

Using Lesson Study as a Tool to Cope with Instructional Challenges: A Case Study of Chemistry Teachers in Nigeria

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Abstract

Educators encounter many obstacles in effectively planning and teaching students in the classroom. One of the most significant challenges is the constraints imposed by curriculum standards, which can hinder teachers from customizing lesson plans that reflect students' current situations. To address this issue, a research study was conducted to investigate how collaborative professional development using lesson study could support teachers in managing lesson planning and teaching issues in schools. Two chemistry teachers in Educational District IV Lagos State, Nigeria, participated in the lesson study process, were interviewed, and engaged in writing a reflection. The data gathered were transcribed, coded, analyzed, and the results revealed that chemistry teachers face difficulties due to curriculum standards and expectations of national and external examinations. Nevertheless, through lesson study, the teachers recognized the necessity of prioritizing students' needs while designing lesson plans to overcome challenges and make chemistry relevant to students.

Keywords: Lesson Study, Chemistry teacher, Instructional challenges.

Introduction

Understanding the pattern of thinking students hold is a progressive approach to education, emphasizing the pivotal role of student perspectives in shaping the teaching and learning processes (Warwick et al., 2019). In a traditional educational setting, lesson planning often revolves around predefined curricular objectives and suggests instructional strategies for teachers, with limited

consideration of students' diverse backgrounds, thinking, experiences, and insights (Hagay & Baram-Tsabari, 2015). This prescriptive curriculum does not completely answer students' questions and plays a lesser role in helping teachers plan a motivating learning experience and environment for students (Hagay & Baram-Tsabari, 2015, Qin, 2024). Lesson study, a professional development approach for teachers, might create an opportunity through which this problem could be addressed. A lesson study is a collaborative space that focuses on empowering teachers to design inclusive, student-centered, and refined instructional practices (Dudley et al., 2019). Grounded in constructivist and social theories of learning, lesson study empowers teachers to explore learners' prior knowledge to enhance the learning experience. However, it remains unclear how students' prior knowledge is elicited and integrated into lesson design and classroom instruction (Arthurs, 2019). Ideally, teachers rely on asking students questions at the beginning of every lesson to consider students' prior knowledge. Assessing the prior knowledge of students at the start of a lesson can pose a challenge for teachers. This is because determining the appropriate teaching strategy at the moment may not be feasible and could have been addressed during the planning phase. To tackle this problem, this study delves into how lesson study can assist chemistry teachers in overcoming planning and teaching obstacles using the 5E instructional design model as a guide. By following the lesson study stages, teachers can proficiently evaluate their students' prior knowledge of the subject matter and employ it in planning their lessons.

Conceptual Framework

Student prior knowledge

The idea of constructivist theory is to build knowledge upon a foundation students had to ensure meaningful connection and learning. It recognizes that students do not come to the classroom as blank slates and that new learning is constructed within the context of their prior knowledge (Arthurs, 2019). Teachers are expected to help students make meaningful connections between their prior experiences and the new experiences to be provided and make learning from the student's perspective and teaching from the teacher's perspective seamless. According to Jones (2009), students become more interested and motivated to learn when students perceive that new experiences have a foot in their prior experiences. Therefore, leveraging students' prior knowledge may guide the planning of student-centered instruction and inform school curriculum improvement (Arthurs, 2019). As a result, we argue that teachers may plan more meaningful and engaging

lessons when they understand students' prior knowledge of the topic. Such understanding might be useful in formulating responsive objectives and the selection of appropriate activities for learning (Barber, 2021; Daniel et al., 2013). According to Barber (2021), "...direct evidence of student thinking within the context of the classroom is an essential component that can impact teacher learning and spark meaningful instructional change" (p.211). This indicates that teachers might benefit more by first trying to understand students' prior knowledge of the topic they want to teach before engaging in the lesson study process. Because learning is constructed from interaction and collaboration within sociocultural contexts (Ono & Ferreira, 2010), lesson study, which gives room for collaboration among teachers in the same discipline, would improve teachers' competency and self-efficacy in planning a responsive lesson for students (Lewis et al., 2011). Additionally, according to Anfara et al. (2009), in the collaborative social learning environment, teachers engage in "mental dialogue" as they interact to plan lessons, harnessing the strength enshrined in the community of practice among the teachers (p.52). Furthermore, working in this social space, the teachers draw on their different experiences, learn, together use their experiences to enhance instructional planning and delivery, and in the process envisage possible challenges, and diverse means to address them.

