NFER International

Learning Study on Sustainability for the Plug-in-Play Project, Rwanda

Sustainability of Play and Technology-based Approaches in Science and Elementary Technology lessons at Upper Primary level

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CONTENTS

ACRONYMS

CBC	Competence-Based Curriculum
CPD	Continuing Professional Development
DEO	District Education Officer
DoS	Director of Studies
FGD	Focus Group Discussion
HT	Headteacher
ICT	Information and Communications Technology
LtPT	Learning through Play with Technology
MINEDUC	Ministry of Education
MEL	Monitoring, Evaluation, and Learning
NFER	National Foundation for Educational Research
PIP	Plug-in-Play Project
PLC	Professional Learning Community
RCA	Reflect-Connect-Apply (Assessment Strategy)
REB	Rwanda Education Board
RTP	Right to Play
SEO	Sector Education Officer
SET	Science and Elementary Technology
SSI	Semi-Structured Interview
STEM	Science, Technology, Engineering, and Mathematics
TSI	Three Stones International
TTC	Teacher Training College
TPD	Teacher Professional Development

Executive Summary

Introduction

The Plug-in-Play (PIP) project supports the Government of Rwanda's ambition to transform Rwanda into a knowledge-based economy. One strategy for achieving this goal is to support schools in delivering engaging and practical Science and Elementary Technology (SET) lessons so girls and boys receive high quality SET education. Accordingly, PIP aims to improve SET pedagogies in Rwandan schools by using Learning through Technology with Play (LtPT) methods, which comprise interactive and playful approaches to education.

The project seeks to integrate LtPT methods into SET subject teaching by supporting upper-primary (grades P4-P6, 10-12 years old) SET teachers' professional development and practices. The LtPT approach integrates play-based pedagogies into three components of the Rwandan SET curriculum: tinkering and making, coding and robotics.

NFER, with the support of TSI, has designed this in-depth study to provide insights into the extent to which the approach to learning through play and technology is intended to be sustained by educators beyond the life of the PIP project. This study builds on a qualitative study we conducted in 2023 with TSI which explored teachers' and learners' experiences of LtPT. It aims to draw out insights from users into what the most useful aspects of LtPT are and how these can be sustained. These insights will inform the potential for the scale up of LtPT to schools across Rwanda.

This study explores the most useful LtPT practices used in SET classrooms in twelve schools supported by the Plug-in Play project in different contexts. It provides insights into the LtPT practices most often integrated into lessons and most likely to be used in SET lessons in the future; the support, guidance and resources that school leaders (headteachers and Directors of Studies), teachers and SET teacher trainers need to master LtPT, and what is currently available. It further explores lessons learnt from the implementation of LtPT, and any challenging factors to maintaining the approach in schools.

The insights gathered, together with recommendations from stakeholders, will help to determine the replicability and/or scalability of LtPT.

The study was conducted in the Cohort 1 districts of Kayonza, Rubavu and Ruhango and the Cohort 2 districts of Nyanza, Musanze, Nyagatare. Data was collected from participating schools in the districts.

The research questions are:

1) Which are the most useful LtPT practices in the classroom?

2) How useful is the support to education stakeholders for using LtPT?

3) What factors support or constrain the sustainability and scale of LtPT?

Key Findings

Which are the most useful LtPT practices in the classroom?

- Teachers use a range of LtPT strategies around active participation and they align their activities to the lesson objectives.
- In lesson observations, headteachers look for teachers' lesson preparation and how teachers use lesson planning to implement LtPT in their classrooms.
- Headteachers and teachers reported on the effectiveness of LtPT practices in supporting learner engagement and improved learning outcomes.
- Teachers reported that they would continue all their current practices in the future due to the benefits to children's learning imparted by LtPT.
- Teacher trainers use LtPT strategies when training teachers to integrate LtPT.
- While conveying their willingness and plans to continue using LtPT practices, teachers highlighted their skills gaps to confidently deliver all aspects of LtPT in coding and robotics.
- The use of teaching and learning materials for hands-on activities has contributed to teachers' confidence in delivering interactive and engaging lessons, however, there is a shortage of resources for coding and robotics.

How useful is the support to education stakeholders for using LtPT?

- All support was conveyed to be helpful; with lesson observations reported to be highly useful for improving the quality of SET lesson delivery.
- Teachers regarded peer learning opportunities highly for helping them to learn how to discuss challenges and share best practice in both their SET-specific and other teaching responsibilities.
- Schools are also supported with lesson observations and general guidance on LtPT by middle tier education officials, particularly Sector Education Officers.

What factors support or constrain the sustainability and scale of LtPT?

- There is cross-curricular application of the hands-on and engaging elements of the approach in non-SET lessons, suggesting institutionalisation of LtPT at the school level.
- All stakeholder groups expressed that they would continue to advocate for increased resources and to generally promote LtPT, and showing a willingness to sustain the approach.
- Parental engagement activities help to embed LtPT but not all schools are carrying these out.
- Effective teaching of technology and robotics needs extended training and resources.
- Ongoing professional development and follow-up support are critical for sustainability.
- Most interviewees generally agreed that LtPT complements the national curriculum but highlighted a few challenges around implementing it alongside the curriculum.
- Some components of LtPT can increase teacher and headteacher workload.
- Providing resources for remote learning is necessary for crisis resilience.
- Resources and guidance for implementing the approach after the end of the PIP programme are needed.
- Participants recommend extending LtPT across Rwanda, while reiterating many of the same challenges that they had experienced in their schools.
- Rural schools, in particular, are likely to be at a disadvantage when scaling LtPT.

Conclusions

Headteachers and teachers reported on the effectiveness of LtPT practices in supporting learner engagement and improved learning outcomes, suggesting that LtPT is adding notable value to learners' SET experience and performance. All stakeholder groups reporting using a wide range of LtPT components, for example, lesson observations, and active participation strategies indicates the effectiveness of these strategies.

Teachers are confident in using teaching and learning materials for hands-on activities in tinkering and making and are becoming more proficient in sourcing local materials. There are, however, resource shortages for coding and robotics lessons. Teachers also face significant skills gaps in confidently delivering the coding and robotics components of SET lessons, despite receiving training through the PIP programme. This scarcity of resources hampers their ability to teach coding and robotics effectively.

Lesson observations and peer learning opportunities are well-regarded forms of support and support from SEOs and DEOs is also valued. Both teachers and headteachers find this helpful for applying LtPT with fidelity. The involvement of SEOs and DEOs suggests that the approach is becoming embedded across some of the education system.

There is some cross-curricular application of the hands-on and interactive elements of the approach in non-SET lessons, suggesting institutionalisation of LtPT at the school level. Although the approach was primarily developed for SET lessons, the permeability of some strategies in other subjects will help to sustain it, as school-wide application will ensure that all staff are practising it.

All stakeholder groups are invested in supporting the continued use of LtPT, both through classroom practice and wider efforts to promote it, for example through robotics competitions, supporting learners to applying their learning. They are also committed to continue to advocate for increased resources. This indicates an ownership mindset which will help to support sustainability.

However, there are challenges around the need for extended coding and robotics training. Addressing both the skills gap and resource constraints is critical to enhancing the overall effectiveness of teachers in implementing the LtPT approach sustainably and suggests that low-tech and contextualised solutions are needed for the sustainability of LtPT overall.

All stakeholder groups generally agreed that LtPT complements the national curriculum but they also highlighted a few curriculum-related challenges, namely, knowing how to apply LtPT for certain topics, the heaviness of the curriculum and the time taken to complete it and that LtPT in general and robotics, in particular, needed to be more visible in the curriculum.

Lesson preparation can lead to increased workload while a few school leaders reflected that conducting lesson observations can be a constraint on their time.

The provision of resources and guidance for implementing the approach after the end of the PIP programme is needed. Furthermore, the resources and guidance for remote learning are similarly necessary for crisis resilience in a school closure scenario.

When considering the implications for scaling LtPT, while participants recommended extending LtPT across Rwanda, they noted that rural schools, in particular, are likely to be at a disadvantage when scaling, mainly due to a lack of connectivity and familiarity with digital devices.

