EdTech Hub

Clear evidence, better decisions, more learning.

WORKING PAPER

Teaching and Learning of Mathematics in the Context of the National Numeracy Programme in Malawi

Findings from a rapid, in-depth qualitative study

Date April 2024

Authors André Correa de Oliveira
Charity Kanyoza
Teresa Smart
Anne-Fleur Lurvink
Violet Boilo
Esme Kadzamira
Björn Haßler

DOI 10.53832/edtechhub.0156

UKaid from the British people

THE WORLD BANK

unicef for every child

About this document

Recommended citation

Correa de Oliveira, A., Kanyoza, C., Smart, T., Lurvink, A.-F., Boilo, V., Kadzamira, E., & Haßler, B. (2024). *Teaching and Learning of Mathematics in the Context of the National Numeracy Programme in Malawi: Findings from a rapid in-depth qualitative study* [Working Paper]. EdTech Hub. https://doi.org/10.53832/edtechhub.0156. Available at https://docs.edtechhub.org/lib/B8SQMMBA. Available under Creative Commons Attribution 4.0 International.

Reviewers

Chris McBurnie, Daniel Plaut, Nancy Chidzankufa (NNP); Arianna Zanolini (FCDO); Laila Friese

About EdTech Hub

EdTech Hub is a global research partnership. Our goal is to empower people by giving them the evidence they need to make decisions about technology in education. Our evidence library is a repository of our latest research, findings and wider literature on EdTech. As a global partnership, we seek to make our evidence available and accessible to those who are looking for EdTech solutions worldwide.

EdTech Hub is supported by UKAid, Bill & Melinda Gates Foundation, World Bank, and UNICEF. The views in this document do not necessarily reflect the views of these organisations.

To find out more about us, go to edtechhub.org/. Our evidence library can be found at docs.edtechhub.org/lib/.

Contents

Abbreviations and acronyms

DQAS	Directorate of Quality Assurance Services
FCDO	UK Government Foreign, Commonwealth and Development Office
FGD	Focus group discussion
MoE	Ministry of Education
NNP	National Numeracy Programme, Malawi
PEA	Primary Education Advisor
SSI	Semi-structured interview
TLC	Teacher learning circle

1. Background to the study

The formal education system in Malawi has made notable strides since 1994 when the government introduced free primary education. Nevertheless, the surge in student enrolment and growing demands on the system have resulted in large class sizes and a need for more infrastructure, educators, and teaching and learning materials. This has led to low learning outcomes, particularly in the foundational years, which comprise most school enrolments (↑Kazima et al., 2022; ↑Rui 2024). In 2022, for example, Malawi had 5,338 public primary schools with a total enrolment of 4,258,932 learners. Approximately 65.3% of these learners (2,781,412) are enrolled in Standards 1–4 (↑Ministry of Education, 2022). The formal education system in Malawi adheres to the following structure: eight years of primary education (Standards 1–8) followed by four years of secondary education (Forms 1–4) and five years of tertiary education (↑Rui, 2024).

Over the last two decades, ongoing assessments have consistently shown a concerning trend: learning achievement in mathematics in Malawian primary schools remains notably low. This persistent challenge can be attributed to the prevalent teaching methods and learning environment, which are often not conducive to learning and can contribute to the markedly low numeracy skills observed. The issue lies in an over-emphasis on rote memorisation with insufficient attention to fostering understanding, application, and reasoning. Additionally, a lack of progression in learning, applying skills and strategies, and working with numbers across the years have been flagged as common issues in the classroom (↑Brombacher, 2019; ↑Kazima et al., 2022).

In this context, in 2020, the Malawi Ministry of Education (MoE) partnered with Cambridge Education (Mott McDonald) to set up the UKAid-funded National Numeracy Programme (NNP). The ministry department responsible for implementing the programme is the Department for Quality Assurance (usually abbreviated as DQAS).

Through the NNP, the MoE aims to improve learning outcomes in mathematics in Standards 1–4. Core components of the programme were designed based on a new approach to numeracy and teaching and include:

- Learner Workbooks

- Teacher Guides
- TLCs to promote reflection on classroom practice
- Training for master trainers, who are tasked with training a nominated school-based trainer — or key teacher — at participating schools
- Formative assessment to gather evidence on student learning

In 2021, the government piloted the NNP in 203 schools. From September 2022 to August 2023 (the school year), over 1,100 schools in different regions of Malawi participated in an extended pilot programme. In the future, the MoE plans to scale the programme so that every learner in public primary schools can be part of this initiative.

The language of instruction is an important contextual issue. Malawi is a multilingual country, with English and Chichewa as official languages. In the education sector, schools are encouraged, but not required, to teach in English in Standards 1–4 (↑Rui, 2024). From Standard 5, teachers must teach in English (↑Rui, 2024). As many families do not speak English at home, many learners enter Standard 1 with little to no knowledge of English. Therefore, many teachers opt to teach in Chichewa in the early grades. However, targeting learners and teachers in Standards 1–4, the NNP nonetheless uses English as the official language of instruction.

The NNP model was initially designed as a cascade combined with a multiplier model. As part of a multi-day residential workshop, master trainers train one teacher (the 'trainer') from every other school. The trainer then provides training at their own school and a nearby school. It is worth noting the issues raised within research evidence about cascade models (↑Allier-Gagneur et al., 2020; ↑D'Angelo et al., 2022; ↑Hennessy et al., 2022). In 2021 and 2022, NNP teachers were trained under this model. However, starting in 2023, based on evidence from research undertaken in 2021 and 2022, the programme has refined this model to make it more effective for teachers.

The teacher training element of the NNP is designed to take place once at the beginning of the school year. It covers both mathematical content for infant and junior phases and pedagogical practice in line with the NNP vision of stimulating critical thinking and reflection. In addition to and building on the training, the NNP also proposes a school-based model of

teacher continuous professional development through TLCs. The TLCs are designed to take place once a month, and in the 2022-2023 school year, these took place fortnightly, at every school that is implementing the NNP. Each session was facilitated by one teacher from that school and followed a specific structure. However, the content covered in each session was determined by the Section Heads in the schools, who were tasked with observing lessons and identifying common challenges before deciding the topic of the next session.