This study, therefore, focused on how the collaborative space among professional teachers in lesson study might help chemistry teachers cope with planning challenging chemistry topics by first exploring students' prior knowledge about the topics and using it as a resource for enriching lesson study processes.

Lesson study

Instructional design is a difficult task for teachers, especially in a context where they have limited access to resources such as the Internet and other technologies for instructional planning and delivery (Sarfo & Elen, 2014). Therefore, lesson study, which originated in Japan, is a professional development approach in which teachers collaborate and design instructions to improve their instructional practices, focusing on students' achievement (Fujii, 2016), and addressing instructional design and implementation challenges (Kadroon & Inprasitha, 2013). Since its publication, lesson studies have been adapted and implemented in non-Japanese settings, providing an opportunity for teachers to understand what must be done to adapt and implement student-centered instruction (Collet & Nakawa, 2022).

Lesson studies present teachers with numerous opportunities to bolster their teaching abilities. These opportunities include participating in meaningful dialogue on mathematical concepts and teaching techniques, predicting student reactions, establishing goals for student progress and growth, and molding teachers' perspectives and convictions regarding teaching methods (Barber, 202). Unlike the traditional approach to professional development of planning lessons where teachers are detached from the design process (Garber, 2021), lesson study brought teachers to the center stage, having them share their experiences with colleagues in similar fields to address instructional design and implementation issues (Fujii, 2016). Lesson study provides an atmosphere for teachers to work with like-minded professional colleagues to plan inclusive lesson oriented to meet diverse students' needs.

Lesson study involves four distinct cyclic stages: study, plan, teach, and reflect (Lewis & Hurd, 2011). Fujii (2016) further delineated these four stages into five: goal setting, lesson planning, research lesson, post-lesson discussion, and reflection. At the study level, which is the beginning of the circle, the team identifies goals that align with students' current realities. These goals then guide the planning of the lesson—extensive research into activities and relatable examples that would make content relevant to students are expected at this stage. The outcome of the second stage (lesson planning) is the "research lesson." The research lesson was implemented by one member of the team, while others observed and documented what happened during the teaching process. The data from this stage were used to provide feedback focusing on the key process in the design, teachers' reactions, and students' responses. The cyclic model was completed with reflection on the entire process, setting the ground for subsequent lesson planning. This reflection stage is significant as the teachers are "...able to deepen their understanding of teaching and expand their capacity to adopt new perspectives" (Yalcin Arslan, 2019, p.11), and increase their agency and self-efficacy (Lewis et al., 2019). The end of the cycle is the beginning of another planning process, demonstrating the value of lesson study as a support system for teachers to cope with teaching challenges (Kadroon & Inprasitha, 2013).

Notably, the lesson study's first stage starts with identifying learning objectives. However, the objectives are derived mainly from the curriculum which specifies what students should know without effort to incorporate their prior knowledge. Reliance on the specifications of the curriculum may jeopardize efforts to orient lessons to address students' needs (Hagay & Baram-

Tsabari, 2015). As part of an effort to address this issue, the Next Generation Science Standards (NGSS) in the United States provides a framework for teachers and curriculum experts to draft a reality objective for students (NGSS Lead States, 2013). The NGSS framework provides a performance standard with which teachers work and suggests what teachers should do to meet the goals of the curriculum rather than dictating to teachers what to do or how to go about it.

Since the inception of lesson study in Japan more than a century ago, lesson study has been adopted and implemented in many countries and social contexts, focusing on improving teachers' capacity to plan and deliver quality instruction to help students learn (Collet & Nakawa, 2022; Fujii, 2016). For example, in Tanzania, an African country, Kihwele and Sang (2020) sought to understand the impact of lesson studies on teachers' ability to design instruction for students. The researcher noted that teachers benefit from the collaborative sphere lesson study provides, helping them "learn new professional skills and knowledge and improve their understanding of the subject and change their attitude towards teaching generally" (p.1). Similarly, research conducted in Portugal indicated that lesson study serves as a way to improve pre-service teachers' pedagogical content knowledge (Conceição et al., 2021). A balanced understanding of the content and pedagogical knowledge is crucial in addressing the challenges that comes with teaching in a complex classroom in which diverse learners come.