Recommendations

- Offer advanced training on coding and robotics to increase teachers' confidence in delivering LtPT.
- Advocate to level up rural schools to close the technology resource gap with urban schools.
- Mobilise support around low-tech solutions and ways to share available tech resources like those used in robotics competitions.
- Continue to support teachers by providing them with further guidance on LtPT while the approach is being more fully integrated into the curriculum.
- Continue to support the embedding of the use of local materials and share successes around the use of local materials in regional knowledge exchange platforms.
- Develop guidance on minimum standards to support the harmonisation of support and activities across schools and educators.
- Spearhead efforts to streamline LtPT approaches beyond SET.

1 - Introduction

1.1 Plug-in-Play Project background

In recent years, the Government of Rwanda (GoR) has increasingly prioritised building a knowledge-based economy with an emphasis on science and technology, which is underpinned by the competency-based curriculum (CBC) launched in April 2015 (MINEDUC, 2019).

One of the strategies for achieving this ambition is to improve the quality of Science and Elementary Technology (SET) education for girls and boys, including learners with Special Education Needs (SEN), across the country by supporting schools to deliver engaging and practical SET lessons.

As set out in Rwandan education policy, this attention to SET derives from a more comprehensive government commitment to strengthening Science, Technology, Engineering and Mathematics (STEM) from pre-primary to higher education (MINEDUC, 2019). This logic is central to PIP, which aims to improve SET learning in Rwandan schools using engaging play-based approaches to education.

The PIP project was piloted and implemented over four years, from July 2021 to December 2024. The project seeks to integrate Learning through Play with Technology (LtPT) into SET subject teaching by supporting upper-primary (grades P4–P6, ages 10-12 years old) SET teachers' professional development and practices. This approach integrates play-based pedagogies into three components of the Rwandan SET curriculum: tinkering and making, coding and robotics.

By improving teachers' ability to deliver practical, interactive, and playful pedagogies, PIP expects to improve learners' academic performance in SET subjects, and to enhance 'holistic skills' or 'generic competencies' through Information and Communications Technology (ICT) and science and technology lessons.

Alongside delivering capacity-building activities centred on LtPT, PIP strives for the sustainability and scale-up of project activities beyond its timeframe. This pursuit is promoted through the project's experimental, iterative, context-sensitive, collaborative approach and gives rise to two key project features. First, PIP relies on successive pilot phases where project stakeholders co-create materials and interventions, regularly collect data and gather lessons allowing them to collectively vet, improve on and validate the intervention's approaches and toolkits. Second, it delivers its interventions through existing Ministry of Education (MINEDUC) and the Rwanda Basic Education Board (REB) teacher training structures to generate government buy-in and capacity to integrate approaches into the formal curriculum and teacher professional development programmes.

Tinkering and making

Teachers are provided with training that develops skills to use play to encourage learners to explore and discover new ideas and engage with their creativity and imagination as they learn about SET concepts.

Coding

Learners are taught how to use computers to code, using playful and engaging approaches which boost a variety of generic competencies such as teamwork and collaborative skills.

Robotics

Using skills and knowledge gained in tinkering, making, and coding, learners learn how robots work by manipulating and exploring them, before being trained to make robots themselves at an appropriate level, and use robots to find solutions to different questions and everyday problems.

Project activities

PIP activities can be grouped into five broad interconnected components of activities.

1 - Developing culturally appropriate contents, materials and training on LtPT.
2 - Training educators and other education stakeholders to deliver LtPT.
3 - Piloting and implementing LtPT in SET lessons with support from communities of practice (COP) for teachers and coaching from Teacher Training College tutors, school leaders and education officials. Coaching for teachers includes classroom observations with feedback, conducted by school leaders (headteacher or Director of Studies), RTP staff and local EdTech partners.
4- Advocacy and communication activities to raise awareness of LtPT and integration into the curriculum in schools and communities.
5 - Sustainability and scale up activities to inform a potential countrywide scale up of PIP.

The project aimed to reach different stakeholders in participating schools from Cohorts 1 and 2 of the Plug-in Play project, as set out in Table 1 below.

1.2 Background to the Learning Study

The National Foundation for Educational Research (NFER), in collaboration with Three Stones International (TSI), are the Monitoring, Evaluation and Learning (MEL) partners on the PIP project, bringing extensive expertise in educational research and knowledge of Rwandan context. They were commissioned by Right to Play in November 2022 to help generate relevant, in-depth and timely evidence to improve project learning, adaptation and scale-up.

NFER is a leading provider of educational research, evaluation, and assessment in the UK. TSI is a Rwanda based management, research, and development firm with an extensive understanding of the Rwanda education context.

As part of this partnership, NFER, with the support of TSI, has designed this in-depth study to provide insights into the extent to which the approach to learning through play and technology is intended to be sustained by educators beyond the life of the PIP project.

This study builds on a qualitative study we conducted in 2023 with TSI which explored teachers' and learners' experiences of LtPT. It aims to draw out insights from users into what the most useful aspects of LtPT are and how these can be sustained. These insights will inform the potential for the scale up of LtPT to schools across Rwanda.

This study explores the views and practical experiences of different stakeholders, including school staff (teachers, headteachers and director of studies) and teacher trainers from Teacher Training

Table 1: Summary of the population targeted in PIP (Cohort 1 and 2 schools)

Target group	Plug-in-Play reach (Cohorts 1 and 2)
Districts	6: Cohort 1 - Kayonza, Rubavu, Ruhango Cohort 2 - Nyanza, Musanze, Nyagatare
Schools	312 Primary schools
Educators	835 in-service SET subject teachers
School leaders	561 (62 female/240 male) Headteachers & Directors of Studies
Trainers	28 trainers of in-service SET subject teachers

Colleges (TTC). This builds on the ongoing monitoring activities conducted by Right To Play as part of project implementation.

This study is the last of two deep-dive studies that have been conducted by the MEL partners (NFER and TSI) to enhance ongoing learning and adaptation for Plug-in Play.

This research delves into the most useful LtPT practices used in SET classrooms in twelve schools supported by the Plug-in Play project in different contexts. It provides insights into the LtPT practices most often integrated into lessons and most likely to be used in SET lessons in the future; the support, guidance and resources that headteachers and Directors of Studies, teachers and SET teacher trainers need to master LtPT, and what is currently available.

It further explores lessons learnt from the implementation of LtPT, and any challenging factors to maintaining the approach in schools. The insights gathered, together with recommendations from stakeholders, will help to determine the replicability and/or scalability of LtPT.

This report is organised into the following sections:

Learning Study Design, which outlines the study's qualitative approach, details the sampling of 12 schools from various regions and describes the methods used to collect data, addressing key research questions related to effective LtPT practices, necessary support for teaching, and factors influencing sustainability and scalability.

The **Findings** section presents the main results, examining the most commonly used LtPT practices in classrooms, the effectiveness of the support provided, and the challenges and enablers of long-term implementation. The **Conclusions** summarise the insights, emphasising the importance of continuous support, effective practices, and addressing challenges like curriculum alignment and resource constraints.

Finally, the **Recommendations** provide actionable steps to improve and sustain LtPT practices in Rwanda, such as aligning with the national curriculum, enhancing resource availability, and ensuring ongoing professional development.

2 - Learning Study design

2.1 Study design

This study adopts a case-study design, drawing on data from semi-structured interviews and a focus group discussion. Qualitative approaches (or 'case-based' strategies) tend to be interested in a small number of interesting or significant cases (Ragin, 1999) which will allow a depth of learning, and an understanding of contextual factors that explain how or why certain patterns occur (or do not occur).

This qualitative study explores the experiences and perceptions of individuals engaging with LtPT in Rwandan schools. Twelve schools were selected as illustrative, deep-dive case studies which look at the lived experiences of those who deliver and engage with LtPT in SET classrooms. A case study approach uses a variety of data sources to explore a specific phenomenon in context (Baxter and Jack, 2008).