On the teacher's side, in addition to the training, the NNP proposed a support system that includes monitoring, supervision, and coaching from key teachers and Primary Education Advisors (PEAs). The programme also provides a printed Teacher Guide, which acts as a point of reference for planning and delivering lessons under the NNP. In doing so, the Teacher Guide provides practical guidance on facilitating activities in the Learner Workbook. Moreover, the NNP planned to provide digital content, particularly videos, to complement teacher support, and plans to provide one tablet per school to ensure accessibility to these videos.

On the learner side, each student receives a Learner Workbook with content for the mathematics lessons for each term. Each lesson is covered in one full page, so as learners complete activities and pages, they progress in the mathematics curriculum of their standard. These books should play an essential role in the NNP by:

- allowing learners to progressively and independently practise the knowledge and skills that are the focus of each lesson;
- providing learners the flexibility to trial and choose methods and strategies to solve mathematics problems;
- providing teachers with a way to assess each learner's level of understanding by reviewing their work and offering feedback;
- allowing parents and guardians to track their child's progress and provide the necessary support.

To inform the development of the programme, EdTech Hub worked with DQAS, Cambridge Education, and the UK Foreign, Commonwealth and Development Office (FCDO) to examine whether the NNP's components have been working effectively and how they might be leveraged to improve teaching and learning of mathematics in Malawi.

In-depth qualitative research in four schools was undertaken to obtain feedback on the programme's components from teachers, head teachers, and PEAs. The study's methodology incorporated semi-structured interviews, focus group discussions, lesson observations, learning circle observations, training observations, and ethnographic methods. Additionally, a mathematics specialist conducted an independent, in-depth, desk-based review of the NNP teaching and learning resources to refine the study's analysis.

This report summarises the principal findings from the study. Section 2 outlines the research methodology, Section 3 presents findings, and Section 4 details recommendations for the programme going forward.

An important note: Since findings from this research were shared (based on the 2022-2023 school year), NNP programme implementers have worked to address its recommendations actively, including conducting significant refinements to the curriculum and teaching and learning materials. EdTech Hub continues to collaborate with the NNP to assess the impact of these revisions on the programme.

2. Methodology

To better understand how the NNP has been implemented and the interplay between the programme's core components and the contextual factors in the Malawi education system, the study team investigated the following research question:

How are the core components of the National Numeracy Programme working in the context of primary schools in Malawi?

To be able to offer rapid actionable advice, the study had to be limited in scope. In order to have an in-depth understanding of the experience of teachers in the schools we were targeting, we opted to conduct deep qualitative work in four schools in Zomba district over the course of three weeks in November 2022. Working with Cambridge Education, the NNP selected schools based on the following criteria:

- Schools were located in peri-urban areas (within a 40-minute car journey of Zomba town)
- Varied levels of experience of the NNP (with one school participating in the pilot from 2021 and three schools participating in the extended pilot from 2022).

Table 1 below provides an overview of the methods.

Table 1. *Qualitative research methods adopted in the study*

Method	Description
Lesson observations	The team observed at least one mathematics lesson per standard (Standards 1–3) in each school. The NNP's classroom observation tool was used for both research and evaluation.
Teacher learning circle (TLC) observations	The team observed one TLC in each school. For the first term of the academic year, TLCs were scheduled to take place once a month. A TLC observation tool was used for this purpose.
Focus group discussions (FGDs)	At least one FGD was conducted with all teachers who delivered the NNP (Standards 1–4) in each school. The goal of the FGDs was to gain a more in-depth understanding of the teachers' experiences and attitudes towards the NNP, the TLCs, and the resources, and to identify the main challenges and areas needing support. The head teacher was asked not to attend the sessions so as to give teachers more freedom to share their experiences.

Method	Description
Semi-structured interviews (SSIs)	The team conducted SSIs with the head teachers of the four participating schools, two key teachers, and two PEAs. The interviews aimed to understand the experience, perception, and engagement of different stakeholders responsible for the NNP.
Ethnographic research	A member of the research team stayed in each participating school for a full week to engage teachers, learners, and the community on a deeper level. During this period, the day-to-day routines of school-level stakeholders were observed and individuals were engaged in informal discussions on the NNP. As a result, the team was able to identify patterns and attitudes that may not have come up in SSIs and FGDs. A record of every interaction and observation was maintained in a diary that was transcribed at the end of each week.
Desk-based analysis of the NNP Teaching and Learning Resources	An in-depth desk-based review of the NNP Teaching and Learning Resources, specifically the Teacher Guide and the Learner Workbooks, was carried out by an independent mathematics specialist. The review prompted the question: *Is this package of learner and teacher materials the most effective way of developing high-quality teaching and learning in the NNP schools?*
Training observation	The team observed four teacher training sessions conducted by key teachers—one at a pre-pilot school and three at an extended pilot school. One training of master trainers was also observed.

All interviews and focus group discussions were transcribed and tagged according to the school where they took place. Each school was assigned a code for anonymity purposes. After processing the data, the transcripts and field note observations were coded, and the data was analysed using Atlas.ti software.

Before conducting any research, formal written consent was obtained from all participants. Importantly, this consent covered audio and video recordings of interviews, focus groups, lessons, and TLCs. Data is only to be used for research purposes.

This rapid study was carried out to enhance the team's understanding of the programme and its key challenges and advantages, and provide initial evidence to inform the development of more robust research. Subsequent design-based implementation research (DBIR) was undertaken, starting from January 2023, over a longer period and with a larger sample of 20 schools; it was designed primarily based on the findings from this study.

Hence, it is crucial to acknowledge the significant limitations of this study. Firstly, its lack of representativeness is a noteworthy constraint, as it encompassed only four out of a total of 1,100 schools. Furthermore, these four schools were in close geographical proximity within the Zomba district, whereas NNP schools are dispersed across various districts throughout the country. Time constraints also played a role, as TLCs were conducted only once a month during the study period, so we could only observe one TLC per school. Additionally, the study commenced in November 2022, leaving a limited time frame before the end-of-term exams—a period when teachers and students fully engage in exam preparations.

