

Improving Science and Technology
Instruction in Rwandan Primary Schools:
Implementation of the

Right to Play Plug-in-Play Project

Implementation Study Brief

NOVEMBER 2025



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Why Science and Technology Matter

To thrive in a rapidly evolving, technology-driven world, young learners need more than basic literacy and math skills. Early exposure to science, technology, and engineering helps children develop critical thinking, problem-solving, and creativity—skills that are essential for navigating complex challenges and contributing to their communities.

In Rwanda, this focus on technology and science aligns with the country's recent adoption of competency-based curriculum, which prioritizes applying knowledge, developing integrated skills, and promoting learner-centered teaching practices. However, despite these goals, many teachers lack the experience, training, and materials required to effectively engage children in science and technology education. The Plug-In-Play (PiP) project, implemented by Right To Play (RTP) and funded as part of the Lego Tech & Play initiative, seeks to bridge this gap by helping teachers integrate learning through play with technology into science and elementary technology (SET) classrooms in grades 4–6.

About the Study and Why It Matters

This study explored how teachers implemented and adapted PiP in their classrooms in the final year of the program, the support they required, and how implementation varied. The research offers practical insights for improving science and technology education in low-resource settings. Many professional learning (PL) programs fail to improve teaching or learning, and evidence of the impact of PL on student learning is mixed. Before evaluating learning outcomes, it is essential to determine if teachers can implement the innovation in practice. Teacher adaptations can support feasibility, but too much variation may dilute core elements and undermine effects. Understanding the balance between adaptation and fidelity is key to scaling effective interventions that are contextually grounded and effective.

The PiP Intervention

RTP worked with 312 schools across 6 districts to implement the PiP model and aimed to reach approximately 838 teachers and 116,000 students. RTP provided professional development (PD), peer learning, coaching, and model lessons to support playful, technology-based activities. The intervention included the following.



Three trainings for Grades 4-6 SET teachers focused on:

- Tinkering and Making – problem-solving with everyday materials as well as hands-on science activities
- Creative Coding – computer programming using visual platforms
- Robotics – designing, building, and programming mechanical devices to solve problems



Community of Practice (CoP) sessions for peer learning



Coaching and mentoring from RTP staff



Model lesson plans aligned to the CBC



This multi-phase training aimed to build teacher knowledge and confidence and shift instruction toward fostering active, student-centered learning.



Focus of the Research

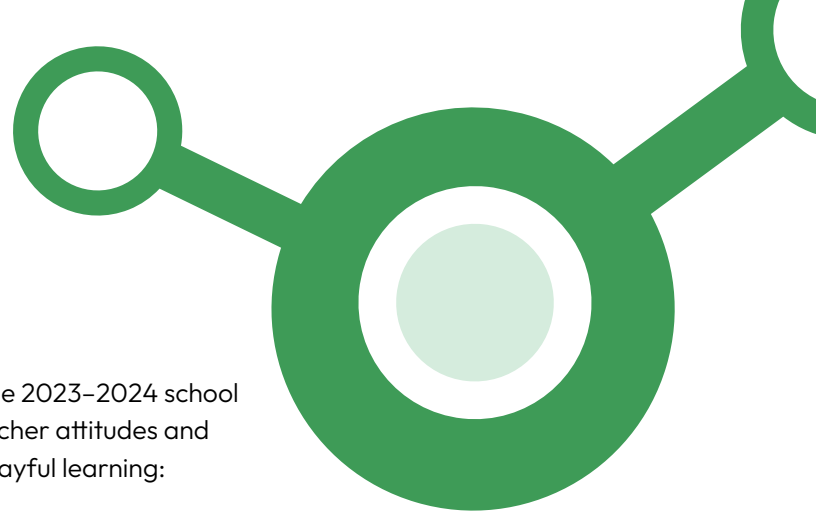


This study explored four research questions.

- 1.** To what extent does participating in the Plug-in-Play project lead to changes in teacher knowledge, attitudes, and practices?
- 2.** How do teachers implement and adapt the PiP instructional approaches with their students, and how does instruction vary across teachers and schools?
- 3.** What factors facilitate and inhibit teachers' implementation of the PiP model with their students?
- 4.** How do students experience the PiP intervention and how do their experiences vary within and across classrooms and schools?



