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Chorusing or questioning: Using EQs and KWLs in the science classroom in Anglophone Cameroon

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Background: Teacher-led recitation, choral responses, and rote learning are common in primary Science classrooms across sub-Saharan Africa. This study examines the impact of teacher training that implemented two pedagogical strategies, Essential Questions (EQs) and KWLs (What do you know? What do you want to know? What have you learned?), in a set of primary classrooms in Anglophone Cameroon.

Aim: The aim of the training was to help teachers shift away from traditional teaching methods, including 'chorusing,' by introducing a more interactive approach designed to open the classroom to student voice.

Setting: Approximately 50 Grade 1-5 teachers in 8 primary schools who took part in teacher training sessions in Science as part of the Student/teacher Education for Primary Schools (STEPS) project.

Methods: This exploratory case study collected data through surveys, interviews and observations.

Results: The results showed that both strategies were well received, with nearly 90% of teachers reporting they were 'very likely' to continue using them after a full year. Teachers reported increased student engagement, participation, and interest in science. Challenges included time constraints, difficulties creating effective EQs and incomplete implementation of the 'L' component of the KWL.

Conclusion: Overall, the results suggest that introducing these pedagogical strategies to teachers can lead to changes in the classroom dynamic. However, the training needs to address several challenges to full implementation if there is to be long-term pedagogical change.

Contribution: This study demonstrates that relatively simple pedagogical interventions can initiate meaningful shifts to more interactive teaching practices in African primary school contexts, while identifying specific implementation challenges that inform the design of future teacher training.

Keywords: teacher professional development; primary school science teaching; science education; Essential Questions; KWLs.

Introduction

In primary Science classrooms across sub-Saharan Africa, teaching methods continue to be dominated by approaches that are characterised by teacher-led recitation, choral responses and rote learning – pedagogical patterns well-documented throughout the region. This exploratory case study examines the implementation of two pedagogical practices – Essential Questions (EQs) and KWLs (What do you know? What do you want to know? What have you learned?) — in the eight primary schools that participated in the Science, Technology, Engineering, and Mathematics (STEM) Student/teacher Education for Primary Schools (STEPS) project in Anglophone Cameroon. The goal of introducing these practices was to motivate teachers to reduce their reliance on 'transmission' teaching and on using chorusing as a pedagogical practice, while at the same time getting learners excited about, and engaged in, Science topics, all without disrupting established classroom hierarchies or requiring extensive resources.

The problem

Across much of Africa, teacher-student interaction takes the form of whole-class chanting, or choral responses, with teachers asking questions that require superficial and predictable answers,

with little follow-up. No matter the subject area, studies from South Africa (Steinke & Wildsmith-Cromarty 2022; Stoffelsma & Van Charldorp 2020; Wildsmith-Cromarty & Balfour 2019), Kenya (Otienoh 2024; Pontegrace & Hardman 2006), Nigeria (Abd-Kadir & Hardman 2007) and Uganda (Mitana Muwagga & Ssempala 2019) all report that teacher-led recitation and choral responses dominate classroom discourse, along with the prevalence of rote learning and recall, with low levels of cognitive demand (Hoadley 2012:192). Although studies of Cameroon schools are scarce, Moore (2006) and Elzinga (2011) both found that in the Cameroon classrooms they studied, direct instruction and whole class involvement that takes the form of chorusing predominated. This was observed in the Cameroon classrooms that participated in this project. Steinke and Wildsmith-Cromarty (2022) note that this is a standard dialogue pattern globally.

There are many reasons for this reliance on chorusing. Large class sizes, often 50 or more students, make it difficult to work with, and track, individual students, so choral responses provide teachers with some feedback and students with a form of interactivity (Stoffelsma & Charldorp 2020:3). In addition, assessments that focus on short-answer questions, as is the case in Cameroon, reinforce the tendency to find quick answers, while the prevalent types of communication in these classrooms, including the use of chorusing, can mask the students' and teachers' command of English and their lack of understanding of the subject (Walker 1989).

It is important to note that in this article, chorusing refers to teacher-elicited, whole-class unison replies in response to simple prompts. This differs from broader call-and-response traditions in music, worship, or oral storytelling. Our research focused on breaking with this traditional classroom use of chorusing, not on the cultural value of collective voice.