3. Findings

To begin addressing our research question, Section 3.1 presents our findings regarding teacher and master trainer NNP training. Subsequently, Sections 3.2 and 3.3 delve into our examination of the Learner Workbook and Teacher Guide through desk-based review, lesson observations, and interviews. Section 3.4 explores the dynamics of teaching and learning in primary schools in Malawi, focusing on the interplay between the Learner Workbook, Teacher Guide, and NNP methodology. Finally, Section 3.5 focuses on TLCs and formative assessment.

3.1. Findings relating to NNP training

Observations of NNP training sessions and interviews with teachers and PEAs suggested that:

3.1.1 The training for master trainers was interactive and action-oriented, however, school- and cluster-based training sessions often lacked teacher engagement due to overly theoretical content and lecture-style.

At the beginning of the extended pilot, the NNP trained master trainers to support selected key teachers to implement the programme. In turn, key teachers cascaded this training to other teachers in their schools. The NNP intended to provide each participating school with a tablet preloaded with video-based training content to support this training.

In some cases, key teachers from clusters of nearby schools came together to deliver joint training sessions at a central location. In doing so, key teachers shared the responsibility for facilitating sessions and provided guidance to each other if they struggled to lead activities.

Training observations indicated that the training of master trainers was highly interactive and action-oriented and used many different materials and digital resources. The trainers facilitated discussions and group activities to prepare master trainers and orient them to address specific questions and issues that key teachers and teachers could raise. However, it was also apparent that school- and cluster-based training sessions often failed to engage teachers. For example, the training content was highly theoretical and did not focus on the practical skills teachers needed to

deliver the NNP. Moreover, key teachers tended to lecture from the training handbook during sessions. This approach limited the levels of interaction and participation from teachers.

3.1.2 Information was frequently lost in the cascade model, as key teachers only sometimes passed on critical programme details.

PEAs have pointed out that information was often lost along the cascade model. Key teachers, who were taught by master trainers and tasked with training the teachers, frequently did not pass on information that could be relevant to delivering the NNP. One PEA reported:

> *"I can say they [the training] are supposed to change. Why? Because the training was somehow going to the key teachers. We, as Primary Education Advisor, we went to the training, but we didn't train the teachers, we were just assisting the key teachers.*
>
> *Since we were just observing the key teachers training the teachers because, for instance, myself, I was just moving up and down to see that key teachers are doing the work training their fellow teachers. So, when I go to a certain cluster I find that the key teacher has missed something, so I'm there to support. So, I can go to another centre and find out that he [the key teacher] has missed something else."*

3.1.3 Participants felt that the training duration was insufficient to fully grasp the programme content. Teachers had to cover extensive content through self-study, often requiring support from master trainers.

Some of the interviewees, including key teachers, teachers, head teachers, and PEAs, raised a concern that they did not have enough time to cover all the programme content. For example, key teachers had to cover much material through 'self-study'. However, some key teachers said they could not understand this content without the support of master trainers.

One PEA raised this issue:

> *"The planners, when they are planning for training, they don't look at the content itself. The content must have adequate time during training. During training, you will find that maybe*

> *the trainers, they will move very fast because looking at the number of days that they have been given to train their fellow teachers."*

One head teacher pointed out that:

> *"The training was very short. The work which is supposed to be covered during the training was too much, was very big work. And for a teacher to grasp everything there, it needs enough time. So, the training was very short. It was supposed maybe to be in two weeks for teachers to understand fully what they are going to implement in schools."*

Sharing a similar experience, another head teacher explained:

> *"Since the training was a one-week programme, it is not enough to cover the whole work. Some of the work was partially done, and sometimes we get support from our PEA. But this one is just a one-week programme. So, the work which was in those manuals is not enough for a week. So, what I can say, we get support from our PEA, and we get support from our key teacher as you have seen. The knowledge that I get from TTC [Teacher training circle] is not enough to support these teachers."*

3.1.4 Teachers face challenges in using tech tools and digital content in training, including ensuring adequate access to these resources and the capacity to use them effectively.

Moreover, by the end of the first term of the academic year, schools in the extended pilot programme had yet to receive a tablet. In this setting, some teachers opted to use their smartphones to view video-based training content. Several challenges emerged, including incompatible video formats, poor audio and video quality, and a need for preparation for manipulating video content.

3.2. Findings relating to the Learner Workbooks

Our team's numeracy pedagogy expert reviewed the Learner Workbooks and also undertook observations and interviews, producing the following insights.

3.2.1 The Learner Workbooks include learning objectives from across the curriculum, show progression, and are well-designed.

The Learner Workbooks are well-designed with good-quality pictures and diagrams and organised with one page for each lesson. The books cover the Malawi mathematics curriculum for Standards 1 to 4. Any one lesson includes a range of activities. So, for example, a lesson on numbers includes a counting activity, a word problem, and a question applying what has been learnt. The learning objectives in any term include learning in each curriculum strand: number operations and relationships, patterns, shape and space, measurement, and handling data. The content in the Learner Workbook activities shows progression across a term, the year, and each year. For example, the Learner Workbooks in Standard 2 start with the learning in Standard 1 and develop it.

3.2.2 The Learner Workbooks lack effective pedagogy support for teachers

Our desk-based analysis of the NNP teaching and learning materials suggests that the Learner Workbooks need more pedagogical support for teachers to foster improved learning effectively. For instance, the Learner Workbooks consist mainly of mathematical problems to be solved. However, merely posing questions is unlikely to promote learning as such. To ensure that learning takes place, teachers must guide the learning process, using questions to assess learning, introduce learners to new mathematical terminology and vocabulary, and support the majority of learners who have no English. Many learners have not yet learnt to read in their home language or English.

The reality of large classes and children's language and reading difficulties may mean that teachers rely solely on following the Learner Workbooks. Without a high level of teacher support, learners are unlikely to make significant progress by only completing activities in these workbooks. While completing these activities may give learners a sense of pride and accomplishment, learning outcomes are unlikely to improve unless teachers have the skills and time to assess what children have learnt.