Teachers' Challenges in Teaching

Effective lesson planning for student-centered instruction can be challenging for teachers, along with other contextual challenges they face in schools. Teachers often face numerous obstacles that impede their ability to deliver effective instructions. These obstacles may include creating content that is relevant and relatable to students, identifying the most appropriate instructional aids, setting achievable goals, a lack of support from school administrators, and inadequate resources (Gutierrez, 2015). The extent to which the challenges affect teachers' effectiveness might be more pronounced in a context where the teachers have limited access to teaching and resources.

These challenges appear constant in different contexts. In the Philippines for instance, to deliver the benefit of inquiry-based instructional strategy to students at the elementary level, Gutierrez (2015) noted that teachers struggle with a lack of "support and training," "time constraints," and the requirement to "focus on content learning rather than learning through inquiry." (p.1). In the same vein, Gathungu (2018) studied Kenya's teachers' effective planning

and implementation of lessons in the classroom and found that teachers expressed concerns about designing a lesson, which included pressure to cover a syllabus for a term, concerns about time spent on planning lessons, concerns about student interest, and the fear that there is too much work in planning a lesson. Considering the nature of chemistry, chemistry teachers face many of these problems which in a way might impede their ability to plan and implement instruction that benefit the students. Consequently, many teachers end up not planning a lesson for the class, which is to the detriment of students (Gathungu, 2018). Furthermore, Morales-Doyle et al. (2019), while critiquing the Next Generation Science Standards (NGSS) demonstrated that the curriculum promotes a reductionist approach to teaching science. This creates implicit challenges for teachers as they are required to be promoters of this approach by adopting strategies that only cater to students' cognitive needs. As a result, teachers may struggle to explore content and its implications for society, leading to students having a detached understanding of the content knowledge. Teachers may follow the curriculum as it is rather than trying to make the content relevant to their students. These challenges vary across different geographical locations, which can negatively impact the quality of instruction and students' success in the classroom (Collet & Nakawa, 2022).

Because students' learning and success in chemistry are dependent to an extent on what the teachers do, especially at the lesson design stage, implementing lesson study might help teachers imagine many of these problems and diverse means of coping. As noted by Lim-Ratnam et al. (2019), lesson study allows teachers to unpack what needs to adapt instruction to meet students' needs (p. 263). Therefore, lesson studies might provide a platform for teachers to cope with teaching challenges in different social contexts and adapt instruction to meet student's needs (Collet & Nakawa, 2022). However, in the Nigerian context, the focus of lesson study has been on students' achievement in mathematics (Lawal & Awofala, 2019; Popoola & Falebita, 2016), with no study on how the lesson study process helps teachers cope with teaching challenges and lesson planning in other subject areas, particularly chemistry. Therefore, there is a need to understand how the lesson study process might help chemistry teachers cope with the challenges experienced in planning and implementing difficult chemistry topics.

Benefits of Lesson Study

Mathematics teachers have benefited more from adopting lesson studies in schools, districts, and nationals probably because the first study on lessons study was conducted with mathematics

teachers. Barber (2021), for instance, found that 6th-grade mathematics teachers learned to diagnose students' misconceptions regarding fractions and design instruction to target specific alternate concepts and prevent others in a lesson study community. Additionally, the extant literature indicates that lesson study offers teachers control over the lesson design process, focusing on the design of students' thinking (Fujii, 2016). One study showed that mathematics teachers' views regarding designing the lesson plan, values in teaching practice, and values in assessment changed because the lesson study process helped to simplify lesson planning and implementation (Lewis & Hund, 2011). Furthermore, teachers feel more empowered to notice "student mathematical thinking" as they engage in the lesson study process (Guner & Akyuz, 2020).