A large body of research discusses the art of questioning in the Science classroom, including the timing, framing and impact of different types of questions. Good questions can engage learners in a topic, aid in the co-construction of knowledge and inform a teacher about a student's progress (Chin 2007; Hamel et al. 2021; Redfield & Rousseau 1981; Wilen & Clegg 2012). However, not all questions are same in terms of their impact on student learning. As noted above, many primary-level African classrooms rely on closed-ended questions, both during teaching and as a mode of assessment, and on collective responses, with the feedback from teachers confined to repeating the students' answer with little follow-up or further discourse (Stoffelsma & Van Charldorp 2020:7). Closed-ended questions often rely on recall and/or have right or wrong answers, thus being tests of specific knowledge. They demand little of the learners other than a memory for facts, because the goal of chorusing is to have all the learners remember and repeat the same facts. Chorusing may also give teachers a false sense of accomplishing their lesson objective. Open-ended questions, in contrast, can help learners think expansively. Open-ended questions have been shown to have a positive effect on student learning, while closed-ended questions have not (Wilen & Clegg 2012). Yet teachers tend to ask far more closed-ended than open-ended questions (İnönü & Demircan 2023). In addition, feeling short of time, they also often give the answers rather than waiting for the learners to speak, or address their questions to individual learners, thus undermining the collaborative construction of knowledge (Hamel et al. 2021).

To address the issue of chorusing, as well as the lack of student engagement in Science classes, STEPS introduced the teachers to two relatively simple pedagogical strategies, namely, Essential Questions and KWLs, described in detail below. Although some of the teachers reported being familiar with Essential Questions, they said that they considered them organising tools, not ways to spark inquiry or interest. None reported any familiarity with KWLs.

The research addressed the following two questions:

> Research question 1: *How, and to what extent, does introducing two pedagogical strategies, EQs and KWLs, during Science Teacher Professional Development sessions change teachers' classroom practice in Science*?
>
> Research question 2: *How, and to what extent, does introducing EQs and KWLs in the Science classroom change classroom interaction patterns*?

The sections that follow will briefly discuss the rationale for using EQs and KWLs, describe the research setting and the Teacher Professional Development (TPD) sessions, explain the research methodology and data sources, and then discuss the results. The article ends with recommendations for implementing these strategies in similar classrooms.

Why Essential Questions and KWLs?

Essential Questions are well known in the United States through the work of Grant Wiggins and Jay McTighe (Wiggins & McTighe 1998). They are provocative and multi-layered questions, posed at the start of a unit or lesson, that have no right or wrong answer, but spark curiosity. The aim is to stimulate thought, provoke inquiry and raise questions. Essential Questions are questions that are not answerable with finality in a single lesson or sentence: answering them should call for higher-order thinking, not simple recall. The best EQs are also tied to enduring understandings – ideas that are transferable within a discipline or even across disciplines (see McTighe & Wiggins 2013; Wiggins & McTighe 1998).

KWLS (What do you know? What do you want to know? What have you learned?) are used at the beginning and end of a lesson or unit (Ogle 1986). These allow learners to report their background knowledge (What do you know?), engage with the topic (What do you want to know?) and show what they have learned (What have you learned?). KWLs thus activate prior knowledge, engage learners by having them ask their own questions and then allow them to reflect on what they have learned. Equally important, KWLs have many possible responses and are therefore not dependent on group recall. The K (What do you know?) tells the teacher

what the learners do or do not already know and is, therefore, a form of diagnostic assessment that helps the teacher plan the lesson, while the L (What have you learned?) breaks the routine of choral responses by allowing the learners to speak for themselves about what they have learned and is, therefore, a form of summative assessment.

Both the K and the L are designed to engage learners, but it is the W (What do you want to know?) that is the most important in terms of engagement because it situates the lesson in what the *learners* want to know, rather than in the textbook or the teacher, and – this is key – allows the learners to make a link between the lesson topic and their own lives. The W is also a guide for the teacher leading the lesson, to be sure that what the learners want to know is covered, or that the reason for not covering a topic is clear.