Given these considerations, the value of Learner Workbooks as presently designed to foster improved learning outcomes is questionable (especially for Standard 1 learners, who lack basic numeracy skills and English literacy).

3.2.3 Low durability of the Learner Workbooks and issues with availability

A critical challenge relates to the durability of the workbooks. Teachers reported that the workbooks are printed in a fragile material that can disintegrate quickly. The situation in Standard 1 is more challenging than in higher standards because the learners are still very young; they are only just learning how to keep and look after their learning materials. Consequently, teachers noted that many learners had damaged or lost their workbooks early in the academic year. One teacher raised this issue during the focus group discussion:

> *"For many learners, you see that, just in* [...] *two weeks, the whole workbook has been torn apart."*

One headteacher also mentioned the issue of low durability when asked about the NNP materials:

> *"The books and the covers are not durable. They are not strong enough. So, learners, when you give the learners the book today, coming tomorrow you will find that some of the papers and some of the covers have been torn out. So, I was assuming that whenever they are giving us books for the second term, they have to make the books very strong."*

Given the central role of the Learner Workbooks in the NNP learning process, the availability and sustainability of the workbooks are key to the programme's success. However, teachers reported that each school receives only one workbook per student. As such, there are no spare books to replace those that have been lost or damaged. There is no possibility of offering workbooks to children transferring to the school throughout the year or those from a school that doesn't offer the NNP. For example, one head teacher emphasised that it is common to have a significant number of new enrolments throughout the year.

The lack of workbooks for learners is a major impediment to the NNP model. A significant component of lesson time is dedicated to independent work on the Learner Workbooks. One of the programme's core elements is learners' ability to think critically and independently, which requires them to have the resources to do so.

During observed lessons, many learners used workbooks that were in poor condition — invariably torn or crumpled. As these conditions were observed

in the first term, these workbooks may soon become unusable, and the contingent of students without appropriate learning resources may increase significantly. In some cases, a few learners did not have a workbook. These pupils may have forgotten the workbook on that occasion, lost the workbook entirely, or were perhaps new students who did not have access to a workbook because the school had no spare copies to provide. Regardless of the reason, we observed that in numerous instances, teachers did not take any action to resolve the problem: learners who did not have their workbooks with them often sat idly until the end of the lesson.

In some schools, teachers reported that they had developed a few strategies to bypass or address this challenge. In more than one school, teachers said that when a learner loses or damages their workbook, they give parents the option of making a photocopy of a workbook at the parents' cost. Although this might resolve the issue in some cases, not every family can afford the copying costs, especially if this happens more than once. Another strategy that one teacher mentioned was to limit the time learners have their workbooks. During the week, this teacher collects the workbooks at the end of every class and keeps them at the school. At the end of each week, she gives the learners the workbooks to take home for the weekend.

Teachers are aware of the importance of the Learner Workbooks to the success of the NNP and emphasised how looking after the workbooks is a priority for them. During the 'Teacher Reminder' session of one TLCs, the facilitator reminded their peers to always encourage their students to take good care of the workbooks. This seems to be a common practice among the teachers. We also observed that a few learners had their workbooks covered with either plastic or paper, further revealing a concern from the family about protecting the book.

3.2.4 Curriculum pacing in the Learner Workbook is challenging for teachers and learners alike

Another issue raised almost unanimously in the schools that were part of this study was the NNP workload. Teachers consistently reported that it had been very difficult to juggle everything they were 'supposed to' deliver in each lesson, such as providing instructions, conducting the teacher-led activity, independent work time, reflection, and marking. There is a general perception that the NNP has considerably increased the workload for

teachers and that there is too much content to cover and too many activities to be completed in just one lesson. As a result, teachers feel they have to rush and fall short of time to properly teach, support, and assess, which, according to them, can compromise the quality of the teaching. They often claimed that there was so much to do that the NNP lessons usually exceeded the time dedicated to them and took up time from other subjects.

When asked about the main challenges of the NNP, one head teacher said:

> *"The challenge is that considering the work for a day, it's too much. The work is too much. For example, if you take page* [... headteacher opens the workbook]. *For example, Standard 2, page 4, you can see a learner is supposed to count these chickens. And after counting, she is supposed to record this number here. And comes again with this question and solve it. But period is 30 minutes for Standard 1 and 2. After solving this question, comes doing this, after doing that comes to this one. It takes almost maybe three periods or four periods for a learner to cover this work."*

Two other head teachers shared this perspective, emphasising that:

> *"The first challenge is that there's a lot of content to be covered per day. As you have seen, on Standard One, Standard Two, the books, you know, there are a lot of activities to be covered in only one lesson. And those activities can take even two hours in order for a teacher to complete those. So, the content itself is too much for a day."*

> *"And too much of work to be covered in a lesson. For example, as I have already said, in Standard 2 we expect to have counting, after counting, there is problem-solving, after problem-solving, there is manipulating. For a Standard 1 learner to count and give him a problem for him to solve, and also manipulating, I think is too much work. Too many different topics at a single lesson. What I'm expecting is, let's say, this work* [pointing at one activity] *should be done in a single lesson, this one in a single lesson, this one should be done in a lesson. But if you combine all these things, at once, using 35 minutes that we use here in Malawi? I think it's enough of work. It's a challenge."*

Such perceptions are primarily based on the instruction teachers received during their training: to "complete one page per day". In one focus group discussion, when asked about the main challenges of the NNP, one teacher said:

> *"We were told that the work* [of a page] *is supposed to be done in one day. Sometimes is not easy to finish the whole work for just a day. Yes, we can do it, but it means that it will take a lot of time. Especially in the large classes, it takes a long time."*

In another focus group discussion, when questioned whether it is compulsory to complete the whole page in one day, two teachers said:

> *"Yes. We have to finish the whole page."*

> *"One page per day."*

Teachers reported that there are often too many activities on one page, and since they feel the pressure to complete all of them, the lesson may be rushed, or other tasks may be compromised. When asked what they would do to improve the NNP, most teachers answered that they would reduce the workload for each lesson.