Research indicates that the implementation of lesson study programs has led to improvements in students' academic achievement and comprehension of mathematical concepts. For example, Popoola and Falebita (2016) documented a notable enhancement in students' mathematics performance in Nigeria. Furthermore, it has been suggested that lesson study facilitates teachers' responsiveness to students' needs in the classroom in the United Kingdom (Warwick et al., 2019). This review underscores the efficacy of lesson study in enhancing teachers' instructional effectiveness and its indirect positive impact on students' learning outcomes. However, literature is scarce regarding how lesson study specifically aids chemistry teachers in addressing the challenges associated with planning and teaching complex chemistry topics within the Nigerian educational context. Given the prevalent difficulties such as resource scarcity and large class sizes encountered by teachers in this geographical area (Onyema, 2020), it becomes imperative to explore whether lesson study can assist teachers in coping with these challenges.

Research Objective

Based on the reviewed literature, this study aimed to investigate the role of lesson study in helping chemistry teachers adjust to lesson planning and instructional challenges in schools.

Methodology

This study employed a case study of the qualitative approach to investigate the experiences of chemistry teachers participating in a lesson study intervention. This pragmatic approach facilitated researchers' engagement with participants, allowing for a deeper understanding of their experiences within the study context (Merriam & Tisdell, 2016). The primary focus of the study

was on the professional development of teachers, and how participation in lesson study could assist teachers in addressing challenges encountered during lesson planning and teaching. Furthermore, given the study's specific interest in examining how the lesson study process could aid teachers in tackling challenges associated with teaching complex topics in chemistry, the study limited its scope to three stages of the lesson study—goal setting, lesson planning, and reflection. This decision was consistent with the approach taken by Kadroon and Inprasitha (2013), who similarly employed three stages of lesson study to monitor changes in mathematics teachers' teaching practices. Hence, the following research questions guided the study:

1. What are the challenges chemistry teachers experience in planning chemistry lessons?
2. How does the lesson study process help chemistry teachers to cope with these challenges?

Research Team

The research team consisted of two people: one doctoral student with expertise in science education—chemistry education, who also serves as a field supervisor at a university in the United States, and a principal education officer in Lagos State Ministry of Education with expertise in chemistry education.

Research Participants

Two chemistry teachers, each possessing a minimum of five years of teaching experience in public secondary schools in Lagos, Nigeria, were recruited for this study. The selection criteria for the teachers focused on their willingness to engage in a research endeavor aimed at enhancing their proficiency in lesson planning and effective instructional delivery. The decision to involve two chemistry teachers was informed by the recognition that some educators may teach chemistry despite their primary disciplinary background lying outside the realm of chemistry, necessitating a nuanced exploration of the case (Tomaszewski et al., 2020). To uphold the confidentiality of both the data and the participants, pseudonyms were assigned to the teachers, with "Titi" and "Funmi" being the chosen pseudonyms.

Intervention

Teachers actively participated in the lesson study process by employing the 5E model as a framework for crafting their lessons. This model, comprised of stages such as engaging, exploring, explaining, elaborating, and evaluating, underscores the importance of structuring lessons around

student-centered approaches and positioning teachers as facilitators of student learning (Duran & Duran, 2004). The process began with an assessment of students' existing understanding of the chosen topic, such as solubility, followed by the delineation of lesson objectives, which were informed by both students' prior knowledge and the objectives outlined in the syllabus. This approach allowed teachers to formulate objectives targeted at students' experiences and to develop activities and examples that are attuned to their perspectives, thereby ensuring relevance and fostering engagement (Daniel et al., 2013). Throughout the planning phase of the lesson study, teachers and researchers adhered to the structured progression of the 5E instructional design model. For instance, during the engagement phase, teachers collectively proposed and agreed upon appropriate questions and activities aimed at capturing students' interest when addressing topics such as solubility. This collaborative decision-making process persisted throughout all stages of the 5E model, reflecting the planning phase of the lesson study. The adoption of the 5E model as a planning tool stems from its recognition as a robust approach for designing lessons that cater to the diverse needs of students (Duran & Duran, 2004).