Research Design



This descriptive, mixed-methods study was conducted over the 2023–2024 school year. The study used a range of tools to assess changes in teacher attitudes and practices related to SET and practices to support engaged, playful learning:

Measures in Brief

Method	Sample
Teacher Surveys	Surveys with 186 PiP teachers and 65 comparison teachers at the beginning and end of the school year
Classroom Observations	34 PiP teachers (70 lessons over 3 waves) + 14 comparison teachers (14 lessons)
School Case Studies	7 PiP schools in 3 districts; interviews with 12 PiP teachers and head teachers, document review
Observations of PiP Trainings & Post-Training Interviews	2 sessions (tinkering & robotics); interviewed 12 PiP teachers
Observations of Communities of Practice (CoP)	6 CoP sessions observed in 3 districts
Student Focus Groups (SFGs)	6 SFGs following lesson observations with 31 students

CONSTRUCTS: Playful Learning with Technology

The research examined how teachers implemented the PiP approach by focusing on two key dimensions of playful learning instructional practices: (1) effective teaching strategies that foster active, engaged learning,¹ and (2) the critical role of content-focused instruction.²

To assess these constructs, we looked at how teachers supported students using the following categories of teacher support:

- Exploration and Critical Thinking
- Agency
- Collaboration and Communication
- Engagement in SET Content and Competencies

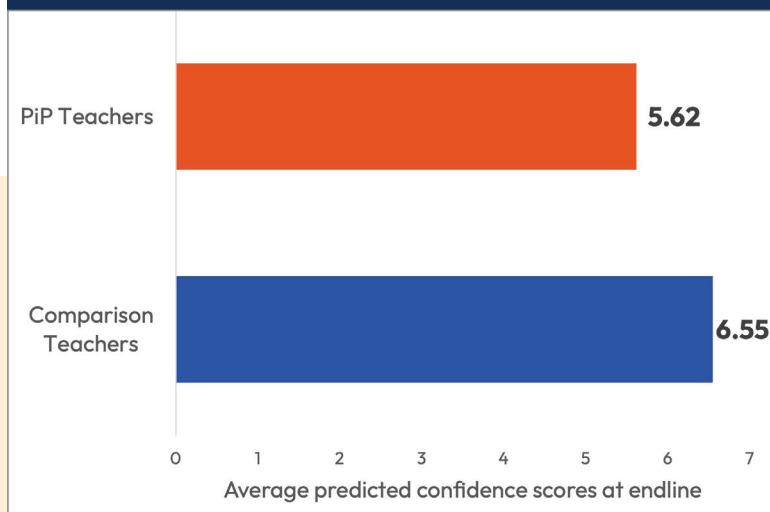
¹ Jukes, M. C. H., Yoshikawa, H., Betts, K., Dubeck, M., Edwards, L., Nduku, T., Staskowicz, E., Stern, J., Gjicali, K., Kim, S., Mahbub, T., Moran, C., Patankar, K. U., Rosenbach, S., Saleh, H. M., Strouf, K., & Zhao, V. Y. (2022.) *Playful Learning Across the Years (PLAY) measurement initiative: Full report*; Stacy, B., Akmal, M., Rogers, H., Venegas Marin, S., Rajaram, H., & Farysheuskaya, V. (2025). *What's at play? Unpacking the relationship between teaching and learning (English)*. (Education Working Paper, No. 9). World Bank Group. <http://documents.worldbank.org/curated/en/099011625211529079>

² Bold, T., Filmer, D., Martin, G., Molina, E., Rockmore, C., Stacy, B., Svensson, J., & Wane, W. (2017). What do teachers know and do? Does it matter?: Evidence from primary schools in Africa. (2017). (Policy Research Working Paper, No. 7956). World Bank. <http://hdl.handle.net/10986/25964>