> *"There's a lot of work to do per day. But if the work was to be reduced, NNP is just fine."*

On the same topic, one key teacher reported:

> *"It's tiresome* [...] *I can say that it is difficult for learners to finish the whole page at the time. Because we are given a page to do at a day. So for the learners to complete the whole page at a day is very difficult* [...]. *The work page has got a lot of work for the learners to do. So, that is the challenge. And also there are many strategies to do at one page. We can see that we have combining, dividing at the same time, combining, grouping, comparing at the same page. So, it is difficult for a Malawian child to cope with all those things at the same time."*

> *"Teachers have a lot of work to teach at the same time. When we want to complete the whole page, the other subjects suffer. Because there is a lot of work to do at the day. So, the teachers also find it difficult because they have a lot of things to do at that period."*

Our lesson observations indicated that teachers struggle to handle all classroom tasks. While teachers attributed this problem to the workload presented by the Learner Workbooks, the research team found that teachers could develop strategies to reduce the time spent on some tasks (e.g., marking the learner's workbooks). This would increase the time dedicated to independent work, practice, and reflection. In this context, this challenge reflects the teachers' extensive workload and their need for strategies for balancing these multiple tasks.

3.3. Findings relating to the Teacher Guide

Below are some insights from a review of the Teacher Guide by our team's numeracy pedagogy expert, as well as observations and interviews.

3.3.1 The Teacher Guide is comprehensive but may be too detailed for daily classroom use, with some teachers favouring the Learner Workbook.

Our desk-based analysis indicates that the Teacher Guide includes some appropriate pedagogy, clear lesson planning directions, and examples of activities that can engage learners. The Teacher Guide is well written and covers many aspects of teaching and learning, and would be highly suitable as a resource for use at a teacher training college/university for a 1-year programme training mathematics specialists for the primary classroom.

The Teacher Guide develops mathematical content knowledge as well as pedagogic knowledge. It may be too detailed for everyday use in the classroom, even if all teachers received a termly 5-day professional development programme. Even if teachers gain familiarity with and value the Teacher Guide through teacher professional development, they may only sometimes use the guide for everyday planning and teaching. This is especially true given the relative simplicity of the Learner Workbook, which teachers may decide is adequate for following the curriculum and can relieve them of the pressure of planning lessons.

3.3.2 Many teachers have a positive attitude towards the Teacher Guide but face challenges in using it effectively due to difficulties in navigation, lack of clear referencing, and a lack of structure by standard.

While teachers have a positive attitude towards the Teacher Guide, many highlighted several crucial issues that could compromise the effectiveness and use of the guides. Most participating teachers reported that the guide is difficult to use and navigate. For example, several teachers struggled to connect content in the Teacher Guide to specific pages and activities in the Learner Workbook. This issue emerged as a result of a need for clearer referencing and indexing. Separately, the Teacher Guide provides content for all lessons in Standards 1–4. However, this content is not structured by standard, which makes it challenging for teachers to identify age-appropriate materials.

When asked about using the Teacher Guide, most head teachers said that the teachers in their schools use the guide regularly to plan their lessons and extract knowledge from it. However, during the focus group discussions, some teachers shared a different experience—some said that the Teacher Guide only partially supports them in delivering the NNP; others pointed out that they do not understand the guide, and according to one:

> *"Me, I prepare the lesson plan using the workbook. The Teacher Guide is too difficult. I don't understand it."*

> *"When preparing the lesson, I find that I am able to use the Learner Workbook. Because this one* [the Learner Workbook] *is more clear than that one* [Teacher Guide]*."*

3.3.3 Many teachers expressed lack of comfort engaging with the Teacher Guide

Moreover, towards the end of the first term, teachers demonstrated a concerning lack of familiarity with the Teacher Guide. During the study, teachers indicated they were uncomfortable using the guide. This observation highlighted an important underlying issue: teachers do not feel prepared or empowered to use materials designed for them. Without further support, content designed to promote teacher professional development can be perceived as another hurdle to improved classroom practice.

These challenges can impede the success of the NNP, as teachers depend on the Teacher Guide to implement programme activities. As noted above, most teachers in the extended pilot programme struggled to access video-based training content. In this context, the guides represented the sole source of guidance for many teachers on delivering the curriculum.

3.4. Teaching and learning with the Teacher Guide and the Learner Workbooks

The NNP developers have created a package of high-quality Learner Workbooks, Teacher Guide, and supporting videos. Review of these materials prompted the question: *Is using this package of learner and teacher materials the most effective way of developing high-quality teaching and learning in the NNP schools?* Due to the cascade model through which training has taken place, successful implementation of the NNP requires teachers to have studied all aspects of the Teacher Guide and use it at all stages in their lesson planning. This is a tall order for busy teachers with large classes.

The subsection below looks at some of the challenges of teaching and learning using the resources available in the NNP.

3.4.1 English is the language of instruction in the NNP, which poses challenges for learners, especially in the first two years, as they often arrive with little to no English language skills.

In contrast to the other subjects taught in Standards 1 to 4, which are normally taught in Chichewa, the language of instruction for the NNP is English. The first lesson for the first day in school for a learner in Standard 1 requires the learner to follow simple instructions, such as, '*Will each boy get a ndasi?*'[1] and to answer with '*Yes*' or '*No*'. There is no proper introduction to numbers or essential mathematical terminology in English.

Most primary learners, particularly in disadvantaged rural areas, will arrive at school only speaking Chichewa (or another home language). They will not have learnt to read, speak, or understand English, and they will have no experience of working independently. The Teacher Guide does not address this issue. While teachers of Standards 1 and 2 will have experience in

[1] Ndasi is a fried Malawian snack.

teaching children to read and write, they will struggle to teach the basics of English as well as reading and writing mathematics in English.

3.4.2 The Learner Workbook at times introduces mathematical vocabulary without providing meaning.

All children need support in learning and using specialist mathematical vocabulary. Unfortunately, the NNP workbook introduces mathematics vocabulary without providing adequate meaning. The workbook uses the word 'triangle' in S1T1 (Standard 1 Term 1) but only defines 'triangle' in S3T2.[2]

In many lessons, learners are given word problems to solve. These problems introduce the learner to addition, subtraction, multiplication, and division operations without helping the learner understand which operation to use. Without this essential support, learners are unlikely to recognise questions such as '*How many altogether?*' or '*How many does she have now?*' relate to addition.