This study explores the most useful LtPT approaches used in SET classrooms in selected schools supported by the Plug-in Play project in different contexts.

It will provide insights into the LtPT practices most often integrated into lessons and most likely to be used in SET lessons in the future; the support, guidance and resources that headteachers and Directors of Studies, teachers and SET teacher trainers need to master LtPT, and what is currently available.

It explores lessons learnt from the implementation of LtPT, and any challenging factors to maintain the approach in schools. The insights gathered, together with recommendations from stakeholders, will help to determine the replicability and/or scalability of LtPT.

The objective of the study is to respond to the research questions detailed in Table 2.

Table 2: Research questions

Research questions	Areas of enquiry
1) Which are the most useful LtPT practices in the classroom?	• LtPT teaching practices most often integrated into SET lessons since engaging with training and support on LtPT. • Stakeholders' perceptions on what will continue to be used in future SET lessons, and any challenges they foresee in this area. • LtPT teaching and learning materials for each of the three lesson types (tinkering and making, coding, and robotics) and how these are used.
2) How useful is the support to education stakeholders for using LtPT?	• The different types of support that teachers need in order to master LtPT, such as communities of practice, professional learning communities, coaching. • Resources provided to schools by TTCs to support sustainability. • Teacher professional development resources provided to schools by PIP and their capacity to update such resources after PIP is phased out. • Guidance available for developing minimum standards of support for LtPT in schools. • How school leaders facilitate/coordinate engagement with parents and the wider community.
3) What factors support or constrain the sustainability and scale of LtPT?	• Lessons learnt from the implementation of LtPT so far. • Enabling and challenging factors to maintaining LtPT in schools and TTCs. • Stakeholder recommendations on what PIP should engage in its last months to support sustainability.

2.2 Sampling approach and methods

The study was conducted in the Cohort 1 districts of Kayonza, Rubavu and Ruhango and the Cohort 2 districts of Nyanza, Musanze, Nyagatare. Data was collected from participating schools in the districts.

This study adopted a non-probability purposive sampling approach and is not intended to be statistically representative of the wider PIP beneficiary population.

Our sample sought to identify cases of beneficiaries who can provide information on differentiated experiences of the PIP project.

Two schools were selected from each of the six districts where the project is implementing activities, for a total of 12 schools in Ruhango, Kayonza, Rubavu, Nyanza, Musanze and Nyagatare.

To ensure a range of relevant contexts and characteristics are included, we identified a set of inclusion criteria, as described in Table 3.

Table 3: Inclusion criteria

Level	Sampling criteria
School	• Plug-in Play participating primary schools. • Schools with at least two Plug-in-Play trained teachers.
Headteachers / Directors of studies	• Headteachers / DoS (school leaders) who have received LtPT and coaching training from the Plug-in-Play project.
SET subject teachers	• Teachers trained by the Plug-in-Play project to deliver LtPT in SET subject lessons. • Mix of male and female SET teachers. • At least two teachers trained in the selected school.
SET teacher trainers	• Teacher training college (TTC) trainers trained by Right to Play to train in-service SET subject teachers. • At least four trainers who have participated in Plug-in-Play from the beginning of the project.

A sampling frame was created by combining the list of project schools and the list of teachers trained through the PIP project. We excluded those schools where less than two SET teachers were trained in LtPT and school that participated in previous Learning Studies.

TSI carried out a study pilot to test out each of the research tools to ensure that the questions were understood by respondents. Following the pilot, the fieldwork team held a debrief session to discuss feedback on the tools and shared this with the wider NFER and TSI team.

A few adjustments were made to the tools following experiences in the field. Table 4 below presents the final, full sample and the research tools for this study.

Table 4: Summary of respondents and achieved sample

Stakeholder group	Number per school	Achieved sample
Headteachers (HT)	1 SSI with LtPT trained headteacher (HT) or Director of Studies (DOS)	6: 1 Female HT; 5 Male HTs
SET Teachers	2 SSIs with LtPT trained teachers	12: 7 Female teachers; 5 Male teachers
SET Teacher Trainers	1 FGD with trainers of in-service SET subject teachers	5: 2 Female trainers and 3 Male trainers

2.3 Limitations

The exploratory approach in our research design allows for detailed learnings on topics of interest but does not draw upon methods which allow us to attribute causality, for example, those used in impact evaluations .

A potential limitation of this research is the influence of social desirability bias, as participants may have adjusted their responses in interviews and focus groups to align with perceived expectations or socially accepted norms.

3 - Findings

We used a thematic analysis approach, using qualitative data analysis software to arrive at the findings. Broadly, this involved the identification of themes on a particular area of interest, for example, commonly used LtPT teaching strategies; finding both similar, and diverging responses from each of the stakeholder groups on each theme, where relevant; and lastly, exploring finer-grained sub-themes to gather detail on, for example, the successes and challenges of using LtPT.

We present the findings as they relate to each research question.

3.1 Which are the most useful LtPT practices in the classroom?

3.1.1 Types of LtPT practices

LtPT encompasses a wide variety of practices around the three lesson types of tinkering and making, coding, and robotics in SET lessons. It includes the following, non-exhaustive examples, as described by interviewees:

- Strategies to encourage all learners to participate in the lesson, e.g. providing a choice of activities, including hands-on activities using materials such as plastic containers, wood, cardboard, twigs / sticks; learners presenting their learning to the class
- Teacher-learner interaction e.g. guiding learners on interacting with learning materials, teacher circulating around the room, checking on understanding by asking learners questions, allowing learners to ask questions
- Seating learners in mixed-ability partnering or groups
- Ensuring girls and boys have equal opportunities to participate
- Lesson planning
- School leaders' coaching practices, such as lesson observations and feedback to teachers.

In this research question we therefore explored which LtPT teaching practices are most often integrated into SET lessons since engaging with the PIP programme. Furthermore, we examined which of these practices participants considered to be the most useful and would therefore continue to use.

Teachers use a range of LtPT strategies around active participation and they align their activities to the lesson objectives

Teachers prioritised active, rather than passive participation of learners and aligning the lesson content to the learning objectives. The use of small learning groups and the creation of a playful learning environment, including the use of games and songs were commonly cited strategies. Inclusion of all learners was mentioned less often, but was still a classroom practice focus, as described by a teacher:

> *"One of the LtPT practices we use is to include some games/plays and songs to activate learners' brains, ensuring that everyone is mentally ready to begin the lesson. In LtPT, the teacher cares for every learner during the lesson, unlike before when the focus was on faster learners, leaving slower learners behind.*

Teachers also set lesson objectives, to orient learners to what they are expected to learn during the lesson. They commonly described the use of play-based, kinaesthetic activities and the Reflect-Connect-Apply (RCA) assessment strategy to support learners to achieve the lesson objectives, for example:

> *When teaching the digestive system to P5 students, I incorporated a learning-by-doing activity that felt like play to the learners but was deeply connected to the lesson objectives. Instead of just explaining the parts of the digestive system, I created a game where the students, in groups, acted out how food moves through the digestive tract. Each group member represented a different part of the digestive system, like the mouth, stomach, or intestines, by saying the importance of each part. This activity of allowing them to work in groups helped them to memorise the function of each part and I know that they cannot forget it easily because they took time in the activity. Afterwards, I asked them RCA questions reflecting on what they had learnt through the lesson so I could make sure our objective was achieved.*

In lesson observations, headteachers look for teachers' lesson preparation and how teachers use lesson planning to implement LtPT in their classrooms

We asked headteachers which elements of LtPT they monitor when conducting SET lesson observations. Most headteachers reported that they centre lesson observations around teachers' lesson plans, in particular looking for how various elements of LtPT such as learners' active participation and engagement, classroom management and use of teaching and learning materials have been planned for the duration of the lesson.

