    a. Could you share examples of reading skills you have taught in your lessons?
    b. Could you please provide an example of how you guide students through opportunities to develop vocabulary knowledge?
    c. Could you share examples of any reading skills you are aware of, but you have had problems with teaching in your lessons?
    d. What are your thoughts about adapting your lessons to the challenges your students encounter as they engage with texts in your science lessons?
    e. What other information would you like to add about teaching reading skills in your science lessons?

5. What writing are your students expected to do in your science lessons?
    a. Could you share examples of writing skills you have taught in your lessons?
    b. Could you please provide an example of how you guide students through opportunities to develop their writing?
    c. Could you share examples of writing skills you are aware of, but you have had problems with teaching in your lessons?

d. What other information would you like to add about teaching writing skills in your science lessons?

6. What are your thoughts about teaching listening skills in your science lessons?
    a. Could you share examples of listening skills you have taught in your lessons?
    b. Could you share examples of listening skills you are aware of, but you have had problems with teaching in your lessons?
    c. What are your thoughts about adapting your lessons to your students' linguistic differences?
    d. What are your thoughts about adapting your lessons to your students' unique experiences?
    e. Could you share an example of how you plan differentiated lessons to promote student collaboration?
    f. What other information would you like to add about teaching listening skills in your science lessons?

Part II – Using online sources to develop students' literacy

7. What are your thoughts about using online sources to develop students' literacy skills in science lessons?
    a. Could you share examples of any online sources you have used?
    b. Could you describe any problems you have with including online sources?
8. What other information would you like to add about using online sources to develop students' literacy skills in science lessons?

Part III – Impact of teachers

9. What are your thoughts about how you currently plan your science lessons based on the expectation that literacy should be integrated into them?
    a. Could you please describe any problems or barriers you have had with planning these integrated lessons?
10. What other information would you like to add about planning these integrated lessons?

Part IV – Professional development

11. What are your thoughts about professional development with regard to teaching literacy in science lessons?
    a. Could you please provide an example of any specific training you have had with regard to teaching literacy?
    b. Could you please describe any problems or barriers you have accessing training with regard to teaching literacy?
12. What other information would like to add about professional development with regard to teaching literacy in science lessons?

13. Are there any other thoughts about integrating literacy into science lessons that you would like to add as we conclude?

Thank you very much for sharing your perspectives. I truly appreciate your participation. I will be able to share access to the interview transcript and audio file if you are interested in having those for your personal records. The data will remain confidential. I will analyze the data from all the interviews and share the results with the stakeholders at the conclusion of the study. Do you have any final questions or concerns as we close?

Appendix E: Sample Interview Transcript With Codes

J: Thank you so much Ms V for participating in this research study. I really appreciate your time, I appreciate the fact that you're a busy professional and practitioner and yet you're still making out the time to support educational research. So thank you again for that, I appreciate it.

V: Thank you for having me.

J: By way of reminder, I am recording this interview just to be able to get the audio file so that when I review and transcribe the content I won't be making any mistakes. All the information you provide is confidential and will not be connected directly to your specific school but will be used in conjunction with other individuals from across the district so that the data is confidential.

V: That's fine

J: Perfect, just to clarify again, how long have you been teaching science in general?

V: 21 years

4-1 Experience teachi...

J: Wow that's well over a decade, so you do have a lot of experience under your belt.

V: I'll say yes, still learning, picking up more experiences every day. Every day just presents something new.

J: That's an interesting perspective. Speaking of something new, there are expectations that every teacher should be a teacher of English. So what are your thoughts about that expectation, that every teacher should be a teacher of English?

V: Yes, I totally agree, especially if you're teaching using English language or English is the means of communication in the classroom, whether you're doing it in writing or it's verbal form, whichever way you're doing presentations; everything is actually going to be in English.

So that sentence or rather, that question is really apt because if you're going to communicate with children, actually communicate with them, they should be able to do same with you. So the rudiments of proper communication, the basics about grammar, structure, and vocabulary should be built into the lesson, for them to actually understand and be able to apply these skills up from the classroom.

4-2 So that sentence or ... Disctrict/Admin e... Teachers'pedagog... Use of written an...

Definitely, it's important that every teacher in English is a teacher of literacy. So like those who are teaching French which still has something to do with literacy because even though you're teaching French and Spanish *(inaudible due to poor connectivity).*

J: Okay, Brilliant it sounds like your comfort level would teach using English for academic purposes is high.

I think my internet has glitched again so if you don't mind, I will turn off my video so that the audio the quality of the audio improves.

So from what you've said it sounds like you're very comfortable or it sounds like your personal comfort level with using English for academic purposes is high because you're talking about grammar and using grammar skills in science. Would that be a correct description of your comfort level of using English?

V: Yes

J: Brilliant, so in terms of teaching reading skills in your science lessons, any thoughts about that expectation?

V: It's really key for me. Initially, I wasn't so into it but after a while, when I started taking exam classes, working with Year 9 and 11, I found out that it was something that actually stood out when children are answering questions. I sensed, okay, this child doesn't have the richness of the vocabulary that I want. They're unable to decode information like I want it; their comprehension skills are not very good because we actually have texts they have to read, they have to interpret, they have to apply, they have to be able to develop a piece of writing, answer a question… I'm like, something is fundamentally wrong. These kids aren't able to apply, those basic skills.

4-3 I found out that it w... Key vocabulary Personal reflective... Teachers' passion ... Teachers'pedagog...