While the Teacher Guide does suggest some approaches for learners to work out the meaning of word problems (including examples of questions that introduce the different operations) more deliberate instruction is needed to provide learners with the understanding they need for future problems, for example, how to identify the correct operations and appreciate that many different expressions mean you must add or subtract. The workbook also does not introduce the names of the four operations and the symbols attached to them. For instance, in the S1T2 workbook, the symbol "+" is suddenly introduced without explanation. A wall poster with mathematical symbols and making a record in the Learner Workbooks of the symbols used to represent the four operations could help learners grasp these concepts.

The Teacher Guide emphasises the importance of learning to count and suggests that teachers use counting songs and games. This method is very valuable for learning, but more is required. Children should be able to chant/sing counting numbers while seeing the number symbols on a number line. This can help them to associate a number name with a number symbol and the size of a group of counters. Once learners are familiar with counting numbers from 1 to 10 in English, then the teacher will

[2] In English and many other European languages, mathematical terms are derived from Latin or ancient Greek. Many learners will recognise that 'triangle' must be linked with 'three'. This link will not be apparent for learners whose first language has not derived from Latin or Greek.

need to spend time helping the learners count from 10 to 20, as the words and numbers are new. Children must understand that the numbers between 20 and 30 look and sound similar in English, and that only the unit's digit changes. Next, learners must understand that the numbers between 30 and 40 are the same as those between 20 and 30, but only the 10s' digit changes.

When children chant and learn numbers by rote, they may hear the number 23 as one word 'twenty-three' and not understand that it is made up of counting on three from twenty. The Learner Workbook promotes a learning progression whereby a child can move seamlessly from counting from 1 to 20 to higher numbers without mentioning or demonstrating place value. Learners will need to see that once they can count from 1 to 10, and they can count from 10 to 20, and then the counting from 20 to 30, or from 30 to 40 or from 70 to 80 follows the same pattern.

Ensuring learners have a sound understanding of the concept of place value is fundamental. Understanding this concept is the foundation of the base 10 number system and the four arithmetic operations. However, NNP resources do not adequately develop this understanding. For instance, the Teacher Guide suggests that the teacher must develop:

> *"A sense of the 'muchness' of number, i.e., the understanding that 5 is a small number, 50 is a larger number and 500 is a much larger number*[3] [...] *and that the last number counted tells us the size of the group."*

The Teacher Guide tells teachers to use Flard cards to help learners gain this sense of size of a number, but nowhere in the Learner Workbook is there support for learners' development and understanding of place value. This omission should be rectified in future editions.

3.4.3 The NNP teaching and learning resources present challenges in helping learners transition from counting in ones to counting in groups.

One of the main pedagogical issues found when analysing the NNP teaching and learning materials is building the bridge between counting in ones to counting in 2s, 3s, 5s, 10s. Some guidance to teachers on helping

[3] Using the rule 'the last number counted tells you the size of the group' is a correct rule but not helpful for learners to know which of 5, 50, and 500 is the largest. Instead, what is more helpful to understanding is having a good sense of place value.

learners to identify and use these patterns does exist in the Teacher Guide, for instance:

> *"Children are frequently asked either explicitly (for example, 'What did you notice?') or implicitly (for example, in extending patterns) to reflect on what they have done, forcing them to reason and develop their understanding of what they are doing. The role of the teacher in this activity cannot be overstressed – the expectation is that teachers will, more than checking answers, review activities by asking questions such as: 'What did you notice?', 'How did you do that?', 'How was this activity similar to or different from previous activities?' etc."* [Teacher Guide, page 3]

However, this requirement to notice or explain is rarely present in the Learner Workbook, and learners are not adequately asked to notice number patterns.

3.4.4 Issues with the introduction of strategies and progression from word problems to formal notation

The Teacher Guide provides a valuable and commendable pedagogic approach to teaching children to perform calculations. But this pedagogic approach is not reflected in the workbook.

> *"The strategies used by children to do the mathematics (e.g., perform calculations) are not prescribed. Rather, children are introduced to a range of different strategies with the expectation that they will develop the ability to apply these strategies fluently (with confidence) and flexibly (selecting calculation strategies or problem-solving approaches that are appropriate to the situation at hand) across a wide range of contexts."* [Teacher Guide, page 2]

While the Teacher Guide effectively demonstrates various calculation strategies like counting on and counting back using diagrams and empty number lines, these diverse strategies should be visually represented in the Learner Workbook, which currently needs more evidence of introducing multiple strategies. Only in Standards 3 and 4 do we see learners directed to use an empty number line for addition/subtraction, with little guidance on applying these or other strategies to solve different problems on the same page.

Additionally, the progression from combining numbers in word problems to utilising formal mathematical notation (+, −, ×, ÷) occurs without any prior introduction in the workbooks. For example, in Standard 3, long multiplication questions are presented; in Standard 4, long division is introduced without proper explanation.

3.4.5 The challenge of formative assessment

The Learner Workbooks provide a daily record of what children have done and hopefully learnt, and could be used creatively to provide formative and end-of-term assessments. For instance, according to the Teacher Guide: says:

> *"Formative assessment involves assessing learners on a day-to-day basis to monitor the learning process. The structure of the NNP Learner Workbooks is such that the pages are in effect daily formative assessment tasks."*
> [Teacher Guide, page 184]

However, teachers are asked to do "more than checking answers, review activities by asking questions such as '*What did you notice*?', '*How did you do that*?', '*How was this activity similar to or different from previous activities*?'". This is a difficult task for teachers of small classes, and even more complex for the large classes most NNP teachers will have. A PEA raised this issue, emphasising:

> *"Another challenge is the mode of teaching. With the number of learners that we normally have in our classes, it's tough time for the teachers to organise the learners in the class.* [...] *Now in Malawi, we have always large classes, in Standard 1, Standard 2, Standard 3, Standard 4, always large classes."*

The NNP aims to support learners to think critically, learn from their successes and mistakes, and reflect on their educational trajectory. To this end, teachers must lead formative assessment and regularly provide individual feedback.