Changes in Teachers' Attitudes, Beliefs, and Reported Behaviors

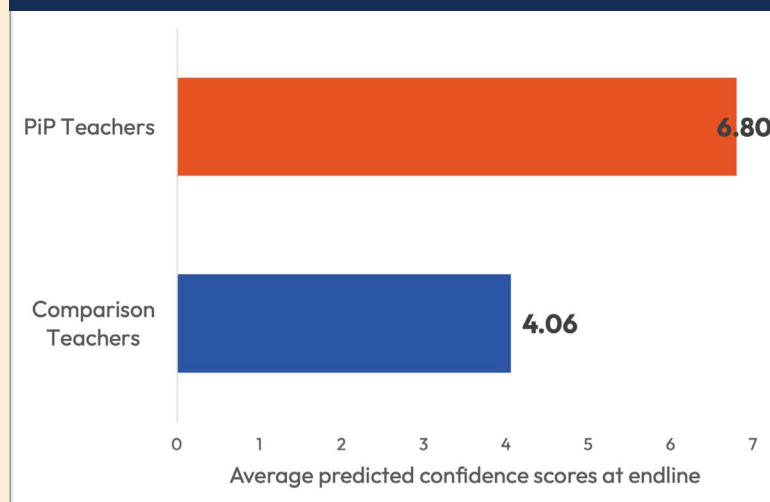
Confidence Using Playful Learning Instructional Strategies



Compared to teachers in the comparison group, teachers in the PiP group on average reported greater confidence and use of strategies to foster playful learning with technology at the end of the year. Specifically, when controlling for baseline attitudes and practices, PiP teachers reported:

- Higher confidence about using technology for learning
- More frequent use of technology with students
- Stronger agreement about the importance of playful instructional practices to support engaged learning
- More frequent use of instructional practices for playful, engaged learning

Confidence Using Technology For Learning



PiP teachers showed deeper awareness of inclusive teaching practices. In interviews, PiP teachers were more likely to mention using strategies for supporting struggling students and those with special needs.

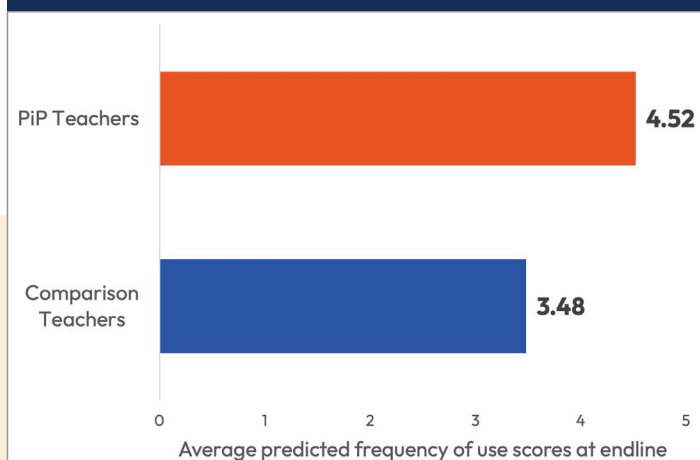
Teachers still needed more support to feel fully competent. Although PiP teachers showed a slight increase in confidence using instructional strategies for active, student-centered learning, they remained, on average, less confident than comparison teachers at the end of the program. This difference may stem from an increase in awareness of the complexity of the strategies as their knowledge grows or may be because many teachers rated themselves very high at the start, leaving little room to show growth.

Figures above display the mean predicted teacher ratings of confidence by teacher group at endline, after adjusting for differences in teacher baseline characteristics. Adjusted ratings (on a scale of 1 to 7) were computed based on regression analysis. Differences between PiP and comparison teachers were statistically significant at $p < .05$.