Another key check is whether the lesson objectives are documented and communicated to learners. They then observe the lesson to check if these elements are present in lesson delivery. Some headteachers also reported checking on the inclusion of all learners, contrasting teachers' practice before and after engaging with LtPT, for example:

> *Before adopting LtPT approaches, teachers often focus more on faster learners without spending sufficient time helping slower learners. This is why, during my observation, I paid special attention to student engagement.*

The RCA assessment strategy was also reported by some headteachers to be an observational focus in teachers' planning and delivery of the lesson:

> *I also focused on ... RCA questions and whether the teacher was able to manage the classroom effectively during activities. From my observation, I found that SET teachers were not able to use RCA questions effectively and still need additional training in this area.*

Regarding RCA, the other headteachers who reported monitoring this did not specifically highlight it as an area which needed further training.

3.1.2 Usefulness of practices

Headteachers and teachers reported on the effectiveness of LtPT practices in supporting learner engagement and improved learning outcomes

Headteachers conveyed that the strategies practiced by teachers were reported to be highly beneficial in making learning more enjoyable and engaging and in embedding the lesson content.

A teacher trainer commented that:

> *LtPT reduces student fatigue by making lessons interactive and enjoyable, which helps students retain information better. Lessons delivered through play tend to stick in students' minds, and this teaching strategy emotionally engages them, leading to improved learning outcomes.*

Some headteachers compared teaching and learning before LtPT and after engaging in the PIP programme to explain why the LtPT practices need to be maintained. They conveyed that the key benefits of LtPT were greater engagement and enjoyment and that this supports better understanding and retention of the learning material, which in turn, is conducive to improved performance, including that of learners in need of additional support.

All stakeholder groups also reported on how LtPT had contributed to learners' improved SET performance, with teachers and headteachers giving examples of how learners improved scores in SET are qualifying them to transition to secondary school:

> *I saw an improvement in students' performance. In the P6 national exams, our students previously struggled in Math, English, and SET, which limited the number of students who could be recommended for boarding schools. However, after implementing LtPT following the training, students were able to grasp the SET content better, leading to improved overall scores in the national exams. In the last two years, some students have achieved scores that qualify them for boarding school.*

> *As a result of implementing LtPT, our students have achieved outstanding scores in national examinations. This success has contributed greatly to our overall performance, leading to students receiving admission letters from REB to go to secondary school in boarding. For instance, we now have many students who scored 6/6 in SET and the last one scored 4 on their national exams, which was a considerable challenge for us in the past. Additionally, students in P4 and P5 have also performed well in SET, indicating the positive impact of this approach on their learning outcomes.*

Teachers reported that they would continue all their current practices in the future due to the benefits to children's learning imparted by LtPT

Headteachers and teachers did not highlight any practices which they had not found useful and would therefore discontinue. They noted that the playful and creative methods in LtPT helped them with classroom management through greater engagement of learners and organising learners into small groups. A teacher explained:

> *LtPT helps me a lot to manage class, especially when there are many students. One of the key benefits is that it keeps students engaged, which significantly reduces noise levels. When I incorporate playful activities into my lessons, students stay focused on the task , making it easier for me to guide them. Since students are actively participating, they are less likely to lose focus or misbehave.*

A few teachers, however, noted that large class sizes made it difficult to give attention to individual learners.

Trainers, who are also SET teachers themselves, cited exploration time, lesson planning and active participation as practices to continue. A teacher explained in detail the reasons why they would continue with LtPT:

> *I've seen noticeable growth in their capacities and performance. The transition from traditional methods to LtPT has made learning more engaging and effective. For example, I can see how the students tire less during lessons now compared to when we were using older methods as students used to sleep in between the lessons but now they can't because they take a big part in the lesson.*
>
> *I find it very creative for lesson delivery because LtPT has made my teaching much easier for me. I no longer struggle with how or where to start my lessons because I have a well-prepared lesson plan that includes all the activities and materials needed to achieve my objectives. Instead of relying on handouts, I utilise visible teaching tools that immediately engage students in the lesson which make their understanding very easy, and delivery goes well.*

RCA was also noted by some teachers as a useful practice to continue as it helps them to check earners' understanding of the lesson content:

> *I find the RCA questions we use during the lesson to be very helpful, and I plan to use them more in the future. Through RCA I am able to ask them questions and encourage learners to ask their own. I gather all their comments and write them on the board. This practice really helps them understand the lesson better and the students really like it.*

Teacher trainers use LtPT strategies when training teachers to integrate LtPT

When commenting on the effectiveness of the teacher training practices they use, SET teacher trainers reported using the same interactive teaching strategies as they train in-service teachers to use with SET learners. This includes the use of energisers and warm ups to keep teachers focused during training, organising teachers into small groups and using RCA to check their understanding of the training topics. Trainers also cited micro-teaching, an activity where teachers plan a lesson, then teach it to their peers and receive feedback, as useful in training:

> *Another thing I tried with my students is micro-teaching. For example, in the training with teachers, there is a part where they had to do micro-teaching. We would ask them to choose a unit from the P4, P5, or P6 Pupil Activity Book, depending on the grade they teach, then prepare a lesson plan and conduct a micro-teaching session. This approach worked very well during the training.*

While conveying their willingness and plans to continue using LtPT practices, teachers highlighted their skills gaps to confidently deliver all aspects of LtPT in coding and robotics

While teachers noted that the PIP programme has provided valuable training on LtPT, many expressed concerns about their ability to fully master and teach these subjects, especially after the programme ends, as highlighted by a teacher: *"We received coding training despite lacking prior skills, and I still find coding challenging. I worry that once the Right to Play programme concludes, we might lose support."*

This sentiment was echoed by others who feel that without continuous support and collaboration with their peers, their confidence in teaching coding will diminish.

Robotics also stands out as a challenging area for many teachers. Several expressed confusion about

how to teach it effectively, with some teachers casting doubt on whether they would continue, for example, a teacher reflected: *"I am unsure if I will continue to use robotics in the future because I am not familiar with it, which makes me feel unconfident about incorporating it into my SET lessons."*

Teachers reported their skills gaps and the need for specialised training, for example:

> *"The bigger challenge lies in applying robotics. For instance, last year we attempted to build a car, but despite collaborating with my colleagues, we were unable to create a moving car with sensors. If the three of us, working together, couldn't achieve this, it clearly indicates that we need more training."*

> *"I will focus on teaching topics I feel confident in, like making a car move and creating a traffic light. However, I'm unsure about teaching irrigation or how to make a smart dustbin, as I don't know how to do either."*

> *"Teaching robotics is somewhat more difficult compared to the other subjects. This is why I believe the training we received wasn't sufficient for us to master it. In the future, it may be challenging for me to continue using robotics because I haven't fully mastered the subject."*

3.1.3 Teaching and learning materials

Since the use of teaching and learning materials in a hands-on approach, in contrast to the teacher leading the lesson from the front of the classroom, is integral to the success of LtPT, we explored various aspects of these materials for the three lesson types of tinkering and making, coding, and robotics.

The use of teaching and learning materials for hands-on activities has contributed to teachers' confidence in delivering interactive and engaging lessons

Teachers conveyed the utility of the teaching and learning materials, particularly in tinkering and making, to help them deliver SET learning objectives. The practice of using local materials for tinkering and making is becoming more established.

Teachers also reported confidence in using teaching and learning materials by providing detail on how they use them, for example:

> *In tinkering and making lessons, I use local materials that depend on the unit we are studying. For example, during the carpentry unit, I ask students to bring materials like banana leaves, wood scraps, or used plastic bottles. One activity could involve students designing a banana leaf basket using these materials. Another activity might include students creating planters by cutting the bottles in half and filling them with soil and putting them into flowers in a way of decoration. I plan to continue using these local materials in future lessons because they are easily accessible and encourage creativity.*

However, there is a shortage of resources for coding and robotics

Some teachers reported facing challenges due to the limited availability of necessary materials, which are often not easily available in schools and have been primarily supplied by RTP, as noted by a teacher: *"I'm worried about using just one computer to teach a class of 68 students."*

Other schools reported having sufficient XO laptops for coding, as well as the related software, for example, Scratch, Turtle Art and e-toys. However, headteachers, highlighted that more resources for robotics such as specialised STEM software, high performance computers and smart rooms are needed.