Both strategies are topic and textbook-agnostic – they can be used with any Science topic and with any textbook – and are engaging, simple to implement in the classroom and easy to integrate into any lesson. Both strategies allow the classroom to remain traditional in the sense that they are teacher-led (Steinke & Wildsmith-Cromarty 2022). In other words, they do not threaten the teacher's traditional role as leader of the classroom. Further, both strategies align with and complement the lesson plan template these teachers received from the Ministry of Education, but still allow room for them to develop their lessons in a way that immediately engages students.

Research methods and design

Research setting

The research described here was part of a TPD programme and research initiative undertaken as part of the STEPS (STEM Student-teacher Education for Primary Schools) project, a 3-year initiative funded by the Global Partnership for Education Knowledge and Innovation Exchange (GPE-KIX) and the International Development Research Centre, Canada, from 2021 to 2024. The goal was to identify and study effective and scalable approaches that would improve STEM primary school education, with a focus on Mathematics and Science, in Cameroon, Benin and the Democratic Republic of the Congo. STEPS specifically addressed the need for low-tech solutions, cost-effectiveness, cultural and gender sensitivity and language needs. The project was led by NextGenU.org, a not-for-profit headquartered in USA whose mission is to provide high-quality, accessible education, training and resources in STEM to primary school teachers and students worldwide, improving learning outcomes while fostering a love for STEM learning. The research discussed here focused on Cameroon only, and on Science education in particular, and the initiative was led by the Cameroon Baptist Convention Education Department.

The population was the teachers in Classes 1 to 5 (equivalent to US Grades 1 to 5) in the eight project schools, all of whom took part in the Science TPD sessions. Throughout the project, approximately 50 teachers attended the TPD sessions, although not every teacher attended every session. There was little teacher turnover, with 74% of the teachers reporting that they had been teaching for 5 or more years. Almost all of the teachers had attended one of Cameroon's teachers' training colleges, although only a few had received any training in Science beyond high school. In addition, there was very little TPD in these schools, with most sessions focusing on government regulations, not on curriculum or teaching.

The schools, which were chosen by the project's local partner based in part on geography and in part on security considerations in Anglophone Cameroon at the time, were widely dispersed across the country. The number of students in each school ranged from 35 to over 1000, with the larger urban schools averaging 50 to 60 learners per class. Twenty per cent of the learners at one of the larger schools had known disabilities, including autism, cerebral palsy, epilepsy and hearing difficulties. At the start of the project, one school had no electricity. Three of the schools were in active conflict zones, with separatist activity leading to repeated school closures, while three schools that were not in active conflict zones had many learners who had been temporarily relocated to them. Science textbooks were few and inadequate, while the only Science equipment that a majority of teachers reported using in Science class was a ruler.

Relatively little class time was devoted to Science in these schools, although the number of hours varied by school and class level. For example, if a school had Science every day, the classes were generally for 30 min, but if the school had Science two, three or four times a week, the classes could run for 45 min, 35 min or 30 min. The average across the eight schools was just over 2 h a week. This is considerably lower than in most Organisation for Economic Co-operation and Development (OECD) countries, where the average is 3.6 h per week (OECD 2024). In fact, even this may be an overestimate. A 2018 World Bank study using data from seven sub-Saharan countries found teachers lose roughly half their teaching time through absenteeism or non-teaching activities (Bold et al. 2017), while studies in South Africa estimated that class time spent on instruction ranged from 6% to 56% (Hoadley 2010). In addition, in Cameroon, a considerable amount of class time is spent with teachers writing on the board and learners copying into their notebooks.

The training

Because the eight schools were spread across the country, the TPD was held at three sites, with the teachers travelling to the site closest to them, lodging there for the entire training. The trainer travelled from site to site. The TPD sessions were held in school classrooms in April 2023, August 2023 and August 2024, and focused on Essential Questions and KWLs, as well as on three forms of assessment (diagnostic, formative and summative).

As both EQs and KWLs are relatively simple to explain to teachers, the trainings were not led by outside 'experts' but

by local teacher-trainers. Given the conditions in Cameroon, where travel was time-consuming, expensive and sometimes dangerous, developing a training model that could be managed locally was important. This might not be true for all subject areas – Mathematics, for example, arguably needs an expert to 'see' the kinds of errors learners make – or even for Science at all class levels, but STEPS found it to be true for Science at the primary level. It was also important to the project to build in-country expertise as a test of scalability.