Data collection

Upon recruiting teachers, we established a WhatsApp group to facilitate seamless communication between them and the research team. This choice was deliberate because there was no clear distinction between the physical and virtual fields for qualitative research of this nature. The virtual environment still provides a level playing field for the quality relationships and interactions necessary to gather valuable data (Bailey, 2018).

Our initial meeting took place via WhatsApp group call. WhatsApp ensures the safety of our conversation because of the encrypted function in the app. Subsequently, unstructured interviews were conducted using the same medium. During these interviews, the teachers responded to questions aimed at uncovering the challenges they faced while planning lessons and teaching. Additionally, before lesson study was introduced to the teachers, we explored their awareness and understanding of lesson study. Sample questions included: "What do you know about lesson study?" and "What challenges do you encounter during lesson planning?" To maintain relevance to our research objectives, a qualitative research expert reviewed and addressed the questions.

Data Sources

This study used two major data sources: interviews, reflective writing, and observation.

Interviews. The interview was conducted at the outset of the research activity to gain insight into the challenges teachers encounter in their daily teaching endeavors and in planning chemistry lessons. The interview was conducted via a WhatsApp call, and the teachers' responses to the questions were recorded and transcribed. The decision to conduct the interview visually aligns with Hyde and Rouse (2023), who argued that online media offers a neutral platform for comprehending participants' experiences. Primarily, the teachers were asked to address the main research question and other related sub-questions, which enabled the researchers to gain insight into the challenges faced by chemistry teachers in schools and in the process of lesson planning.

Weekly Collaborative Virtual Meetings. The weekly meeting between the teachers and the researchers allowed for lesson planning following the 5E model, which took place for three weeks. During the meetings, the researcher noted keywords that indicate teachers' adjustment to the challenges they mentioned in the interview. The keywords result from the interaction between the teachers and the researchers about the experiences in the classroom as they plan the lesson challenges while planning the lesson.

Reflective Writing. The reflection happened at the end of the first and second stages of the lesson study—goal setting and lesson planning. The teachers were asked to reflect on the goal setting and planning processes. The focus of the reflective writing was to see how exploring students' prior knowledge, goal setting process, and lesson-planning processes helped the teachers think of adjusting to the challenges identified in the interview. The teachers' responses were sent to us through WhatsApp messages and their discussion between the teachers and researcher was recorded.

Observation. To enrich the data, practical implementation of the lesson was video-recorded and sent to the researchers via Google Drive, which was used to understand how the teacher activities in the classroom were influenced by the collaborative design activity and how the same experience helped them adjust to some of the classroom challenges (e.g., class size).

Data Analysis

The process of data analysis comprised line-by-line inductive coding of the data, adhering to the methodology outlined by Jason and Glenwick (2016). Initially, immersion in the data was pursued, entailing attentive examination of recorded interviews and video, written reflections, and documents emanating from weekly meetings. The objective was to categorize the challenges confronted by chemistry teachers, while also discerning disparities in their perspectives and comprehending how engagement in the lesson study process facilitated their management of these challenges. Throughout this phase, both researchers maintained these objectives at the forefront of their analysis. Subsequently, the second step involved the generation of initial codes. Building upon the familiarity acquired with the data in the preceding phase, researchers independently formulated representative codes, guided by the research question. For instance, attention was directed toward identifying challenges related to curriculum objectives and standardized tests. Emphasis was placed on identifying keywords and phrases indicative of the difficulties chemistry teachers encounter in lesson planning and instructional delivery, as well as expressions signifying their adaptation strategies within the context of the lesson study.

The third step encompassed the identification of themes. During this phase, researchers collectively reviewed the codes generated in the prior step and proceeded to classify them into overarching themes. Through discussion and consensus-building, these themes were refined to encapsulate commonalities among the codes and align with the research inquiries. Codes reflecting challenges associated with lesson planning and instructional delivery were grouped under the theme of "Planning and Delivery of Instruction," whereas those indicating challenges stemming from the curriculum were categorized as "Formation and Alignment of Instructional Objectives." Step four entailed a critical review of the identified themes. Both researchers revisited all data sources to ensure alignment of the data with the established themes and to verify the coherence of the thematic framework. Step five involved the definition and naming of themes. Researchers collaboratively delineated the characteristics of each theme and assigned names that encapsulated their significance within the context of the research question. Finally, the production of reports ensued, following the recommendation by Jason and Glenwick (2016) to present findings as arguments rather than mere data descriptions. This concluding step ensures the coherent presentation of findings in the subsequent section of the study.