There can be stark differences in access to technology in urban and rural areas, with the latter having sporadic access to electricity and digital devices. Teacher trainers also expressed that there are shortages of the more tech-related resources, such as software and computers:

> *Another thing I tried with my students is micro-teaching. For example, in the training with teachers, there is a part where they had to do micro-teaching. We would ask them to choose a unit from the P4, P5, or P6 Pupil Activity Book, depending on the grade they teach, then prepare a lesson plan and conduct a micro-teaching session. This approach worked very well during the training.*

We report on the resource challenges in more depth in Section 3.3

3.2 How useful is the support to education stakeholders for using LtPT?

3.2.1 Types of support

Since the initial trainings for each stakeholder group on LtPT, including trainings on tinkering and making, coding, and robotics, the approach has been supported through various initiatives aimed at enhancing the capacity of school leaders, teachers, and SET teacher trainers.

These initiatives include structured Communities of Practice (COPs), Professional Learning Communities (PLCs), coaching, and Continuing Professional Development (CPD). Table 5 below summarises the different types of support received as reported by each stakeholder group after their initial training to facilitate the mastery and effective implementation of LtPT.

3.2.2 Usefulness of the support

We explored how useful participants had found the different types of support in helping them to deliver SET lessons using LtPT. All stakeholder groups expressed that the support had brought about changes in how they approached their practice.

All support was conveyed to be helpful; with lesson observations reported to be highly useful for improving the quality of SET lesson delivery.

Teachers reported that they found the feedback from the observations done by their school leaders to be valuable in understanding how to deliver the various components of LtPT correctly. They found guidance on how to deliver lessons using interactive strategies such as circulating around the classroom to check learners' understanding particularly helpful:

> *The feedback I received from the classroom observation has helped me improve my teaching methods. I can give an example of how once the Director of Studies (DOS) pointed out that I wasn't moving around to support the students. Previously, I confused child agency with just providing materials and would stand at the door watching them instead of engaging. The DOS advised me to move around and ask questions, and this has helped me achieve my lesson objectives.*

School leaders also stated that they had learned more on how to conduct lesson observations effectively and non-judgmentally from their Community of Practice or Professional Learning Community meetings.

> *The most important thing I've learned from these PLC is how to give feedback. For example, during a class observation, when it hadn't gone well, I used to focus on the negatives, and only the negatives. I could be really harsh to teachers in a way that might even be counterproductive, but I've since learned to find the positives as well and give feedback carefully, so as to not discourage the teachers.*

Table 5: Types of support received after initial LtPT training

Stakeholder group	Type of support received
School leader	• Attended PLCs and COPs for knowledge sharing
Teacher	• CPD every week in school, though not always SET-specific • Received coaching from headteachers and lesson observation with feedback • Participated in COPs, and received coaching and lesson observations conducted by District Education Officers (DEO), Sector Education Officers (SEO), and TSI staff.
SET teacher training	• In their training role, participated in COPs and coaching from RTP

SET Teacher trainers commented that supplementary resources, including video links, had helped them to train teachers and they also appreciated the consistent access to materials like robotics kits and logistical support from RTP and EdTech partners. They also participated in Communities of Practice (CoPs), fostering collaborative problem-solving.

Teachers regarded peer learning opportunities highly for helping them to learn how to discuss challenges and share best practice in both their SET-specific and other teaching responsibilities

Teachers gave examples of particular areas of practice in which they needed support and how they found that knowledge learned from Continuous Professional Development sessions in school or external Communities of Practice helped to address these.

> *I participated in peer learning during COPs outside of the school, and it was incredibly useful. For example, one teacher shared strategies for handling undisciplined students. He explained some of the reasons why a student might be misbehaving, such as family conflicts or lacking basic needs like school materials or food. He advised us to first understand the root cause of the student's behaviour. And this is a really great thing in classroom management.*

When it came to teaching SET, many teachers used the CPD and COPs to share their experience with tinkering and making. They shared that this is a versatile approach that could be applied across different units. In addition, CPD and CoP sessions helped teachers adopt and refine techniques like Reflect-Connect- Apply (RCA) questioning, a practice critical to ensuring students fully grasp SET concepts. RCA questions, which prompt students to reflect on previous knowledge, connect it to real-world applications, and think about how to use it, were seen as vital for deepening understanding. However, there was some variation in CPD opportunities from one school to another. In some schools, CPD sessions included structured, SET-focused activities but in others the CPD was not SET-specific:

> *I can't say that CPD (Continuing Professional Development) helps me master LtPT because, at our school, the leaders don't usually talk more of LtPT approaches in CPD sessions. However, they sometimes encourage teachers to ask us to share what we have learned or remind teachers to use RCA questions, inform students of the lesson objectives, create lesson plans before teaching, and include learning through play activities where possible.*

Teachers also described more informal learning often taking place outside school hours with peers. COPs organised by RTP were an essential form of support, allowing teachers to learn from each other and share challenges. However, not all teachers had equal access to these sessions, with some missing out due to scheduling or other constraints. This uneven access to support contributed to varied experiences in implementing LtPT across schools.

Schools are also supported with lesson observations and general guidance on LtPT by middle tier education officials, particularly Sector Education Officers

Most headteachers explained they mostly interact with Sector Education Officers (SEO), who visit schools more often than District Education Officers (DEO). They reported finding the guidance from SEOs and DEOs on applying LtPT correctly a useful supplement to their initial training from RTP . Some headteachers reported that contact with DEOs is mainly via social media channels, partly due to the expansive geography of districts and wide dispersal of schools therein. This can mean that DEOs do not often visit schools, as one headteacher outlined:

> *I wouldn't say there's much collaboration going on with the district. We have a big district, a lot of schools to visit and as a result we don't get visits from district education officials as we'd like. However, the last time district officials visited us, SET teachers were mentioned and encouraged, so that's about it.*

A few teachers conveyed finding the SEO and DEO visits helpful, for example, for encouraging them to continue using LtPT in ways that motivate learners.

Headteachers also reported their participation in Community of Practice and Professional Learning Community meetings, although in some cases, these terms were used interchangeably. Around half of headteachers stated that LtPT was not discussed in these district-level meetings, however, other headteachers described the beneficial knowledge exchange and cross-school support that takes place, for example:

> *During that meeting, the SEO asked us to share the new approach we are using to teach SET with our colleagues, and we did just that. Since we are the only two schools*

using this approach in our sector, he also requested that nearby schools come and learn from us. Our SEO appreciated this approach so much that he regularly follows up to ensure it's being implemented. As a result, we are now mentoring another school. Our teachers meet periodically to support them, and they even coordinate among themselves. For example, a P4 teacher from our school meets with a P4 teacher from that school to share knowledge.

3.3 What factors support and constrain the sustainability and scale of LtPT?

In this section, we present the enablers and challenges to the sustainability of LtPT.

3.3.1 Sustainability enablers

Interviewees shared their perspectives on the overarching benefits of LtPT: greater engagement and enjoyment, leading to better retention and in turn to improved performance and understanding, including that of learners in need of additional support. The benefits have brought about a determination to continue the approach through various activities which will help to sustain it.

There is cross-curricular application of the hands-on and engaging elements of the approach in non-SET lessons, suggesting institutionalisation of LtPT at the school level

A common theme was that elements of LtPT are beginning to be used in non-SET lessons. Headteachers reported that, for example, in English lessons, learners participated in debates to practice their speaking skills and in Social Studies, the teacher would hold a lesson outside to see examples of what they are learning. Another headteacher described how they encouraged their SET teachers to share LtPT approaches with other teachers and the resulting benefits:

> *Teachers discuss methods that support their colleagues, such as creating effective lesson plans, utilising group work, formulating RCA questions, and connecting lessons to real-life situations. Some maths teachers have adopted more group work, allowing students to actively participate and assist each other in understanding the material.*

All stakeholder groups expressed that they would continue to advocate for increased resources and to generally promote LtPT and, showing a willingness to sustain the approach

Teachers articulated how they planned to continue using the different elements of LtPT. While teachers reported some LtPT practices to continue, they also shared some wider strategies to support this. These included general advocacy and raising of issues about resource shortages to school leadership, creating further opportunities for learners to embed the lesson content, a focus on building their own learning in their own time and knowledge sharing with teacher of grades lower than P4.