The TPD was built around a series of activities, including two role plays. The goal was to engage the teachers and, at the same time, give them a visceral understanding of how integrating these strategies into their classrooms could change the classroom dynamic without being overly disruptive. For example, in one activity, a participant played the role of a classroom teacher, and the rest acted as learners. Each group chose a topic and then brainstormed EQs for that topic, writing them on paper or directly on the board. In another activity, a different participant played the role of teacher and led the 'class' through a KWL on a topic chosen by the group. The responses were written in columns on the blackboard or paper. A final activity asked the teachers to list the different forms of assessment they used and then classify them into types (diagnostic, formative, summative), to demonstrate how the K in the KWL can be used as a diagnostic assessment and the L can be used as a summative assessment.

Research methods and data sources

This was an exploratory case study (Yin 2017) with limited quantitative data. The teachers responded to a series of surveys developed by the STEPS research team. The first was a background survey to learn about the teachers' experiences and needs, administered in May 2022. There were also end-of-semester surveys in May 2023, December 2023 and May 2024. A majority of the questions were open-ended and probed for the teachers' experiences in their classrooms, but all asked about the teachers' intentions in terms of future use of EQs and KWLs. In addition, the eight Heads of School responded to short surveys administered in December 2023 and December 2024. Finally, two local teacher-trainers observed classrooms and interviewed teachers in October 2023.

Questions about the use of EQs and KWLs were analysed quantitatively, using frequencies, in order to see if use or intent to use had changed over time. The open-ended survey questions, which focused on the teachers' experience using these two strategies, were analysed qualitatively by the lead author, using inductive coding to look for recurring themes (Creswell 2013). Most answers were short and were assigned preliminary codes, which were then refined iteratively into categories.

Ethical considerations

Ethical clearance to conduct this study was obtained from the University of British Columbia, Behavioural Research Ethics Board (No. H21-02303-A002).

Results

Research question 1: *How, and to what extent, does introducing two pedagogical strategies, EQs and KWLs, during TPD sessions change teachers' classroom practice in Science?*

A large percentage of the teachers reported that they had adopted the two strategies. Table 1 shows the percentage of the 45 teachers who had attended both the April and August 2023 trainings and who responded positively to a question that asked if they had used EQs or KWLs (each separately) since the most recent training.

There was more time between the December survey and the August TPD than between the May survey and the April TPD, which may partially explain the greater use reported in December, but it may also be that the TPD itself was more effective on its second iteration or that the teachers needed two trainings to integrate these practices into their classrooms.

By May 2024, after a full year of teaching, over 83% of the May 2023 respondents reported that they were 'very likely' to use EQs again, while 89% reported that they were 'very likely' to use KWLs again (Table 2).

The teachers reported many reasons for adopting these strategies. For example, when asked, in the May 2023 survey, if there had been changes in what and how they teach, more than half (52%) of the teachers wrote about how EQs and KWLs had helped them structure their lessons. However, for EQs in particular, it is not clear how many of the teachers really understood their purpose. Essential Questions are difficult to write: they need to be broad enough to open up a subject, but narrow enough to frame the particular topic. When the teachers were asked in the December 2023 survey if they found using EQs useful, they all said, 'yes'; but when asked to list what they found useful about them, all but 5 of the 49 who responded referred not to EQs but to KWLs, while those whose responses seem to have been referring to EQs all gave almost the same answer – 'They help frame questions' – suggesting that this is what they had been told, but not necessarily what they did. By May 2024, after a year of classroom teaching, when they were asked to give examples, many were direct questions ('Which animals feed on grass?')

TABLE 1: Percentage of teachers who reported using the KWLs and Essential Questions, May 2023, compared to December 2023 (N = 45).

Use of EQs and KWLs	May 2023 (%)	December 2023 (%)
Used EQs	64	82
Used the K	71	84
Used the W	60	80
Used the L	82	84

EQ, Essential Question; KWL, What do you know? What do you want to know? What have you learned?.

TABLE 2: Percentage of teachers who reported they were 'very likely' to use KWLs and Essential Questions again, May 2023, compared to December 2023 (N = 53).