That was when I began to take it more seriously and put in a bit of structure, guidance for them to be able to use, those skills in science lessons. So it's really key for us in science because everything basically is about communication and if the children cannot communicate and apply and you see the value you want in what they've written, it makes it absolutely impossible for them to, enjoy the lesson and get the full experience of the content you're teaching. So it's really a big one for science especially because Science has so many words *(internet glitch so words are inaudible)* I can give you an example. In the science paper, they're asked a question and they wouldn't actually start a proper introduction to the response they're able to give; they're unable to structure their points, martial out those points properly and have a proper ending, so you see those lapses. Some kids can't even give you more than two or three sentences because they cannot develop a piece of writing based on the aspect of the topic you're asking from so it's really a problem for them. In a five-mark question, they write one line and it's over. They can't do much so, you know, so I began to take it more seriously.

4-4 Yes, I can give you an ex... Use of rubrics and... Writing strategy - ...

J: Wow, so how do you scaffold that writing process for them, can you share any examples of the specific writing skills or strategies you use to help them extend their writing

V: So for one, first we do baseline in my school. So I try to find out okay, what are the skills they already have? How are they with the decoding words? How fluent are they with, making simple sentences?
So sometimes I make up sentence starters. If I have, a practical lesson, I'll give them sentence starters so they use it to develop their reports. Of course I'm giving guidance on how to write a proper report, they've seen models, samples, so they follow the same model, like a scaffold. Okay, this is what I expect from you at this point; how you're going to write?

4-5 So ... Differentiation
4-6 So sometimes ... Writing strategy - ... Writing strategy - ...

Then we have proper evaluation rubrics. We give them rubrics, like a guidance or in English, we call it a writing frame. So they have introduction, you have your body and you have an ending. For some children you actually help them break out their points using spider diagrams. So have a spider diagram, write out your points, things you already know about, whatever they're asking about then

4-7 The... Use of rubrics and...
4-8 For ... Visual or graphic ... Writing strategy - ...

think, how do I start up this piece of writing? An introduction, then how do I develop the points based on what I've written up and how do I end?

So we actually go that really prescriptive, to help them, do such. It's a short piece of writing and then we go into long essays and they grow like that and it really gets better with time. They don't get it the first time because they're like, Ms....., this is a science lesson; why am I having to write a seven-line summary? I'm like, well you have to learn to write a four-line summary first before you can develop a seven-line summary.

J: Exactly, well that sounds very interesting. It sounds like you include very specific writing skills in your science lesson. So writing frames, I hear scaffolding, I hear trying short summaries, long summaries e.t.c. That sounds very interesting. So if I go back to the reading for a minute, you said that you get them to focus on decoding, so does that mean there's a focus on vocabulary, like specific vocabulary?

V: Yes, so we pull out some key vocabulary, we may ask them to find out the meaning of those words and then, in the context of the topic. Let's see, okay, you know the meaning of the word as an English word, let's see how it falls in the science context and once they know the meaning then it's easy for them to apply it in science context.

Okay, like photosynthesis; first we break it up - which words are you familiar with? I have photo which means light; synthesis in English which means to create, so already the child has an idea oh I'm creating something using light. So once they have that background understanding of what the word photosynthesis is, then I'll build it into the definition for what photosynthesis is. It flows easily for them, it simply means creating something with lights that you can feed in the remaining creating food *(internet glitch)* glucose so that's how you just make it very simplified, you know, for them. You can even try synonyms, simpler words that mean almost the same thing. Okay, classification give me an English word; the child who says 'sorting'; someone else would say 'grouping'; another child will say 'classify'. And I'm like, how are you using the same word again?

Okay, it's that what you mean by classification? So they see it first as an English word and the meaning, then bring the science context to it and it just flows. It's very helpful with decoding because once they look at the meaning, then they can get the real, when you're explaining the concept, they can understand what you're trying to say, and then you help them feedback and it just flows like that. It's not very easy, I must confess.

J: But it sounds very interesting.

V: But we just go that far and after a while they begin to even give you the keywords. They start telling you other words; oh 'sorting' another child says 'grouping', you hear some other students say 'bringing together' the child is thinking about something, I'm like, okay "why did you say bringing together?" "It's based on similarities" "oh, good, I like that word" 'bringing together - similarities'. So let's see, 'why am i grouping a set of blue circles, there's something similar'.

That child is decoding already he's moved from just grouping he's going ahead to think deeper about why I'm having to group, so it helps them just go and flow a lot easily with concepts when they know the meaning of the words, they can

4:8

4:9 They don'... — Use of summaries; Writing strategy - ...

4:10 Yes, so we pull out some key ... — Context clues; Glossary/dictionar...; Key vocabulary; Reading strategy -...; Teachers'pedagog...

4:39 You c... — Reading strategy -...

4:11 But we just go that far an... — Key vocabulary; Reading strategy -...; Speaking and liste...

now decode different aspects of learning and it brings a bit of fluency with what they do. They're fluent they can use those words when they're explaining things it just works like that but it takes a while I must confess to you.

4:12 — Challenges - time ...

J: I can, imagine it sounds like you already use clear listening skills in your lessons, where you are getting them to contribute and to listen to the contributions of others and to extend or share feedback. Can you expand on that a little bit.

V: Now the area of listening, I find that it's kind of challenging because of the… maybe, I don't know if it's the age group I handle though- teenagers. The distraction from technology, the short attention span we have these days. If you just say a word, they are rushing, and I have to say 'calm down, can you just calm down and listen.' So sometimes I think one thing that works for me is trying to just still the atmosphere, remove the distractions because sometimes the room can be distracting.

So first, I think about my displays, what do I have on my wall that could distract them and they're already thinking about something else? Okay, I think about the sitting position of the children, how close are they? How easily can I come close to them, so that it will cause them to focus and they're not moving away. So those strategies I've seen actually helps.