In Malawi, the education sector faces three structural challenges that the NNP needs to account for to promote suitable strategies for formative assessment. First, many teachers have to support and manage many learners. In Standard 1, for example, class sizes often exceed 100 pupils. In this context, providing individual feedback would significantly increase teachers' workload. Second, most teachers independently support

students, even though every class is supposed to have a teaching assistant. Third, in many schools, NNP lessons overrun regularly and take up time from other subjects.

In this study, teachers identified the practice of marking Learner Workbooks as a shortcoming of formative assessment in the NNP. Teachers noted that marking every workbook consumes a significant amount of lesson time because of large class sizes. In some cases, formative assessment took up to half of the time allotted to maths lessons.

In this setting, marking became the sole interaction between the teacher and learners, who received limited individual feedback. For example, teachers often fail to explain how pupils could resolve mistakes such as calculation errors, the use of unsuitable strategies, and conceptual misunderstandings. Without this guidance, learners are unlikely to develop the critical thinking skills the NNP aims to promote.

Our findings show that most teachers are unprepared to conduct formative assessments. By primarily focusing on marking workbooks, teachers do not provide input for learners to reflect on. In this context, teachers require support to develop strategies to monitor learners' progress effectively and to provide tailored feedback for each learner. Without these strategies, teachers either follow the NNP's theoretical structure or use traditional approaches to assessment.

3.5. Teacher learning circles

At the start of the extended pilot programme, teachers participated in school-based TLCs every month. The section head for Standards 1–4 in each school usually facilitated sessions, although teachers in some schools shared this responsibility. Here, facilitators were essential in supporting teachers in discussing and reflecting on classroom practice. In doing so, facilitators guided teachers to identify—and commit to adopting—practical strategies to address classroom challenges. In subsequent sessions, teachers could hold each other accountable for such commitments.

Under the NNP, the TLC sessions have eight sections:

1. Welcome
2. Just for fun

3. Reflect and share
4. Practice and feedback
5. Teacher reminder
6. What will I do differently?
7. Next time
8. Co-facilitator support

Below are some insights from observations of the sessions.

3.5.1 TLCs tended to become a routine exercise with limited interaction and reflection, as teachers focused on completing prescribed activities.

In participating schools, teachers diligently went through every section mentioned above and completed all the prescribed activities. However, this approach turned sessions—or parts of sessions—into a routine with limited opportunities for interaction and reflection.

Moreover, facilitators adopted a lecture-based approach to managing TLCs. Teachers should have reviewed, discussed, and practised a specific topic or skill in the 'practice and feedback' section. Instead, most facilitators delivered highly theoretical content in a lecture format. In most sessions, for example, facilitators stood at the front of the class and dictated content to teachers who sat and answered questions when asked. Notably, this format can create a traditional classroom 'hierarchy' where the facilitator acts as a 'lecturer' and other participants act as passive recipients of content.

In the 'reflect and share' section, meanwhile, teachers were expected to share successes and challenges, exchange classroom strategies, and learn from each other's experiences. However, most facilitators dominated this section, which typically resembled a 'recap' of the previous sessions and the main challenges from classroom observations. Even when teachers shared their experiences, facilitators mostly simply acknowledged these contributions before moving on to the next agenda item with no follow-up questions.

In one exemplary school, the facilitator demonstrated the potential value of this section. Here, the facilitator led a role-play activity where some

participants were assigned the role of learners while others were assigned the role of teachers. The objective was to test effective ways to respond to learners' errors. During the exercise, participants rotated roles and saw how their peers would address this issue. Even though there was little time for feedback and reflection after the activity, this is a positive example of how learning can take place in an engaging and collaborative way.

Teachers were not regularly encouraged to try new classroom strategies outside this section. In most cases, teachers pointed out what they could do differently to improve overall instead of identifying specific practices that they would adopt in the following weeks. In this context, TLCs made a limited contribution to promoting school-level change and creating a culture of accountability.

These findings highlight some of the challenges related to the delivery and structure of TLCs. Critically, key teachers need additional support to develop the skills to facilitate sessions effectively. Moreover, the NNP should outline practical strategies and activities to prompt teachers to participate, discuss, and reflect during sessions.

4. Recommendations

Based on the study's findings, we make the following recommendations to address the challenges identified by this study:

1. Training for master trainers and school-based facilitators should model and cover strategies for facilitating interactive professional development sessions.
2. The allocation of Learner Workbooks should reflect:
    - the number of pupils enrolled in each school at the beginning of the year
    - a projection of the number of new enrolments throughout the year
    - a projection of the required number of replacement workbooks.
3. The links between the Learner Workbook and Teacher Guide should be simplified, and page numbers should be used to refer teachers to relevant activities.
4. The Teacher Guide should be restructured and organised by standard so that teachers can locate level-appropriate content more easily.
5. The structure of TLCs should follow a more classroom-oriented approach, incorporating videos modelling relevant skills and classroom practice to support critical reflection and discussion.
6. Existing digital content should be repackaged to align with activities in the TLCs.
7. TLCs should include time for teachers to develop lesson plans that incorporate the skills discussed in the session and form the basis of reflection in subsequent sessions.
8. The NNP can strengthen teaching and learning by introducing changes to and providing additional resources for the Learner Workbooks.
9. TLCs could be refined and redesigned to be more hands-on. In the short term, this support should take the form of time for teachers to

work together on enhancing their knowledge, practise pedagogical approaches, and develop lesson planning skills.

10. Teachers must feel they have some ownership and become more involved in the project. This could perhaps be achieved by finding and deploying lead teachers who receive training who could model lessons and share pedagogy with other teachers in their schools/region, and:
    - setting up WhatsApp groups to share lesson plans and even short videos of classroom practice
    - ensuring all teachers have resources such as number lines, 100 square number grids, Flard cards for place value and a glossary of key mathematical vocabulary, to name but a few.
11. The NNP would benefit from specialist teacher input on multilingual teaching, particularly key guidance on early years mathematics teaching in English to children who enter school with no English and no reading or writing skills.
12. The NNP must evaluate the benefit of providing all Standard 1 learners 1 with a workbook when most cannot read or write. Could the saved cost be used more productively for teacher resources and support?