All stakeholder groups gave examples of how they would continue to flag the need for resources, for example, a teacher explained: *I will ensure that the school administration is aware of our needs. We don't have a smart room, and I will not hesitate to raise this issue with anyone who can advocate for us. Having this would allow my students to easily access XO laptops without wasting time charging them all day.*

Teacher trainers conveyed plans to similarly collaborate with school leaders on resource challenges and furthermore, to organise refresher training workshops to be run by the teachers who were trained in nearby sectors.

As an example of promoting LtPT, some teachers and headteachers recommended that more robotics competitions be organised to foster creativity and encourage student participation in technology-based learning. The robotics competitions that were organised by PIP were highly praised by both teachers and headteachers. They noted that these events served as excellent motivators for students and helped boost their interest in technology and robotics. The competitions also provided an opportunity for students to showcase their skills and for teachers to engage with new learning approaches.

Teachers and headteachers suggested that PIP organise more competitions and expand them to include other subjects, as they help foster creativity, collaboration, and engagement, with a headteacher explaining:

> *Robotics competitions have proven to be a highly effective method for motivating both students and teachers. These competitions not only foster creativity and teamwork among students but also enhance their engagement with the learning process. Additionally, such events can serve as a platform for showcasing the skills and knowledge gained through the LtPT approach, further encouraging the adoption of this approach.*

Parental engagement activities help to embed LtPT but not all schools are carrying these out

Since parental support of their children's SET learning can help to embed the benefits of using LtPT we also asked school leaders if they carried out any activities to engage parents to support their children in LtPT activities. Half of the headteachers described outreach to parents via parents meetings, workshops and presentations of learners' work. A headteacher described how parents show interest, with some having initially doubted the relevance of the approach:

> *"At first, parents were quite resistant, expressing concerns that soap is costly and that their children's clothes were getting dirty, which required them to wash the clothes daily. They were also afraid that the students were just playing. However, they were convinced by their children's strong performance in the SET lessons. Now, the parents are the ones reminding their children to bring learning materials. For instance, one parent even came to school today with clay; when I asked her why she brought it, she explained that her child had forgotten it and they were going to use it in the lesson. This shows a significant improvement in their understanding.*

3.3.2 Sustainability challenges

Among the challenging, often interconnected, factors when considering the sustainability of LtPT in their schools, participants most often cited those around a lack of resources, large classes and further training needs. These challenges are particularly acute for robotics teaching.

Effective teaching of technology and robotics needs extended training and resources

Teachers and headteachers recommended that the PIP project provide more time for training, particularly in complex areas such as coding and robotics, and that resources like laptops be made available for both teachers and students.

Teachers and headteachers highlighted the importance of additional and longer training sessions, particularly for mastering technology-focused topics like coding and robotics. They felt that the current training periods were too short, leaving them with insufficient time to practice and internalise new skills. Related to the issue of skills, a less common theme was around trained teachers leaving schools and the impact that this could have on the continuation of LtPT. When considering the sustainability of LtPT, one school leader expressed their concern that schools could go back to using methods used before engaging with LtPT and another explained:

> *I'm concerned because teachers are often transferred to different schools or change jobs. If all the trained teachers leave, it will be hard for me and the DOS to teach those skills to new teachers. With our limited time and busy schedules, I'm not sure this practice will continue in the future.*

Many teachers also expressed a need for more resources, especially laptops, to effectively integrate ICT into their lessons and ensure that students can fully engage with technology. There was a general consensus that technology skills are essential for students' futures, and continuous refresher courses would help both teachers and headteachers build confidence in delivering these lessons. Furthermore, providing laptops to teachers would allow them to improve their skills outside of the classroom.

> *We are not familiar with technology, so we need additional training for a better understanding. The training on coding and robotics was very rushed. It would be helpful if we had more time to practice. I would recommend PIP provide laptops for SET teachers to improve our skills in using technology.*

Ongoing professional development and follow-up support are critical for sustainability

Teachers and headteachers recommended continuous professional development and follow-up visits to ensure lasting impact and consistent implementation of LtPT.

Both teachers and headteachers emphasised the importance of ongoing professional development to sustain the success of LtPT. They suggested that PIP organise regular refresher training sessions, especially at the beginning of each term, to help teachers remain up-to-date with the latest methods. In addition, follow-up visits from PIP staff were seen as crucial for maintaining the quality of lesson delivery, particularly in rural schools, where teachers may have less frequent access to support. Participants recommended a more structured system of follow-ups and monitoring to ensure that schools continue to benefit from the programme after the initial training period ends.

A school leader noted:

> *"Learning is continuous, and we need refresher courses on coding and robotics. Regular follow-ups would also help teachers who might be struggling with implementing LtPT. Some schools only receive visits once a semester, but more frequent visits would ensure that we're staying on track.*

Most interviewees generally agreed that LtPT complements the national curriculum but highlighted a few challenges around implementing it alongside the curriculum

Teacher trainers, teachers and headteachers generally agreed that LtPT complements the national curriculum but highlighted some issues around its full alignment with the curriculum. Some teachers noted that they would welcome guidance on using LtPT for teaching certain topics in the curriculum, with a teacher explaining: *"...it can sometimes be difficult to determine which approach to use for specific units. For example, I am unsure which approach would be most suitable for the unit on reproduction."*

The heaviness of the curriculum was also highlighted, along with the impact that using LtPT could have on the sustainability of the approach, with one teacher explaining: *"We have a long curriculum and sometimes using LtPT can delay its completion leading to sometimes reverting to the old ways of teaching SET just to be able to complete it."*

All stakeholder groups mentioned that LtPT in general needed to be more visible in the curriculum and that this would help streamline lesson planning and reduce the likelihood of skipping important content. They suggested that providing clear guidelines or a framework to support them to complete the curriculum on time while using LtPT. Robotics was seen as an area that could benefit from formal curriculum inclusion to avoid it being treated as an extracurricular subject:

> *"LtPT aligns with the curriculum, but it can take longer to implement, and sometimes it's hard to keep up with the required lessons. It would be easier if everything was aligned with the curriculum, especially for complex topics like robotics, which are only covered in ICT clubs right now."*

> *"I would recommend that LtPT aligns more closely with the curriculum. Teachers sometimes skip units to focus on coding because Right to Play encourages them to teach it, even when they have not yet reached the relevant unit in the curriculum."*

> *Find a way to integrate this into the curriculum by REB. We are teaching using this approach, saying that it aligns well with the CBC, which is true, but it would be better if it were included directly in the CBC. This way, every teacher could see it in the curriculum without needing additional documents.*

Teachers and headteachers also mentioned Rwanda Equip as a very different approach to teaching and learning, and the challenges of delivering both approaches in parallel. In one case, this meant that a school could not adopt LtPT as explained by a teacher:

> *The PIP project was really beneficial, and the content was excellent. However, they struggled to convince our leaders to adopt LtPT over the Rwanda Equip programme. I would recommend that, when selecting schools to work with, priority should be given to those not involved with other projects. It's disappointing that we couldn't implement LtPT due to the constraints of the Rwanda Equip project.*

Some components of LtPT can increase teacher and headteacher workload

Although there was a consensus on the clear benefits of using LtPT, there were some concerns about the amount of time it can take to prepare lessons, with a teacher noting that: 'It requires me much time for lesson preparation, from lesson planning to creating teaching materials. I often have to work extra hours to prepare for SET lessons.' Teacher trainers echoed this view, highlighting the heaviness of the curriculum as a factor in using the approach:

> *Another challenge is that preparing an LtPT lesson requires a significant amount of time. Teachers need much more time to plan these types of lessons - thinking about the activities students can do during exploration time, gathering the necessary materials - it's time-consuming. Teaching the lesson itself also takes more time. We appreciate this method because students actively participate, which has a great impact on their learning. However, we still have a certain number of units to complete by the end of the semester. As a result, some teachers opt to continue teaching using the knowledge-based curriculum to move faster. Once they feel confident they will be able to finish all the units, that's when they start using LtPT.*

A teacher further explained that while the approach was useful for lessons that are practical in nature, for example, on object production, other topics are more theoretical, so more time was needed to think of activities for these.