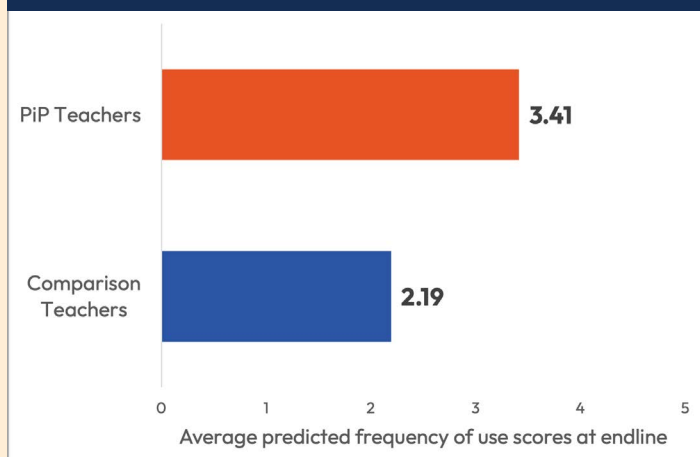


Changes in Teachers' Attitudes, Beliefs, and Reported Behaviors

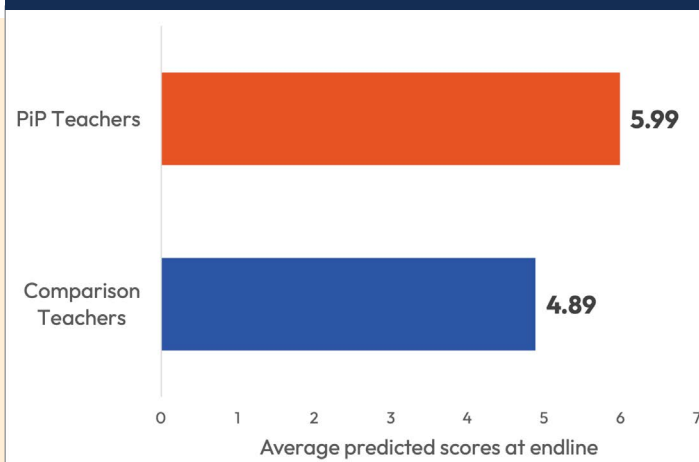
Reported Use of Playful Learning Practices



Reported Use of Technology for Learning



Perceptions of the Importance of Playful Instruction for Learning



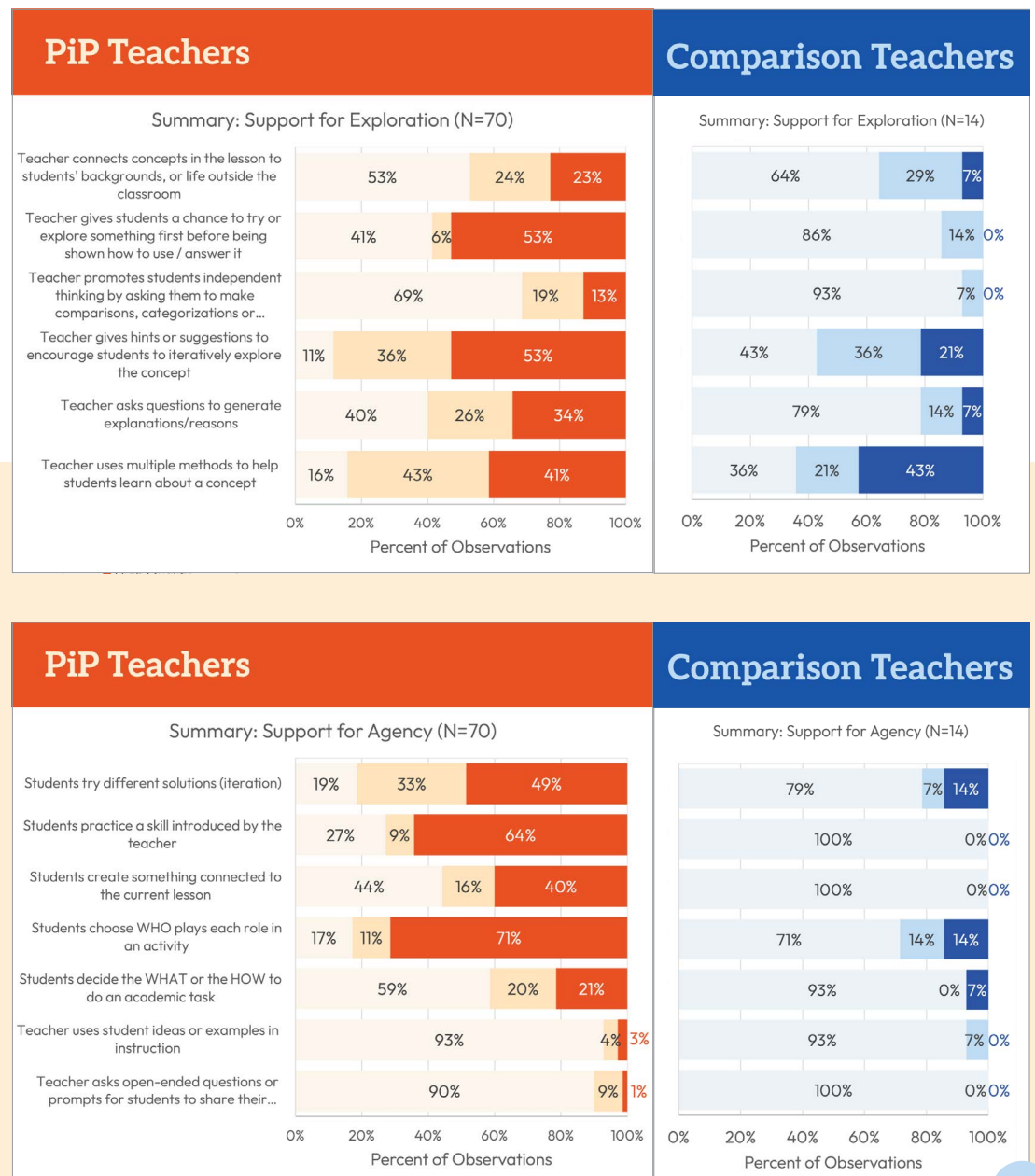
Figures above display the mean predicted teacher ratings of the importance of playful instruction for learning by teacher group at endline, after adjusting for differences in teacher baseline characteristics. Adjusted ratings (on a scale of 1-strongly disagree to 7-strongly agree) were computed based on regression analysis. Differences between PiP and comparison teachers were statistically significant at $p < .05$.