Findings

The findings of this study are presented and discussed in two categories based on the themes: the challenges chemistry teachers experience in planning and teaching chemistry and how lesson study helps teachers cope with the identified challenges. These categories were informed by the research questions we sought to answer. The themes (planning and delivery of instruction, and formation and alignment of instructional objectives) were coined to show the levels of challenges teachers experience in planning and teaching a lesson.

Research Question One. What are the challenges chemistry teachers experience in planning chemistry? The findings are discussed below:

Formulation and alignment of instructional objectives. By formation and instructional objectives, we mean observable skills and behavior students are expected to demonstrate at the end of a lesson and the limited control teachers have over its formulation. In the Nigerian context, the syllabus given to teachers at the beginning of every term usually contains expected behavior and attributes students should demonstrate at the end. The teachers used keywords or phrases that showed that this syllabus and the curriculum at large constrained teachers to do exactly what the curriculum dictated, which is a challenge. The teachers observed that the documents were not sufficiently fluid to allow for innovation in the formulation of objectives, as expressed in their responses:

Titi: We expected to cover the objectives stated in the WAEC (*West African Examination Council*) curriculum, which don't largely address students' real-life experiences.

Funmi: We are expected to teach the content to align with the marking guide.

Titi: I feel like the curriculum itself is pushing us to teach students how to write WAEC exams.

Titi: I have to always teach what WAEC will accept.

Funmi: The schools' administrators expect us to keep to the syllabus.

Instructional delivery

In this context, the instructional delivery includes all the challenges chemistry teachers experience in the process of enacting impactful instruction in the classroom. Examples of challenges under

this category are expressed in terms of lack of resources and large class size. Below are sentences that indicate the manifestation of these challenges.

Funmi: In my class, there is no visual, no projector to display videos and slides, a lack of reagents in the laboratory, and a lack of electricity.

Titi: I have close to eighty students in my classroom.

Titi: I find it difficult to meet up with time.

Titi: Students feel chemistry is disconnected from their lives.

The first set of summarized data provided above comprises the verbatim statements of the teachers, illustrating the multitude of challenges they encounter in formulating objectives and planning lessons. The data elucidates the presence of expectations, particularly those imposed by the curriculum, as evidenced by the teachers' remarks. Teachers expressed a sense of constraint imposed by the curriculum in crafting responsive lessons for students, owing to the necessity of adhering to the requirements set forth by the West African Examination Council (WAEC). This requirement constrains teachers' ability to develop lessons that truly reflect the realities of their students. For instance, during the interview, Titi remarked, "I have to always teach what WAEC will accept," indicating the restrictive nature of the curriculum in allowing teachers to design lessons that are more pertinent to students' needs. Such expressions signify teachers' perceived limitations in innovating and implementing creative instructional strategies that cater to the dynamic needs of their students. Titi's statement, "I feel like the curriculum itself is pushing us to teach students how to write WAEC exams," highlights her concern regarding the subtle yet significant role the syllabus plays in constraining teaching practices. Similarly, Funmi observed that "schools' administrators expect us to keep to the syllabus." These broader expectations may impede chemistry teachers' willingness to explore alternative approaches to engaging students and rendering learning more meaningful beyond the confines of the prescribed syllabus.

In the execution of pedagogical activities within the classroom setting, chemistry educators encounter a distinct set of challenges. Notably, temporal constraints emerge as a significant obstacle, as articulated by Titi, who expressed difficulty in adhering to designated timeframes: "I find it difficult to meet up with time." This issue arises due to the substantial content load imposed by the curriculum, thereby subjecting teachers to undue pressure. Moreover, a lack of resources

poses a formidable challenge within this context where the teachers find themselves. Funmi expressed the absence of essential instructional aids in her classroom, stating, "In my class, there is no visual, no projector to display videos and slides, a lack of reagents in the laboratory, and a lack of electricity." These resources are imperative for facilitating effective teaching practices aimed at enhancing student learning outcomes. Furthermore, Titi highlighted the prevalent lack of student interest in chemistry, attributing it to a perceived disconnection between the subject matter and their daily lives. Funmi echoed similar sentiments during weekly meetings, noting, "I am being monitored and graded by the specifications of the syllabus," which restricts her ability to employ innovative teaching methodologies beyond the prescribed curriculum.