Prompts to work well but I've seen classroom environment basically really helps with listening. Close the doors, ensure my AC is not too loud, I tell them don't fiddle, because some of them still do that, dropping off pencils and rulers, so that the atmosphere is a bit calm. So that way, I say 'can we all just look at me' so I have them looking at least that eye contact helps me and helps them to focus.

So I think that's one thing that actually helps me but it can be difficult, because that is when one person goes *(imitate clearing of the throat) and* they all just turn *(indicating distraction with gesture)*, so I say 'fine thank you for coughing, now let's come back to the room'. *(laughing)* it's so strange.

4:13 So first, I think about my displays... — Speaking and liste...

J: Interesting, so how do you then handle.., so I hear what you've said about handling students that are easily distracted and you pay attention to your environment and that sounds very interesting. How do you handle students with the different linguistic abilities? I mean people who have English as an additional language, English as the second language you know, how do you do differentiation in your lessons?

V: Okay, now, that one can be a little tricky but I think one thing that I see is, first try to understand the child's background, where is the child coming from? Maybe it's India or a typical example the Asians, I think Indians are even better because they teach and have English. But the Asian, who we know they teach in their language, so fine, where are they coming from? Have a bit of little background check - Where is this child coming from? What has this child learned before? And then I now see how I can use examples from their own part of the world in my class. That way the child sees something familiar.

So if there is some concept, I look for a text that has to do with China and let him read something, that child will be willing to share, so can we ask…Maybe there is a Victor something, I will say, tell us about how you people plant crops in your country, he will say it the way he knows. 'In my country, we do this and

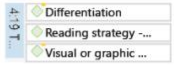
4:14 hild's background, ... — Teachers' passion ...

4:40 — EAL support; Instructional strat...

that'.. so the fact that others are listening to him, he's saying something and I try to pick out words from what he's saying, it may not be so perfectly said, but at least I can draw meaning from what he's saying.

So that's one thing that helps. First is try to get the child to be comfortable in the room to know that I am not different, just maybe the language, the way I say it may be different, or the way I hear it may be different, the way I interpret it may be different, that's one. Then another thing that works again is, I try not to use very big words in my teaching because I know those vocabulary will be really high for them. So like the 'Classification' I'll rather use 'Grouping' for that child, it's easy for that child to say 'to group something' is easier than classification, that's a big word. So look for simpler words, synonyms that will help the child. I think EAL, in the second language, scaffolding helps a lot. Give them scaffolded tasks, so you give them leads so they can help you finish a piece of writing maybe three or four line summary and there are words to help them build that sentence, but of course words that will not be as I said, big words like the other ones and they need to still put into more complex words. It's really sometimes…

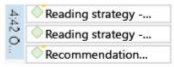
I actually have a boy right now in Year 9 nine in my school, who has that EAL issue. We found that what we're teaching, he's learnt it in his country, just that it was not in English and he's really smart. So the very first struggle I had was, getting him to actually speak up in class so we had to do flip learning for him. So I upload videos. he loves cartoons I found that he likes cartoons so I'll build cartoons of concept ahead of time so he'll watch the videos, when he comes into class, he has something to say. I'll give him the words, 'go and find out the meaning of this Victor', 'can you tell us the meaning of photosynthesis?' Okay, 'you make food with light, … I'm like wow, 'that's good'. So it gives him, a bit of confidence and he is able to contribute in the class and the others will appreciate that he's not he's not dull, it's just that he can't speak, so that flip learning approach is very helpful for them. They can read ahead, watch something and you come to the class with no matter how small a concept and then slowly, grow into it. Then their tasks, worksheets we differentiate it a lot, we put a lot of images, they can see pictures and even if they can't write three lines, they can write a few words in there, as they grow. I think that is one thing I'm trying with the boy, it's working, it's slow pace but he's getting better and now he can actually say 'hello', 'Good morning'.



J: Wow, that's amazing, amazing work, yes, to be able to get a non-english speaker to begin to use literacy skills to begin to speaking and even extend that to science that's fantastic.

Okay so, do you have any other thoughts any other ideas, anything you'd like to add about teaching, like discreetly teaching maybe reading skills or writing skills or listening skills in the science lessons, any other thing you'll suggest? You know you're a veteran teacher so any other thing you would suggest the non-veteran teachers could add.

V: One thing I think Science teachers need to incorporate into their lesson is bringing reading tasks into their lessons… you create room no matter- five ten minutes, so that children can read out a portion of, maybe there's one theory you're talking about, let them read something because, one, it develops their confidence level, it can also help you hear them read and that's when you can tell the challenges they're having with words.



We had a girl like that, she's still in my current school she was not confident enough to speak up in public because she had reading problems. When you ask her to read a text, '*I am…. I am, I am ' (imitating referenced girl)* so I'll supply the word '..going' '*okay, I'm going to school'* we'll just mouth it 'school'. So you support her and now she's reading three sentences. More so, reading task, conscious reading task in the lesson, let them read something out to the group is very, very helpful, so that is one.

Then comprehension skills, it's a big problem, it's big. I noticed that when kids are answering questions because biology particularly you have a text, you see them there's a question, they go to the picture and they're looking for the answers in the passage, that's the wrong application of your comprehensions skills. You're supposed to read the passage first, at least twice, try to highlight some key information before you go to the question but you see them read the question and they're looking for the answer in the *(inaudible)*. That really underlines some things, try to get the message in the in that text, before you go to a question so you have more information to give, you can decode easily, of course, there'll be guidance.

A lot Science Teachers will refuse and say 'no, am I a Teacher of English', but I am like, but you have to do it, it's very important. That we begin to, do it consciously in class tasks, before they go into an exam hall and they're faced with…strange information that they can't work with.

J: Fantastic, okay great. You mentioned earlier that you use videos and things to help teach keywords, basically to extend one of your student's literacy skills what other online sources, could you use? Are there any challenges you had with including these resources in your lessons? Could share a bit more?