Below are some practical tasks to improve learning. Some of these can be developed through a co-design process. It will be important to get some input from classroom practitioners and/or primary educators from the teaching colleges.

13. Draw up a list of the key mathematical areas of weakness that need addressing in the workbook and the teaching.
14. Create some professional development resources and activities to share with teachers. These need to be short and straightforward and able to engage teachers easily, and can include lesson plans.
15. Support teachers in creating vocabulary guides and posters portraying keywords that learners in each standard need to know.
16. Design and draw up additional pages for the Learner Workbooks to support learning. These can include:
    - place value illustrations

- a glossary of keywords and symbols
- 100 square grids and number lines
- illustrations of different strategies for number calculations.

17. Develop easy-to-apply strategies for formative assessment such as ‘Show me your answer’, ‘Check your answer in your group’, and ‘Come and help me write the answer on the board’.

5. Implications for future research

The NNP has been designed to meet a pressing need for improving learning outcomes and reducing learning poverty in Malawi. This study was carried out during the first term of the extended pilot phase of the programme, taking place in the 2022-2023 school year. It aimed to understand how teaching and learning take place, considering the training that teachers have received. It also aimed to understand how teachers and learners interact with the available resources, and how teachers are supported in their schools to ensure continuous professional development.

Through this rapid research, the team sought to better understand the programme by observing lessons and TLCs, assessing the teaching and learning materials, and drawing on teachers' experiences. The study's key finding is that the NNP has a robust model comprising high-quality resources to support teaching and learning. However, leveraging these resources to achieve better learning outcomes requires teachers to be better prepared and continuously supported. Teachers must be able to take ownership of the programme, master the skills and strategies it covers, connect the different activities across lessons, and assess levels of understanding during lessons. Teachers must build greater confidence in their mathematics knowledge and pedagogy, and feel supported in overcoming identified challenges.

The findings of this study have been used to inform the work to be undertaken during the second term of the school year and subsequent scale-up phases. To ensure continuous improvement in teaching practices and student learning outcomes, providing comprehensive support to educators is crucial, enabling them to expand their knowledge, skills, and instructional approaches. By doing so, they will be better equipped to foster mathematical fluency among their students. The NNP provides face-to-face training for teachers at the beginning of each school year, introducing and refreshing essential concepts, skills, strategies, and pedagogy. While this initial training is valuable, we recognise its limitations due to the constrained time frame and extensive content to be covered.

Considering the vital role that teacher continuous development plays in the effectiveness of these types of interventions, and the pressing need for support that teachers have demonstrated in the context of the NNP, the team has decided to focus on the TLCs and undertake design-based

implementation research. This will help to build evidence on how to optimise key features of school-based teacher continuous professional development. The aim is to support Malawi's NNP to improve numeracy instruction effectively.

In addition, this study's findings have fed back into the programme and informed crucial revisions to both the Learner Workbook and the Teacher Guide to be carried out in Terms 2 and 3 of the 2022–2023 school year. The ongoing partnership between FCDO, Malawi's MoE, Cambridge Education, and EdTech Hub is crucial to ensure that research, evidence, and implementation are seamlessly integrated to improve numeracy education in Malawi.

References

These references are available digitally in our evidence library at https://docs.edtechhub.org/lib/B8SQMMBA

Allier-Gagneur, Z., McBurnie, C., Chuang, R., & Haßler, B. (2020). *Characteristics of effective teacher education in low- and middle-income countries: What are they and what role can EdTech play?* [Helpdesk Response No. 10B]. EdTech Hub. https://doi.org/10.53832/edtechhub.0007. Available from https://docs.edtechhub.org/lib/R9VVKUH5. Available under Creative Commons Attribution 4.0 International. (details)

Brombacher, A. (2019). *Research to Investigate Low Learning Achievement in Early Grade Numeracy (Standards 1–4) in Malawi: The victory of form over substance*. HEART. https://www.numbersense.co.za/wp-content/uploads/2022/05/Scoping-Report_Malawi-Early-Grade-Numeracy-Research-Activity.pdf. (details)

D'Angelo, S., Hennessy, S., Kreimeia, A., Koomar, S., Cao, L., McIntyre, N., Brugha, M., & Zubairi, A. (2022). *Technology Use for Teacher Professional Development in Low- and Middle-Income Countries: Recommendations for policy from a systematic review* [Policy Brief]. EdTech Hub. https://doi.org/10.53832/edtechhub.0080. Available from https://docs.edtechhub.org/lib/7S9CUP77. Available under Creative Commons Attribution 4.0 International. (details)

Hennessy, S., D'Angelo, S., McIntyre, N., Koomar, S., Kreimeia, A., Cao, L., Brugha, M., & Zubairi, A. (2022). Technology use for teacher professional development in low- and middle-Income countries: A systematic review. *Computers and Education Open*, *3*. https://doi.org/10.1016/j.caeo.2022.100080. Available from https://www.sciencedirect.com/science/article/pii/S2666557322000088. (details)

Kazima, M., Longwe, J. & Gobede, F. (2022). Improving teaching and learning mathematics in Malawi primary schools: a review of reforms, interventions, successes and challenges. *Journal of Applied Learning & Teaching*, *5* (Special Issue 2). https://doi.org/10.37074/jalt.2022.5.S2.3. Available from https://journals.sfu.ca/jalt/index.php/jalt/article/view/559. (details)

Ministry of Education. (2022). *Education Statistics Report*. Government of the Republic of Malawi. http://www.education.gov.mw/index.php/edu-resources/2022-education-statistics/category/10-reports?download=74:2022-malawi-education-statistics-report-emis (details)

Rui, Y. (2024). *EdTech in Malawi: A Rapid Scan*. EdTech Hub. https://doi.org/10.53832/edtechhub.0152. Available from https://docs.edtechhub.org/lib/NMJMENAG. Available under Creative Commons Attribution 4.0 International. (details)