Research Question Two. How does the lesson study process help chemistry teachers cope with teaching challenges?

In addressing this question, the interactions between the two chemistry instructors and the researchers were documented during their weekly meetings, while the 5E instructional design model served as a framework for planning the lesson. The utilization of the 5E instructional design model facilitated a structured approach that harmonized with the procedural steps of the lesson study, encompassing goal setting and lesson planning. This alignment was evident as the teachers seamlessly transitioned from setting the goals of the lesson study to the planning phase, with the 5E model complementing and enhancing this progression. The initiative commenced with the identification of a challenging topic in chemistry, specifically solubility, which was subsequently shared within a research WhatsApp group. Subsequently, the teachers were directed to pose inquiries to students concerning the topic. The responses elicited from the students provided insights into their existing comprehension of the subject matter, thereby furnishing the research team and the teachers with valuable resources to delineate responsive objectives and deliberate on suitable instructional activities. When queried about the rationale behind prioritizing the exploration of students' prior knowledge, Titi articulated, "For me, doing this has helped me to think more about students, not the curriculum." This sentiment underscores the significance of leveraging prior information regarding students' understanding of the topic, as opposed to conjecture, in tailoring instructional strategies to meet their educational requirements (Hagay & Baram-Tsabari, 2015).

Furthermore, when teachers were asked how they felt about the lesson study, in Funmi's words:

It feels enlightening and encouraging, to hear great and workable ideas one can implement in the classroom to make learning more fun. It feels good. I feel more comfortable planning lessons to address students' needs. I think knowing students' prior knowledge on solubility and thinking about it throughout the lesson process helped me know exactly where to start with students.

When the teachers were asked to reflect on how the lesson study process supports them in coping with the instructional challenges they initially expressed, their responses were: Titi acknowledged that:

Planning instruction with colleagues is essential in addressing instructional challenges because it helps to anticipate potential obstacles and develop strategies to overcome them. I think this process helped me think more about designing hands-on learning, and promoting student engagement, stimulating their critical thinking and analytical skills as science students.

When asked to give specific examples of how the lesson study process helped, Funmi responded:

Before now, most times, I explained the concept to students and then practical afterward, but with me considering Lesson Study in my lessons, I will let them carry out the experience first and come up with their conclusion, following the 5E methods. I can now modify my existing lesson plan to include elaboration questions to make the learning more relevant to students.

Titi also mentioned that "Rather than being constrained by the dictate of the curriculum, I would begin to think more about questions to ask to stimulate students' thinking." Moreover, amidst the ongoing discourse, Titi proposed a viable strategy for managing large class sizes. She advocated for the utilization of the "think-pair-share" technique, asserting, "I think using think-pair-share can help to address the issue of a large class." This suggestion garnered unanimous agreement among the teachers, prompting its adoption in the classroom setting. Furthermore, the instructors collectively acknowledged the inevitability of challenges arising from the prescribed curriculum and syllabus. However, they contended that the lesson study methodology, complemented by the 5E instructional model, offered a means to adapt and prioritize catering to students' needs. Titi, in particular, articulated, "I can now modify my existing lesson plan to include elaborative questions to make the learning more relevant to students." She further expressed her intent to shift focus

from adhering strictly to curriculum mandates towards contemplating thought-provoking queries aimed at stimulating students' cognitive engagement. This shift in perspective towards prioritizing student-centric approaches, as opposed to rigid adherence to curriculum directives, is pivotal in crafting and executing instructional strategies that resonate with students' realities. By centering on students' needs, educators can design lessons that are not only pertinent but also responsive to the diverse learning requirements of their students.

Discussion

The study aimed to explore the challenges faced by chemistry teachers in planning and delivering lessons and how the lesson study process assists in addressing these challenges. The findings indicate that lesson study integrated with the 5E model helped the teachers realize the need to consider students' needs as a strategy to cope with the teaching challenges they experience.