V: Yes, one major challenge I've had is, me taking over the lesson. You know, in my bid to prompt them to say something at some point, I just go on as a teacher and I catch myself like 'no don't monopolize information, still keep prompting, keep leading', I'm checking time,
time, it's already 15 minutes, these children have not gotten this thing and I just take over and I just go on. When I have like 10 minutes, I'm like oh no, no, I thought you were trying to help them, you know trying to walk them through the process. So that's one area that I know I need to continue to work on because you just unconsciously do it, if you're not careful.

You just get a bit impatient maybe they're taking so long to catch on and I just give the meaning, and one child will say 'oh, but I actually got that meaning, and I am like, 'oh it's that what you wanted to say?' but I'd already said it.

J: Ahh, Okay, that's it, in terms of providing support for the Student, right.

V: Yes, sometimes you just carry on but you just have to consciously hold back.

But online resources I recently got one, National Literacy Trust, it is actually a web page, where you have a number of activities for secondary school children. I'm still exploring the page so you have to sign up as a member. You have some online challenges where they get to do you know maybe like a poem, or some kind of essay competition, just working with their peers from other parts of the world and they have, something like, they give them instruction, steps they have to work in that setting.

That's one I found of recent, so I'll just work on this. There are other resources but not necessarily as comprehensive as this page that I found.

J: Okay, so does this page really support you with developing the literacy skills or is this like a general resource for science?

V: It's just an additional resource, most of the resources I use, I develop myself. So sentence starters, I work with the English department to help us draw up sentence starters, then download some, you find some online rubrics in science, online for application, for evaluation for analysis, so I just adapt it to what I want, or to the age level I am dealing with. TES gives a lot of resource, so I just do a search, it just prompts you, gives you videos you can work with and I just change it and for the class I want.

4:24 It's just an addt...
- Personal reflective...
- Teachers'pedagog...
- Use of technology...

J: Okay, I hear you say that you adapt a lot of your resources, so you have the rubrics then you work with the English team and you adapt your resources, that sounds very interesting. What other suggestions, I don't know if you have any additional ones you would add to that. So in addition to adapting the resources to suit the students in your room if I hear you correctly, how else do you use those resources and what other things could science teachers do?

J: Well, I think something else is, if I'm getting your question correctly, is trying to draw ideas from other people, maybe observe another teacher to see what they're doing with their group and try to pick up some tips from them that will apply in my class, then observe other teachers who teach the same children I teach, especially the English teachers, because it's always fascinating to see how well these children are able to develop a piece of writing in English class and they come into the sciences and they're struggling. So I'm wondering how come they can't transfer the skill? How come they're able to do an essay a full page with the English Teacher and then they come into science lessons and I'm asking them to do seven-line summary and it's a struggle? So talk to English teachers maybe they can pick a topic from science and give it as an English task, maybe that would break that barrier between English and Science, so they can see that the skill can be transferred. So I think that's one thing that's really worked well.

4:25 Well, I th...
- PD (internal) - pee...
- Recommendation...

4:26 So I'm wonder...
- Collaborative lear...
- PD (internal) - pee...
- Personal reflective...
- Recommendation...

J: Oh fantastic, that's a great suggestion. So from what you're saying it does sound like you currently plan your science lessons based on the expectation that literacy should be integrated into them, so I don't know if you've had any challenges or barriers with planning these integrated lessons? Or how do you plan these lessons and what do they look like?

V: The challenge for one, is being able to cover enough content with the time I have, because, if one goes a bit deep into trying to capture literacy at all, you may end up not finishing the content as you would want it. You may drag on because you're spending more time looking at the skills and I find that oh, of all the maybe seven learning objectives I've being able to only address three because I spent more time on helping them to listen correctly, helping them to decode, helping them to pick the keywords in every piece of writing. So that's often the struggle, so sometimes I am like, should I let this go or should I focus on this? I had to actually carry on and finish the seven objectives even though I'm building it in.

4:27 T...
- Challenges - Time...

4:44 You may...
- Challenges - time ...

So with my planning, what I do is try to use class activities to contribute to the literacy part of it. In an activity I have for the day, let's say there's a poem they're supposed to write, I'm trying to use, maybe they're working on the Periodic

4:28 S...
- Challenges - time ...
- Instructional strat...
- Use of rubrics and...

Table and I want them to learn the elements, so I'll draw up the Rubrics like a guide for them, so that way I'm not spending so much time marking it but at least, I'm forcing them to use it to achieve a particular objective, so it's channeled towards an objective for that day. Then it's easy for them to work.

4:28

But it's really challenging because it pulls the lesson, it's longer because now we're making SPAG as well in Science, because the Exam Body expects them to be able to spell words correctly, their punctuation should be right, all those grammar; they're marking as well especially for Biology.

So I have to look at sentence structure I have to look at how they use their punctuations I have looked at spellings because if you misspell a word, you change the meaning. So all those things, they actually cause the lesson to drag I'm like, look just focus and carry on but I can't walk away because I know it's impact on their …the way they demonstrate the skill, particularly in the exam or even after school, wherever they find themselves.

4:29 But it's really challenging bec...
- Challenges - Time...
- Disctrict/Admin e...
- Focus on how to a...
- Teachers' passion ...
- Writing strategy - ...

J: Right, so how would you suggest teachers deal with this need to plan these integrated lessons? Because if I hear you correctly, there's a lot to include but there's rarely enough time and so you have to be creative with the use of activities to try and meet the objectives. So how would you advise or how would you suggest, the novice or the newer or less experienced teachers handle this integrated planning?