Likely use of KWLs and EQs	May 2023 (%)	May 2024 (%)
'Very likely' to use EQs again	70	83
'Very likely' to use the KWL again	79	89

EQ, Essential Questions; KWL, What do you know? What do you want to know? What have you learned?.

or versions of K questions ('What do you know about clay?'). On the other hand, some provided good questions, such as these:

- What are flowers?
- Where do you think rain comes from?
- Where does wind come from?
- How are animals different from plants?
- How do animals feed?
- What makes parasites able to live in other organisms?

KWLs do not require any advance work and therefore can be adopted immediately. In the final May 2024 survey, one question asked about how using the KWL had changed their practice. They wrote that they liked the K (What do you know?) because it immediately engaged the learners in the topic. In fact, many were surprised at how much their learners knew. As one teacher said in an interview, she was amazed to discover that her learners were not 'empty vessels'. In addition, the K also helped the teachers structure their lessons. For example, one wrote, 'When you find out what the pupils know, it will help you emphasise what they don't know'. In an interview, one teacher noted that she had made too many assumptions about what her learners knew and had to adjust her lessons when she discovered they knew much more than she had anticipated.

They liked the W (What do you want to know?) because it gave the learners an opportunity to take charge of their learning and to connect the topic to their interests and their lives, rather than to the textbook. It also helped them structure their lessons so that the learners' questions were answered, or an explanation was provided for why they were not. Some also reported that the learners' questions influenced what they covered in the lesson, adding to their planned content:

- They told me so many things they want to know, which was like giving me topics to teach.
- There were some lessons I never used to teach the learners because I thought it was difficult for their level but when I taught them, the learners were excited and even had so many ideas about the lessons.

In interviews, the teachers said that they were surprised at how many questions their learners had, some of which they had not thought of themselves, at how learners who had been passive in the past now competed to talk, and at how every learner now had something to say. One teacher noted that the W gave each student their objective. Another said that in the past, she had never asked the learners for their opinions, but the W brought her out of the mindset that she knew everything and let the learners bring in their ideas.

While a large percentage of the teachers clearly appreciated having been introduced to both EQs and KWLs and expressed an intent to continue using them, classroom observations provided a more nuanced picture. Observations (unannounced) were conducted by local teacher-trainers in two of the larger schools (class sizes averaging 55) about halfway through the project, in October 2023. At this point, most of the teachers had attended two trainings, in April and August. Seven teachers, Classes 1 to 4, were observed in School 1, while five were observed in School 2, Classes 2 to 4.

All seven of the teachers observed in School 1 reported that they had used Essential Questions, and all had used at least parts of the KWL: seven used the K, six used the W and four used the L. (The others used a more formal assessment that was in their workbooks.) Only four wrote the K and the W on the board, probably because board space was limited and needed for other work. There was excellent participation in all seven classrooms, although the observer described two of them as 'rowdy' as the students vied to call out answers. In School 2, all four teachers used Essential Questions, the K and the W, but less so the L. However, the observer noted several challenges. In School 1, the teachers were reluctant to give up their former approaches, which meant they reviewed the lesson from the previous day, thus slowing the momentum. Some teachers also felt that they had to send their students home with something in their notebooks, so they turned the L into a summary of what they had taught, or intended to teach, not what the students had learned. In School 2, one teacher found that she had to adjust her lessons in order to address the W questions, which affected her schedule, while another reported that during the L, she ended up having to redirect the students to what she wanted them to learn.

Research question 2: *How, and to what extent, does introducing EQs and KWLs in the Science classroom change classroom interaction patterns?*

In their year-end survey, in December 2023, the eight Heads of School were asked what changes they had noticed in their Science classrooms. Although the Heads presumably wanted to present their teachers in their best light, they all reported that the classes were more participatory and the students more engaged.

This was echoed by the teachers in their survey responses. In the final survey, in May 2024, when teachers were asked if they had seen changes in their students' behaviour in class, 45% wrote about how much more participation and interaction there was in their classes once they started using the KWL. (The rest wrote about how the students now liked Science, how their performance had improved and how they liked the practical aspects of Science.) When asked more generally if they had seen changes in their classrooms, many used the term 'lively' in describing how their classrooms had changed:

- There is a lot of excitement in class during science lessons.
- Children are more lively, happy, and interested when it comes to science lessons.
- The Science classes are now lively.

- Teaching Science is very lively since many children now participate in the lessons.
- During Science, learners are interactive, which makes the class lively.