As indicated by the study, effective instructional design, and delivery, which should align with student and societal needs, are hindered by a range of factors, particularly the curriculum standards. Even though the goal of the curriculum is to prepare students for societal needs, the prescriptive nature of the stated objectives in the curricula constrains teachers' ability to demonstrate creativity in formulating learning and behavioral objectives that resonate with students' daily life experiences. Chemistry teachers, in particular, struggle to design lessons that connect with students' everyday lives showing the relevance of chemistry to the environment and society probably because of a lack of time and resources. A similar concern was echoed by Morales-Doyle et al. (2019), who highlighted the constraining role of curriculum standards in shaping teachers' questioning approaches due to entrenched ideological commitments within school curricula. Teachers were constrained by curriculum requirements and reluctant to venture beyond these boundaries to incorporate reflective societal objectives and corresponding implementation strategies. Despite their reluctance to openly acknowledge these challenges, the collaborative environment fostered by lesson study enables teachers to voice their concerns and learn from others' coping strategies. This assertion aligns with Stewart and Jansky's (2022) recommendation for novice teachers to engage in dialogic discussions with colleagues and experienced educators to navigate teaching challenges.

Considering the significant role students' prior knowledge plays in their learning, chemistry teachers found it engaging knowing beforehand what students learn about the topic they want to

teach, as it enables them to plan instruction more effectively by tailoring activities and questions to address students' needs. This finding echoes Hagay and Baram-Tsabari's (2015) suggestion that incorporating students' perspectives enhances teachers' ability to design responsive lessons. Unlike the traditional practice of assessing what students know at the beginning of every class, assessing students' prior knowledge before planning a lesson further clarifies what chemistry teachers can do to make the content relevant to students.

Worthy of note is the pressure experienced due to resource constraints in lesson delivery and administrative expectations to meet curriculum standards. Chemistry teachers feel frustrated when there is no hope for improvement, resorting to teaching to the test and prioritizing exam-focused instruction. This claim is consistent with Gutierrez's (2015) findings, which noted that a lack of resources and support for teachers makes teachers focus on curriculum coverage over student-centered learning, leading to student neglect. Of course, this does not mean teachers should not be monitored; however, teachers' effectiveness should be measured by their compliance with curriculum standards and their observable impact on their students.

The lesson study process is an ongoing platform for teachers to enhance their competencies and glean insights from peers on designing student-centered lessons. Within this support framework, teachers strengthen their pedagogical skills to cater to 21st-century learners' needs and foster critical and design thinking skills essential for addressing societal issues (Collet & Nakawa, 2022). This transformative approach becomes feasible when teachers notice how students learn and design instruction accordingly (Kadroon & Inprasitha, 2013). In this study, therefore, teachers tend to know more about the dynamics of teaching and develop self-efficacy to meaningfully engage their students when they feel supported and learn from colleagues doing the same thing (Kihwele & Sang, 2020). Furthermore, this supportive system can help chemistry teachers realize that making content relevant to students is more critical as students might comprehend and apply scientific knowledge of the content while still being successful on the National Examination (Duran & Duran, 2004).

Educational Implications

This study aimed to investigate the potential of lesson study in assisting chemistry teachers in addressing challenges associated with lesson planning and delivery of complex topics in chemistry. The findings revealed that chemistry teachers enhanced their proficiency in designing lessons on

challenging topics by collaboratively sharing ideas and strategies with colleagues. Moreover, they recognized the importance of prioritizing students' cognitive processes and learning experiences to enhance the relevance of content and effectively navigate the complexities inherent in lesson planning and delivery. These findings suggest that chemistry educators can leverage lesson study with the 5E instructional model as a supportive framework for crafting instructional strategies to foster student engagement and inspiration in chemistry education. Effective teaching in chemistry entails a firm grasp of the subject matter, and an appreciation of students' individual needs and diverse learning preferences, which are considered in the social collaborative environment to enhance understanding of how to design lessons to meet the needs. Through regular professional development initiatives, chemistry teachers can cultivate an environment conducive to learning, accommodating the challenges encountered in teaching practices.

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