V: Well I think one thing that will help is, if the issue of Literacy is planned at the whole school level. What I mean is, it's not just individual teachers, it is going to be much more difficult if only one person is doing it. The whole department focuses on it, then when they contact the Physics teacher, there's some emphasis on it, they contact that the Chemistry Teacher he's doing the same thing, even Biology Teacher. So they pick up from different points and it makes it easier for that lesson, or that subject to address it.

4:30 Well I think one...
- Collaborative lear...
- Disctrict/Admin e...

But imagine it's the whole school level and everybody is doing this, pulling out sentence starters, they're emphasizing writing of essays and giving them guides and how to do a piece of writing, everybody's talking about punctuation and grammar, then they're hearing it everywhere, then the weaknesses are easily…they can overcome those weaknesses easily, unlike if it's just one person.

So for the new teacher now, there's a structure on ground the school is pursuing literacy as you know as a whole school thing and they've said okay, we share sentence starters. English department gives us spider diagrams samples to work with, or writing frames, so the novice teacher is more like, you're leading them by the hand so they're forced to use those tools and they flow that way.

4:31 But imagine it's the whole school...
- Disctrict/Admin e...
- PD (internal) for li...
- Recommendation...

But if it's just one person trying to do it alone, it's kind of laborious because, you can't address it alone, not one person can do it to be really effective but if it's a team effort, it makes it easier for everyone to… and the children are hearing it from every single person, then they just must learn how to do presentations right.

They go to history lesson there's a presentation and the teacher has given them the guide on how to do it, how to marshal out your points. They come into a Math lesson, there's a word problem, the Math teacher has taught them how to decode words, giving them images to work with or something and they go into

4:32 They ...
- Cross-disciplinary ...
- Disctrict/Admin e...
- Recommendation...

136 every single lesson, they're seeing the same thing it's very helpful even for the new ones to just flow in that same line. I think that's one way the Schools can
153 *(inaudible).*
137
138 J: So it sounds like there should be a school-wide approach or there should be
143 school-wide attempts to plan for literacy, across / in all subject areas.
139
140 V: Yes.
141
J: Right, okay. Is this something that is I don't know, easy to achieve, challenging to achieve? What has been your experience with achieving this kind of school-wide approach to literacy.

V: Well for one, starting with the leaders, if the leaders embrace the fact that literacy is key for the school, that is already 50 percent done. Because if the
147 leaders of the school agree that we have a literacy issue here in the school, not
148 just because it's peculiar to our school, but it's something that cuts across all schools, then it will flow because everyone understands it's a school goal.

It's one of the goals as a school, to develop literacy skills of our children, their reading skills, their comprehension skills, their listening skills, all those things, then departments should be forced to include it as part of their targets and when they're planning they're forced to plan for it and they are like checklists for them
149 to monitor how people are doing it in class and not just necessarily to say oh
150 you're not doing it well, but you've done this so far, can you try this and that way it just works better.

151 But if it's not coming, as the direction is not coming from the leaders to the teachers, some people will not just do it. Some teachers will say, 'oh I think it's a need but some will be like, it's not my problem it's the English department, that's their problem' because some still have the mindset that literacy issues is English department's issue, they don't agree that it's a whole school…and underpins everything they do.

J: So in view of this, what are your thoughts about professional development, with regard to this whole idea of teaching literacy in Science.

V: Well I've not seen much I don't know if it's me I've not seen much of trainings about it. I understand they have some, I know Cambridge does some training, like they do examiner sessions, okay, basic vocabulary, developing writing, some exam bodies have small workshops they do for it and then Youtube has so many videos that one can watch on their own but I'm not sure I have actually seen any Workshop that focuses on..I know AISEN did one once, there was one training, AISEN had one once, it was in either Ghana or so. Such, these school bodies or school professional organizations when they have in those meetings short sessions, I think they could include. But a particular training by some person, no I haven't come across it.

J: Okay, so how about you as a person I know you've talked about and just for clarification, AISA is the Association of International Schools in Africa and they organize trainings for their teachers. But have you attended any specific training that like directly connected to teaching literacy in science?

V: Yes I have attended one, by AISEN and there was online, I stumbled on one and I guess that was when I began take it more seriously and I also began to also

4:32

4:45 Well for... — Unclear expectati...

4:33 It's one of the goals as a school, to deve... — Disctrict/Admin e... — Recommendation...

4:34 — PD (external) for li...

4:35 I know Cambridge doe... — PD (external) for li... — PD (internal) for li...

4:36 — PD (external) for li... — Recommendation...

156 talk, teach other people about it, any opportunity I have with Colleagues, I emphasize that, please, Teachers, you see this one aspect we need to look into,
170 whether you believe it or not, everything you're doing can only be possible if
165 that aspect is addressed. So when I have sessions with Colleagues, I try to chip it in, little trainings here and there done for people particularly for science because
168 maybe that's my field. But I've attended two sessions like that.
157
158 J: I like that, okay, okay but from what I hear you say, it seems that, practitioners
175 need to make these trainings more available or more accessible.
159
160 V: Yes
161
162 J: Which one is it now, is it more available or more accessible? Or which would
176 you say it is?
163

V: More available, accessibility will be easier if it's less because if it's online and
178 they put you through some of these school organizations, or you find on
179 Linkedin all these kind of platforms, people will definitely sign up for them. If you bring it even to the school to the doorstep of the school, run a training, school-wide you know just maybe statewide, regions or districts, it's very helpful because some people some teachers already are conscious that there is a problem in this aspect but it's not a front burner for them because I think 'oh I have content to teach but they are not very conscious of the impact that literacy problem has on their teaching and children's learning.

J: Amazing, amazing thank you so much and these are very interesting thoughts, very insightful and considering the fact that you've had so many years, over two decades of experience, it's great to hear of the things you're doing, the challenges even you as a veteran teacher are facing and the things you're doing to support your younger peers or your Colleagues.
Are there any other thoughts about integrating literacy into science lessons that you would like to share, as we conclude.