Others wrote more generally about how participation had improved:

- Interaction during lessons is high and learners no longer find Science boring.
- Their participation in class has improved.
- The learners are very interactive and willing to learn during science periods.
- Learners show more interest when a science period is going on in class.
- Pupils are so curious to learn new things when you use the KWL approach.
- They are more inquisitive and intend to know what/why things happen the way they happen.
- Learners enjoy and participate fully in the Science subjects.
- Learners are more serious in Science subjects than in any other.
- There is excitement in the way they answer questions and full participation.

Others wrote about how their learners' interest in Science as a subject had increased:

- The learners have developed a love for Science.
- They now like Science lessons more than before.
- Pupils are developing a lot of interest in Science subjects.
- Most of them have developed interest in the learning of Science.
- It urges them to be curious and anxious to learn. Some bring out their aims like becoming doctors, pilots, etc.
- Learners are delighted by lessons that awaken scientific curiosity.

Several wrote that the KWL, in particular, had made it easier for learners to learn the material:

- My pupils now are so excited during Science lessons and easily assimilate the lesson.
- The learners master the subjects they learn without too many flaws.
- We have noticed changes in the learners, they are beginning to understand the concepts of science.
- They show more interest during Science class and concentrate more.
- During the Science class it makes pupils more attentive and they have developed interest in the lesson.
- Parents complain that learners have an understanding of topics in science that are more than their age.

A few wrote about how using the KWL made learners feel personally invested in their learning. These responses showed an understanding that one of the major benefits of the KWL, and the W in particular, is that it links learning to the learners' lives and interests:

- The atmosphere in the classroom for Science lessons had completely changed from before when class used to be for some learners and others were not involved.
- Every child is involved, and has a sense of focus. They feel belonging, have confidence in themselves.
- Learners have been responding positively and relating what they have learned to their daily life.
- They think critically and relate the various lessons to real-life situations.

These responses suggest a subtle shift towards a more learner-centred classroom, although only a few teachers were explicit about this:

- (The KWL) brings us out of the mindset that the teacher knows everything – learners get to bring in their own ideas.
- When it comes to Science lessons, they are very excited since they know that their contributions also count a lot.

Discussion

It seems clear that the introduction of EQs and KWLs changed the dynamic of many of these teachers' classrooms, shifting both teachers and students away from call-and-response interactions, or chorusing, to more open-ended interactions that gave the students a voice. However, although the teachers' responses indicate genuine enthusiasm and provide insights into how both EQs and KWLs led to changes in classroom dynamics, we do not know how often the teachers used them or if they used them fully. As noted above, the amount of time devoted to Science in these classrooms varied greatly, but was relatively little compared to international standards (OECD 2024), and those teachers who had little time allocated to Science felt pressured to move quickly to cover the entire syllabus.

In addition, Table 2, as well as the surveys and interviews, suggest that some aspects of these strategies were more difficult for teachers to adopt than others, particularly the Essential Questions and the L of the KWL. Creating EQs is challenging. Although in the TPD, the teachers came up with good EQs, the reduced use of EQs over the year 2023 to 2024, and the few examples given in the May 2024 survey, suggest both that the teachers did not understand how to create good EQs and that they found EQs a difficult strategy to integrate.

As for the KWL, asking the learners what they know is not uncommon. It is coupling that with asking them what they *want to know* that can change the classroom dynamic in a major way. That the teachers understood this change is clear from their responses. However, students often raise more questions than the teacher can answer, and although some were able to adjust their lessons to address questions they had not intended to cover, it was not clear from the

survey results that most of the teachers knew how to deal with this. Not returning to all the questions learners raise can lead to learners feeling ignored, which runs counter to the goal of the KWL.

The L (What have you learned?) provides a cross-check on a teacher's success in teaching a topic. It may be the most difficult part of the KWL to implement in traditional classrooms, where asking narrowly focused questions and expecting the same answers from all learners – chorusing – is a common way of assessing student learning, where the material covered in the high-stakes tests these learners take is entirely fact-based, and where teachers have not been trained to use assessment results to assess their teaching. In addition, in such classrooms, assessment on a lesson-by-lesson or unit-by-unit basis is not common, with the focus being on larger written assessments. It is therefore not surprising that fewer teachers wrote about the use of the L than the K or W. Even though some of those interviewed talked about how having the learners report what they had learned enabled them to decide if parts of a lesson needed to be revised or retaught, and to evaluate themselves and if they taught the topic well, these were in the minority.