A few headteachers also noted that when they provide feedback to teachers after lesson observations on what went well in the lesson and how to improve, the observations themselves and formative feedback can increase workload, even when shared with the Director of Studies (also referred to as Dean of Studies), with one headteacher explaining:

> *"I wouldn't say it's easy, it's really not. Sometimes we have so much work that we can't manage, but it's a part of my responsibilities, so I try to find time. Ideally, you'd visit every teacher once every month, but that's not always done, so with the help of the Dean of Studies, we try to visit at least twice a trimester.*

Providing resources for remote learning is necessary for crisis resilience

Teachers and headteachers highlighted the need for schools to be better equipped with materials that would allow teaching to continue during crises, such as school closures. Several teachers and headteachers raised concerns about the lack of resources to support remote learning during school closures, referencing the challenges experienced during the COVID-19 pandemic. They recommended that PIP provide schools with laptops, tablets, and other necessary materials to ensure that teaching can continue even during crises. This would allow students to engage in lessons from home and prevent disruptions to their education. Additionally, training teachers on how to effectively use these resources for remote learning was viewed as equally important as conveyed by a school leader:

> *"During the lockdown, many schools struggled because we didn't have the necessary resources for remote learning. If PIP could help provide laptops or tablets for students, it would help us continue teaching in case of future crises."*

Resources and guidance for implementing the approach after the end of the PIP programme are needed

We explored whether school leaders had been provided with documents or resources which they could refer to support them with LtPT beyond the life of the PIP project. They reported that schools mainly had lesson plans and lesson observation forms and not all had Teacher Professional Development (TPD) manuals. The SET teacher trainers reported that they had not been provided with TPD manuals and were not aware of any guides on how these would be updated and validated once the programme finished. There was no minimum standards or guidance document, for implementing the programme, with one headteacher conveying that it would be helpful to have such a resource.

3.3.3 Implications for scaling LtPT

Participants recommend extending LtPT across Rwanda, while reiterating many of the same challenges that they had experienced in their schools

When considering whether they would recommend LtPT to schools across Rwanda, respondents conveyed that the key strength of LtPT is that it supports greater learner engagement and improved learning. The increased confidence around staff ability in most schools to source materials for tinkering and making was considered to be key to scalability of this component of LtPT, as noted by a school leader:

> *"This approach can be easily adopted by other schools like ours because for example in tinkering and making activities it requires to use locally available materials which I think every school can be able to find."*

Headteachers also noted that the adoption was contingent on school culture and staff commitment and meeting training needs.

> *I can't say it will be easily adopted by similar schools right away, but learning is a process. Some teachers may have a fixed mindset and feel like it's a burden to shift to a new method, but if they get trained and apply it, I'm 100% sure they will easily move from KBC (Knowledge Based Curriculum) to Competence Based Curriculum (CBC) because they'll quickly see positive results in their students.*

Although a less common theme, lesson length was noted to be an issue which could affect scaling LtPT, with participants highlighting the need for two 40 minute sessions to be merged into a double period (this issue has been resolved in most PIP schools).

A need for further alignment of LtPT to the national curriculum and a shortage of materials were considered to be key barriers to be addressed before scaling the approach, as highlighted by a teacher:

> *"Not having enough materials and the limited time available for teachers while delivering lessons are significant barriers. As you know, these approaches are not aligned with the curriculum, so teachers must find time within the limited period they have to include these approaches. If possible, they should consider these issues before implementing these approaches more widely."*

Rural schools, in particular, are likely to be at a disadvantage when scaling LtPT

There was a concern that rural schools are at a greater disadvantage compared to urban schools when it comes to resource shortages, with a teacher explaining:

> *In rural schools, it can be challenging to teach coding because students need to use XO laptops, which require charging. Some schools don't have electricity, making this difficult.*

Similarly, teacher trainers highlighted that rural schools needed support in progressing their delivery of the ICT component of SET lessons:

> *There should be advocacy for schools that don't have laptops. I'm sure that if REB were aware of this, there might be some changes. However, most leaders tend to visit schools that are nearby and don't want to go far. I have to mention this. The schools in rural areas, which are often very far away, don't have anyone advocating for them. Yet, we expect them to be on the same page as others regarding ICT skills. This is not possible, as they only see laptops during training."*

The issue of multifaceted differences in resourcing, parental education and funding that can exist between rural and urban schools was illustrated by a headteacher in a city school:

> *Since we are a model school, our school is often chosen as a training site for RTP programmes. Being in the city is an advantage because our parents are educated and supportive, and the government helps us easily. RTP has provided us with valuable resources for our classes.*
>
> *For example, after the training, we received materials like manila paper, flip charts, markers, and scissors, which we use regularly. Additionally, the government gives us funding each term to buy more supplies. Recently, RTP also provided us with new materials for robotics, which I had never seen before. I think these materials were imported from another country, and they will greatly enhance our teaching."*

4 - Conclusions

In this section, we summarise the key findings of the study for each research question.

Which are the most useful LtPT practices in the classroom?

Headteachers and teachers reported on the effectiveness of LtPT practices in supporting learner engagement and improved learning outcomes, suggesting that LtPT is adding notable value to learners' SET experience and performance.

Lesson observations are used by headteachers to check teachers' lesson preparation and how teachers implement LtPT in their classrooms. Teachers use a wide range of LtPT strategies around active participation, the RCA assessment strategy to check learners' understanding of the lesson content and they align their lesson activities to the lesson objectives.

Headteachers and teachers reported that they would continue all their current practices in the future due to the benefits to children's learning imparted by LtPT approaches.
SET teacher trainers also use various LtPT strategies when training teachers to integrate LtPT, indicating the effectiveness of these strategies.

Teachers are confident in using teaching and learning materials for hands-on activities in tinkering and making and are becoming more proficient in sourcing local materials. There are, however, resource shortages for coding and robotics lessons. Teachers also face skills gaps in confidently delivering the coding and robotics components of SET lessons, despite receiving valuable training through the PIP programme. This scarcity of resources hampers their ability to teach effectively and respond to students' natural curiosity, especially when students ask questions on topics outside the teacher's comfort zone.

How useful is the support to education stakeholders for using LtPT?

Lesson observations were commonly cited as a useful form of support for teachers, for improving the quality of SET lesson delivery. Teachers, in particular, regarded peer learning opportunities highly for helping them to learn how to discuss challenges and share best practice in both their SET-specific and other teaching responsibilities.

Schools are also supported with lesson observations and general guidance on LtPT by middle tier education officials, particularly Sector Education Officers. Both teachers and headteachers find this helpful for applying LtPT with fidelity. The involvement of SEOs and DEOs suggests that the approach is becoming embedded across some of the education system.

What factors support and constrain the sustainability and scale of LtPT?

There is some cross-curricular application of the hands-on and interactive elements of the approach in non-SET lessons, suggesting institutionalisation of LtPT at the school level. Although the approach was primarily developed for SET lessons, the permeability of some strategies in other subjects will help to sustain it, as school-wide application will ensure that all staff are practising it.

All stakeholder groups are invested in supporting the continued use of LtPT, both through classroom practice and wider efforts to promote it, for example through robotics competitions, supporting learners to applying their learning. They are also committed to continue to advocate for increased resources. This indicates an ownership mindset which will help to support sustainability. Headteachers' parental engagement activities also help to embed LtPT and to demonstrate the benefits of LtPT to parents, but not all schools are carrying out such activities.

However, there are challenges, including, in particular, the need for extended coding and robotics training. It is important to note that the Cohort 2 schools will have only received robotics training recently, but there are still numerous resource issues for this strand of SET lessons.