V: I think none for now, what I'll just say is, let's just do it as in a matter of urgency, let's just do it now, let's start any way we can, there's necessarily not any structure to it, just start. If you can start with the keywords, getting them to understand the meaning of the keywords, if you can work on their listening skills,…let's just start somewhere and just keep pushing and keep pushing, until the kids get better get better

J: Okay, so start with keywords, promote better listening skills and vocabulary in the lessons.

V: Yes, reading too.

J: Okay thank you so much for sharing your perspectives I'm sorry that my internet connection is so poor and I had to turn off my video but I really appreciate your participation, your experience is amazing, so I will, like I said before, I will share the interview transcript so you can see to make sure I've captured the perspectives very well.

Thank you, thank you, thank you. Do you have any final questions concerns or anything to ask as we wrap this up?

V: No, none now, if I have any, definitely I will send it to you.

J: Okay, thank you, thank you very much.

4:36

4:37 More available, accessi... — Disctrict/Admin e... — Personal dispositi... — Recommendation...

4:38 what I'll just say is, let'... — PD (internal) for li... — Recommendation...

Appendix F: Personal Notes From Teacher 9's Interview

How do you plan these lessons?

- Barriers are time; mood of the students in the room; the lesson plans can dramatically change by a set of tired and demotivated students.
- He's interested in the students' lives, gets into their world and this makes it easy to connect the learning to their real lives. Between Nikky M and Cardi B who is better? Then the argument is linked to evaluation. Ronaldo and Messi debate. This is a type of looking at 2 people to evaluate/ compare and contrast.
- This switches the atmosphere in the class
- Trends in periodic table; links to trends on social media such as the man who had 3 kids from a woman and DNA tests showed that the children were not from the man.
- Implies the need to be flexible and differentiate the lessons.

How do you address students with linguistic challenges?

- Repetition of words
- Separation into work groups

Online sources

- Videos: downloaded; questions included (comprehension skills)
- Google classrooms;
- Implied Self-directed learning strategies
- Materials used after the class

Final comments

- Important that teachers teach the whole child to communicate effectively.
- Uses a lot of feedback when communicating with the students and gives them a lot of feedback to prepare them for the brighter future/the larger world that the students are going to be part of – passionate!
- Teachers should teach students that there are multiple ways to solve problems.
- Teachers should go the extra mile to support their students.

Appendix G: Code Tree for Teaching Strategies

	Teaching Strategies			
	Instructional Strategies	**Reading Strategies**	**Writing Strategies**	**Learning Strategies and resources**
Teacher 1	Big questions Connect to students' prior knowledge Practical/Kinesthetic activities Student peer assessment Student peer coaching	Key vocabulary Check for understanding Flipped learning Inference and decoding Reflective practice – student self-assessment Spelling focus – linked to key vocabulary	Focus on exam questions Marking for SPAG (spelling and grammar) Outlines and drafts	Collaborative learning Differentiation Digital texts Meaningful feedback Use of rubrics and mark schemes Use of technology in lessons
Teacher 2	Big questions Students independent research	Key vocabulary Check for understanding Guided reading (aloud) Flipped learning Read questions multiple times Silent guided reading Syllabification/etymology Reflective practice – student self-assessment	Focus on exam questions Marking for SPAG (spelling and grammar) Outlines and drafts Use of summaries	Differentiation Digital device Glossary/dictionary/encyclopedia/thesaurus Meaningful feedback Use of technology in lessons
Teacher 3	Flexible grouping Practical/Kinesthetic activities Student peer coaching	Context clues Key vocabulary Check for understanding Guided reading (aloud) Inference and decoding	Focus on exam questions Outlines and drafts Use writing samples as models	Collaborative learning Differentiation Digital texts Glossary/dictionary/encyclopedia/thesaurus Meaningful feedback Use of rubrics and mark schemes Use of technology in lessons
Teacher 4	Big questions Practical/Kinesthetic activities	Context clues Key vocabulary Check for understanding Flipped learning Images to facilitate understanding Read questions multiple times Syllabification/etymology	Focus on exam questions Outlines and drafts Use of summaries	Differentiation Use of technology in lessons
Teacher 5	Connect to students' prior knowledge	Context clues Key vocabulary Check for understanding	Focus on exam questions Marking for SPAG (spelling and grammar)	Collaborative learning Differentiation Digital texts

	Teaching Strategies			
	Instructional Strategies	**Reading Strategies**	**Writing Strategies**	**Learning Strategies and resources**
	Practical/Kinesthetic activities	Guided reading (aloud) Flipped learning Images to facilitate understanding Inference and decoding Read questions multiple times Silent guided reading Syllabification/etymology	Outlines and drafts Use of summaries Use writing samples as models Visual or graphic organizer	Glossary/dictionary/encyclopedia/thesaurus Use of rubrics and mark schemes Use of technology in lessons
Teacher 6	Student peer assessment	Context clues Key vocabulary Guided reading (aloud) Inference and decoding Reflective practice – student self-assessment	Focus on exam questions Marking for SPAG (spelling and grammar) Outlines and drafts Visual or graphic organizer	Collaborative learning Differentiation Glossary/dictionary/encyclopedia/thesaurus Meaningful feedback Meaningful feedback from student to teacher Use of rubrics and mark schemes Use of technology in lessons
Teacher 7	Big questions Mnemonics	Context clues Key vocabulary Check for understanding Spelling focus – linked to key vocabulary	Focus on exam questions Marking for SPAG (spelling and grammar) Outlines and drafts Use of summaries	Differentiation Meaningful feedback Meaningful feedback from student to teacher Use of technology in lessons
Teacher 8	Flexible grouping Practical/Kinesthetic activities Student peer coaching Students independent research	Context clues Key vocabulary Check for understanding Guided reading (aloud) Flipped learning Spelling focus – linked to key vocabulary	Marking for SPAG (spelling and grammar) Use of summaries	Collaborative learning Differentiation Digital device Digital texts Glossary/dictionary/encyclopedia/thesaurus Meaningful feedback Use of technology in lessons
Teacher 9	Student peer coaching Students independent research	Context clues Key vocabulary Check for understanding Guided reading (aloud) Inference and decoding	Link to key vocabulary Use of summaries	Collaborative learning Meaningful feedback Use of rubrics and mark schemes