Changing the dynamics of the classroom does not happen overnight, and training must be repeated and sustained over time. This was confirmed by those doing the observations, who reported that they saw more progress among the teachers who had attended more than one training. However, although STEPS believed they had broken the TPD sessions down into manageable chunks, more attention needs to be paid to the design and effective use of EQs and to the importance of doing the complete KWL.

In addition, the TPD was expensive and time-consuming, including costs for lodging, food and travel. This would be true in any country where distances are large and travel is difficult. Multi-school TPD may not be a viable model in countries with limited resources. Towards the end of the project, STEPS experimented with doing school-based trainings, led by senior teachers, thus removing the need for a teacher-trainer, for transport, and for lodging. These localised TPD sessions were well received by the teachers and may provide a way forward for certain types of TPD, but in this case, there was no opportunity to assess its effectiveness.

Limitations

This research has several limitations that need to be taken into consideration when evaluating the results. Firstly, this is a study of one set of schools in one country, and of one TPD initiative; so although it seems likely that the findings would apply to similar situations, the context is always important. Secondly, time, distance and funding led to a heavy reliance on teacher surveys, which by definition are teachers reporting on their practices and may be biased to please the questioner. Further, these surveys were specific to the programme being implemented and were therefore not validated in a formal sense. The teachers' verbal descriptions, in interviews, of how they implemented EQs and KWLs helped us understand how they were being implemented and what the difficulties were, and in this respect provided insights that the surveys could not provide, but were limited in number because of financial constraints. In addition, STEPS was only able to do classroom observations in two schools, once in each school. Future research incorporating classroom observations would provide valuable insights into implementation fidelity over time and could guide refinements to TPD in similar contexts.

Conclusion

This exploratory case study demonstrated that introducing two pedagogical strategies, Essential Questions and KWLs, transformed traditional classroom practices in several primary Science classrooms in Cameroon. Over a year, the teachers increasingly adopted both strategies, with 89% reporting they were 'very likely' to continue using KWLs and 83% reporting the same for EQs. This high adoption rate suggests that these pedagogical approaches can effectively address the challenges of predominantly transmission-based teaching in resource-constrained environments.

The teachers reported that these strategies had an impact in three key areas. Firstly, they provided the teachers with a structured framework for lesson planning and delivery. Secondly, they increased student engagement, with teachers consistently reporting more active classrooms where students showed a greater interest in Science. Thirdly, they began shifting the classroom dynamic away from rote learning and choral responses towards more interactive and student-centred learning experiences, in which learners' prior knowledge and questions helped shape the lessons.

Despite these successes, implementation challenges remained. Teachers struggled with creating effective Essential Questions and fully implementing the 'L' component of the KWL. The limited time allocated to Science instruction also constrained the teachers' ability to address all the students' questions generated during the 'W' phase. These challenges highlight the need for sustained professional development and institutional support to fully realise the potential of these strategies.

Overall, the findings suggest that relatively simple pedagogical interventions, if carried out carefully, can initiate meaningful changes in classroom practice without disrupting established educational structures or requiring extensive resources. By encouraging teachers to elicit and value student input, the KWLs can help make traditional classrooms more interactive, with less chorusing and more questioning. And that is how a Science classroom should look.

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Competing interests

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Author's contribution

S.L. worked on the design of the TPD described here, worked with the research team to design the trainings, the instruments, and the interview protocols, and was responsible for the data analysis and drafting the paper. E.M.W. and L.N.D. did field research, including interviews and observations. L.N.D. also led the trainings. N.A.A. supervised the project in Cameroon while G.N. helped develop the trainings and extensively reviewed the article.

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Data availability

The de-identified raw data that support the findings of this study are available from the corresponding author, S.L. upon reasonable request. The data are not publicly available because of ethical restrictions.

Disclaimer

The views and opinions expressed in this article are those of the authors and are the product of professional research. The views expressed herein do not necessarily represent those of IDRC or its Board of Governors or those of The Frank Foundation/NextGenU.org. The authors are responsible for this article's results, findings, and content.

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