Addressing both the skills gap and resource constraints is critical to enhancing the overall effectiveness of teachers in implementing the LtPT approach sustainably and suggests that low-tech and contextualised solutions are needed for the sustainability of LtPT overall.

All stakeholder groups generally agreed that LtPT complements the national curriculum but they also highlighted a few curriculum-related challenges, namely, knowing how to apply LtPT for certain topics, the heaviness of the curriculum and the time taken to complete it and that LtPT in general needed to be more visible in the curriculum.

Robotics is seen as an area that could benefit from formal curriculum inclusion to avoid it being treated as an extracurricular subject. Teachers, schools leaders and teacher trainers all see the value of LtPT and requested support and guidance to help them integrate LtPT fully and effectively into SET lessons.

Some teachers highlighted that some parts of LtPT, in particular, lesson preparation can lead to increased workload while a few school leaders reflected that conducting lesson observations can be a constraint on their time.

While schools are supported during the PIP programme, they have managed to embed LtPT, however, providing resources and guidance for implementing the approach after the end of the PIP programme are needed. Furthermore, the resources and guidance for remote learning are similarly necessary for crisis resilience in a school closure scenario.

When considering the implications for scaling LtPT, while participants recommended extending LtPT across Rwanda, they reiterated some of the same challenges to sustainability. Lesson length is one concern to be addressed and while there has been some highly useful progress, for example, lengthening lessons to 80 mins, this still needs to be effected in some schools. Rural schools, in particular, are likely to be at a disadvantage when scaling LtPT, mainly due to a lack of connectivity and familiarity with digital devices.

5 - Recommendations

Moving forward, we offer recommendations for the sustainability of LtPT to Right to Play and to institutional stakeholders in Rwanda, in broad order of priority. The recommendations could be of use for sustaining the activities initiated by the programme after its completion and for future programming or other, similar programmes in RTP's portfolio.

1 - Offer advanced training on coding and robotics to increase teachers' confidence in delivering LtPT.

Teachers are confidently delivering the tinkering and making element of LtPT, but additional support is needed to build on their foundational training in coding and robotics. This will help to build their mastery in these areas and sustain the achievements of the PIP programme.

RTP could include refresher trainings for teachers in coding and robotics in PIP and in future programmes and advocate for the provision of more specialised training as part of government-funded CPD to equip teachers with the knowledge and confidence to teach advanced topics and embed them into practice.

RTP can build on positive relationships with existing structures and relationships with Teacher Training Colleges and EdTech partners to deliver the training.

2 - Advocate to level up rural schools to close the technology resource gap with urban schools.

This speaks to RTP's Theory of Change assumption that schools have the necessary infrastructure to implement LtPT. Interviewees conveyed that there is limited access to electricity and materials such as laptops and software as well as digital devices in rural schools. This hinders the full implementation of the coding and robotics elements of LtPT.

RTP could support school-level advocates to raise attention on the resource gaps and differences in equipment across schools. Encouraging visits from sector and district education officials into the rural areas could help advocacy efforts for more funds to the resource- and infrastructure-constrained schools (this could be done with project funds or government funds).

3 - Mobilise support around low-tech solutions and ways to share available tech resources like those used in robotics competitions.

Initiatives to overcome resourcing issues in tinkering and making materials are emerging in resource-constrained schools. In future programmes, RTP could support existing and new initiatives led by schools to extend benefit of the activities despite the lack of tech materials, such as the use of locally available materials for SET lessons, and competitions.

4 - Continue to support teachers by providing them with further guidance on LtPT while the approach is being more fully integrated into the curriculum.

All stakeholder groups made curriculum alignment-related recommendations for using LtPT to its full potential. Teachers requested more ideas for how to apply LtPT for certain topics.

To help meet this need, RTP could conduct a brief survey with teachers to gain insights on which units need to be supported and advise schools on LtPT strategies for these units.

RTP could then further work with the REB on messaging for schools to reassure them that LtPT is still relatively new and that further work is being done to ease the transition to its full use.

As the government moves towards greater ownership of LtPT, sector and district education officials could then work with the REB on strategies to make LtPT more visible in the curriculum, including integrating robotics more formally.

5 - Continue to support the embedding of the use of local materials and share successes around the use of local materials in regional knowledge exchange platforms.

These strategies help deliver engaging lessons in large classes of at least 40 learners keeping them motivated. This will be useful in collective action efforts to address the learning crisis in the region.

They also partially address resource shortages in less-resourced schools by encouraging teachers to create lesson content with available materials and engage learners with materials they are familiar with.

School leaders could continue championing the use of local resources in schools. RTP could showcase the practice across their networks and integrate it in future programming.

6 - Develop guidance on minimum standards to support the harmonisation of support and activities across schools and educators.

Across schools, there is a variation in experiences of LtPT. CPD in some schools features SET-specific and LtPT sessions, which teachers find very helpful, while other schools, CPD is limited to more general teaching practice. Furthermore, teachers and school leaders have a high level of buy-in for lesson planning and lesson observations and find them valuable, but these can create an increased workload.

RTP and REB could consult with school leaders and teachers to develop guidance on, for example, the ideal frequency of SET-specific CPD sessions to guide school leaders and teachers on LtPT, the number of lesson observations required per year and detail on lesson planning. It could also help to support senior leaders in schools to monitor their own and teachers' workload by giving them a document which outlines requirements for delivery of SET to a good standard and which is mindful of workload.

By setting standards which are based on the least-resourced schools, this will help to consider variations in school context, for example, differential funding and rural / urban differences. Furthermore, establishing minimum standards will also be useful in maintaining standards after the end of the project, and particularly if large numbers of trained staff leave a school. RTP could also consider integrating this recommendation in future programmes involving LtPT.

7 - Spearhead efforts to streamline LtPT approaches beyond SET.

LtPT approaches are recognised as beneficial for learner engagement and learning outcomes in project schools and are applied beyond SET lessons. School leaders and MOE could champion the wide spreading of these practices in COPs, PLCs and CPD more generally for their consistent application in and across schools.

In some schools, LtPT pedagogy, such as incorporating play into lessons, outdoor learning and groupwork is increasing in the lower grades. These strategies do not use tech, so schools should be encouraged to share these successes more widely. This could be done through cross-school knowledge exchange and school to school mentoring, as outlined by a headteacher in Section 3.2.2.

8 - Develop resilience or disaster preparedness strategies on how to deliver the SET curriculum using LtPT during school closures.

The benefits of LtPT could be undermined in case of school closure caused by health, natural or security crisis. Within resource limitations the REB and RTP could consider providing schools with a number of laptops, tablets and training on their use to ensure that teaching can continue during events that may disrupt education.

This will allow students to engage in lessons from home and mitigate consequences of further disruptions to their education.

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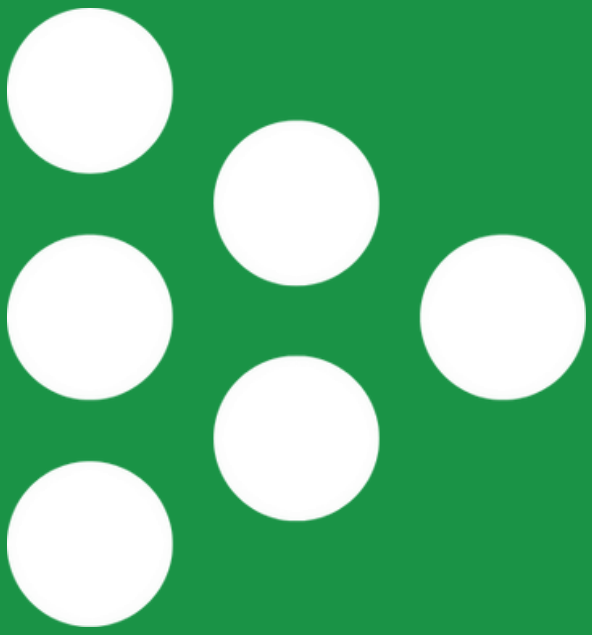

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