Appendix H: Code Tree for Other Themes

	Professional Development	Teacher motivation to meet requirements	The classroom environment	Challenges	Recommendations for improvement
Teacher 1	PD (external) for literacy instruction – done Personal disposition to CPD Personal disposition to Use of English Personal reflective practices – teachers Planning for literacy inclusion	Cross-disciplinary collaboration District/Admin expectations and recommendations Experience teaching science – 10 to 15 years Focus on how to answer exam questions Personal disposition to CPD Personal disposition to Use of English Personal reflective practices – teachers Use of written and verbal literacy skills	Classroom management Collaborative learning Differentiation Digital texts Speaking and listening skills Use of technology in lessons	Personal disposition to CPD Personal disposition to Use of English Planning for literacy inclusion PD (external) for literacy instruction – not available PD (internal) – for literacy instruction – not available Teachers' pedagogical knowledge of teaching literacy	Cross-disciplinary collaboration District/Admin expectations and recommendations Personal disposition to Use of English PD (external) for literacy instruction PD (internal) for literacy instruction Researcher observation - Missed opportunity for teaching literacy skills
Teacher 2	Collaborative Planning PD (internal) – Peer observations PD (internal) – for Diction Personal disposition to CPD Personal reflective practices – teachers Planning for literacy inclusion Specialist teacher planning	Collaborative planning Cross-disciplinary collaboration Diction – teacher's accent and the impact on understanding District/Admin expectations and recommendations English teachers' focus, not science teachers Experience teaching science – 16 years and above Focus on how to answer exam questions Personal disposition to CPD Personal reflective practices – teachers Teachers' background – level of English	Classroom management Differentiation Digital device Glossary/dictionary/ encyclopedia/thesaurus Speaking and listening skills Use of technology in lessons	EAL support English teachers' focus, not science teachers Personal disposition to CPD Planning for literacy inclusion PD (internal) – for literacy instruction – not available Students' prior learning Teachers' background – level of English Teachers' pedagogical knowledge of teaching literacy	Cross-disciplinary collaboration District/Admin expectations and recommendations PD (internal) for literacy instruction Researcher observation - Missed opportunity for teaching literacy skills

	Professional Development	Teacher motivation to meet requirements	The classroom environment	Challenges	Recommendations for improvement
		Teachers' background – secondary school English lessons Use of written and verbal literacy skills			
Teacher 3	PD (internal) for literacy instruction – done Personal reflective practices – teachers	District/Admin expectations and recommendations English teachers' focus, not science teachers Experience teaching science – 10 to 15 years Focus on how to answer exam questions Motivating students to improve Personal reflective practices – teachers Use of written and verbal literacy skills	Collaborative learning Differentiation Digital texts Glossary/dictionary/ encyclopedia/thesaurus Speaking and listening skills Use of technology in lessons	English teachers' focus, not science teachers Identifying student ability levels PD (internal) – for literacy instruction – not available Teachers' pedagogical knowledge of teaching literacy Time for planning differentiated lessons	District/Admin expectations and recommendations PD (internal) for literacy instruction Researcher observation - Missed opportunity for teaching literacy skills
Teacher 4	Personal disposition to Use of English Personal reflective practices – teachers Planning for literacy inclusion	District/Admin expectations and recommendations Experience teaching science – 16 years and above Focus on how to answer exam questions Personal disposition to Use of English Personal reflective practices – teachers Teachers' passion for educating young people Use of written and verbal literacy skills	Speaking and listening skills Use of technology in lessons	Personal disposition to Use of English Planning for literacy inclusion PD (external) for literacy instruction – not available PD (internal) – for literacy instruction – not available Teachers' pedagogical knowledge of teaching literacy Time management in lessons	District/Admin expectations and recommendations Personal disposition to Use of English PD (external) for literacy instruction
Teacher 5	PD (external) for literacy instruction – done	Cross-disciplinary collaboration	Collaborative learning Differentiation Digital texts	Direct teacher input EAL support	Cross-disciplinary collaboration

	Professional Development	Teacher motivation to meet requirements	The classroom environment	Challenges	Recommendations for improvement
	PD (internal) – Peer observations Personal disposition to CPD Personal reflective practices – teachers	District/Admin expectations and recommendations English teachers' focus, not science teachers Experience teaching science – 16 years and above Focus on how to answer exam questions Personal disposition to CPD Personal reflective practices – teachers Teachers' passion for educating young people Use of written and verbal literacy skills	Glossary/dictionary/ encyclopedia/thesaurus Speaking and listening skills Use of technology in lessons Visual or graphic organizer	English teachers' focus, not science teachers Personal disposition to CPD PD (external) for literacy instruction – not available PD (internal) – for literacy instruction – not available Teachers' pedagogical knowledge of teaching literacy Time management in lessons Time to learn the literacy skills Unclear expectations of Admin	District/Admin expectations and recommendations PD (internal) for literacy instruction Unclear expectations from Admin
Teacher 6	LAC training PD (internal) – for Diction Personal disposition to CPD Personal disposition to Use of English Personal reflective practices – teachers Planning for literacy inclusion	Cross-disciplinary collaboration District/Admin expectations and recommendations English teachers' focus, not science teachers Experience teaching science – 10 to 15 years Focus on how to answer exam questions Personal disposition to CPD Personal disposition to Use of English Personal reflective practices – teachers Teachers' background – level of English	Classroom management Collaborative learning Differentiation Glossary/dictionary/ encyclopedia/thesaurus Speaking and listening skills Use of technology in lessons Visual or graphic organizer	EAL support English teachers' focus, not science teachers Personal disposition to CPD Personal disposition to Use of English Planning for literacy inclusion PD (external) for literacy instruction – not available Teachers' background – level of English Teachers' pedagogical knowledge of teaching literacy Time for planning different activities Time for planning differentiated lessons	Cross-disciplinary collaboration District/Admin expectations and recommendations Personal disposition to Use of English PD (external) for literacy instruction PD (internal) for literacy instruction Researcher observation - Missed opportunity for teaching literacy skills

	Professional Development	Teacher motivation to meet requirements	The classroom environment	Challenges	Recommendations for improvement
Teacher 7	PD (internal) for literacy instruction – done Personal disposition to Use of English	Cross-disciplinary collaboration District/Admin expectations and recommendations English teachers' focus, not science teachers Experience teaching science – 10 to 15 years Focus on how to answer exam questions Personal disposition to Use of English Teachers' background – level of English Teachers' background – secondary school English lessons Use of written and verbal literacy skills	Differentiation Speaking and listening skills Use of technology in lessons	EAL support English teachers' focus, not science teachers Personal disposition to Use of English PD (external) for literacy instruction – not available PD (internal) – for literacy instruction – not available Teachers' background – level of English Teachers' pedagogical knowledge of teaching literacy Unclear expectations of Admin	Cross-disciplinary collaboration District/Admin expectations and recommendations Personal disposition to Use of English PD (external) for literacy instruction PD (internal) for literacy instruction Researcher observation - Missed opportunity for teaching literacy skills Unclear expectations from Admin
Teacher 8	PD (internal) Differentiation for SEN PD (internal) – Peer observations Personal disposition to CPD Personal disposition to Use of English	District/Admin expectations and recommendations Experience teaching at current school – less that 5 years Experience teaching science – 5 to 9 years Personal disposition to CPD Personal disposition to Use of English Teachers' background – secondary school English lessons	Collaborative learning Differentiation Digital device Digital texts Glossary/dictionary/ encyclopedia/thesaurus Speaking and listening skills Use of technology in lessons	EAL support Personal disposition to CPD Personal disposition to Use of English PD (internal) – for literacy instruction – not available Time to learn the literacy skills	District/Admin expectations and recommendations Personal disposition to Use of English PD (external) for literacy instruction PD (internal) for literacy instruction Researcher observation - Missed opportunity for teaching literacy skills

	Professional Development	Teacher motivation to meet requirements	The classroom environment	Challenges	Recommendations for improvement
Teacher 9	PD (external) for literacy instruction – done PD (internal) Differentiation for SEN PD (internal) for literacy instruction – done Personal disposition to CPD Personal disposition to Use of English Personal reflective practices – teachers	Cross-disciplinary collaboration District/Admin expectations and recommendations Experience teaching science – 5 to 9 years Motivating students to improve Personal disposition to CPD Personal disposition to Use of English Personal reflective practices – teachers Teachers' background – level of English Teachers' passion for educating young people Use of written and verbal literacy skills	Classroom management Collaborative learning Speaking and listening skills Use of technology in lessons	Personal disposition to CPD Personal disposition to Use of English PD (internal) – for literacy instruction – not available Teachers' background – level of English Teachers' pedagogical knowledge of teaching literacy Time for planning different activities Time management in lessons	Cross-disciplinary collaboration District/Admin expectations and recommendations Personal disposition to Use of English PD (internal) for literacy instruction Researcher observation - Missed opportunity for PD Researcher observation - Missed opportunity for teaching literacy skills

Appendix I: Participant Response to Member Check

Gmail Joy Isa [redacted]

Research - data analysis results

Joy Isa [redacted] Sat, Mar 19, 2022 at 8:42 AM
Draft

Joy Isa
[redacted]
The diligent find freedom in their work; the lazy are oppressed by work.

---------- Forwarded message ---------
From: **Joy Isa** <[redacted]
Date: Thu, Mar 10, 2022 at 12:17 PM
Subject: Re: Research - data analysis results
To: [redacted] <[redacted].org>

Thank you for the feedback, [redacted]

I truly appreciate it.

Have a lovely day.

Joy
Joy Isa
[redacted]
The diligent find freedom in their work; the lazy are oppressed by work.

On Thu, Mar 10, 2022 at 12:05 PM [redacted] wrote:
> Dear Mrs Isa.
>
> I have reviewed the document.
>
> All the issues raised in our discussion are fully captured.
>
> Regards,
>
> On Fri, 4 Mar 2022 at 15:28, Joy Isa [redacted] wrote:
> > Dear Mr [redacted]
> >
> > Thank you so much for volunteering to be part of my research study. Your perspectives and experiences are an invaluable contribution to the study.
> >
> > In line with research expectations from the university, please find attached findings from my study. I would appreciate it if you could share any feedback on what I might have missed from our discussion.
> >
> > I will appreciate your prompt response.
> >
> > Thank you.
> > Joy
> > **Joy Isa**
> > [redacted]
> > *The diligent find freedom in their work; the lazy are oppressed by work.*

--

[redacted]

Teacher of Science/[redacted]

[redacted]

Lekki Phase 1, Lagos.

[redacted]

facebook icon twitter icon
linkedin icon instagram icon