Figures above display the mean predicted teacher ratings of frequency of use by teacher group at endline, after adjusting for differences in teacher baseline characteristics. Adjusted ratings (on a scale of 1-never to 5-almost daily) were computed based on regression analysis. Differences between PiP and comparison teachers were statistically significant at $p < .05$.



Student-Centered Instruction for Active Learning

- PiP teachers were more likely to implement student-centered instructional practices than were comparison teachers.** Classroom observations suggest that PiP teachers were more likely than comparison teachers to use practices to foster student agency, exploration, and personal and social connections. In PiP classrooms, many teachers incorporated group work and provided opportunities for student agency, choice, and peer learning. Observations and teacher reports highlighted that many PiP teachers created positive classroom climates. In contrast, while group work was occasionally present in comparison classrooms, strategies specifically aimed at promoting student agency were rarely observed.





Building SET Understanding

- **Plug-in-Play teachers integrated new technology content and concepts into their lessons.** During observations, most teachers integrated tinkering and making across a variety of SET topics and engaged students in programming, while just over half of observed teachers were able to engage students in robotics.
 - **However, teacher supports for SET concepts and competencies and critical thinking were limited.** Classroom observations revealed that while many teachers incorporated active learning strategies, these activities were sometimes disconnected from underlying SET concepts, limiting opportunities for learning. Few lessons used authentic science questions or problem-solving, and teachers rarely asked questions to prompt higher-order thinking or explanations.
 - **Hands-on tasks were not always minds-on tasks.** During observations, the lesson goals and activities focused on completion of tasks rather than understanding of SET concepts. For example, about half of tinkering and making lessons observed did not clearly focus on SET concepts, and almost all programming lessons focused on following step-by-step guidance for a final product rather than understanding the processes of programming, such as debugging, iterating, and looping. Use of materials sometimes took time away from learning concepts and were overly focused on simple goals, such as drawing, labeling, or identifying parts.

“Before receiving training from RTP, teaching was straightforward because I couldn’t incorporate many activities. However, after the training, I learned the importance of student participation exceeding that of teachers during lessons.”

—FEMALE GRADE 5
TEACHER, NYANZA DISTRICT

“I would strongly recommend that future PiP training sessions allocate sufficient time for comprehensive learning. While the provided training was beneficial, the condensed schedule made it challenging for us to fully grasp all the skills being taught.”

—FEMALE GRADE 6
TEACHER, NYANZA DISTRICT



Variation in Implementation

- **Depth and quality of implementation varied across SET content and contexts.**

PiP teachers were less likely to support student agency during programming lessons, compared to tinkering and making and robotics lessons. PiP teachers were more likely to include a strong focus on SET understanding in physical science topics such as circuits compared to other SET topics such as life science.

- **Classroom context contributed to variations in implementation,** including access to resources and large classes. For example, many teachers were not able to implement robotics because of a lack of access and compatibility challenges with technology.

- **Engagement also varied within classrooms.** Teachers frequently used group work in their lessons but need more support to ensure all students fully engage. In some classrooms, students took active roles and collaborated meaningfully. However, in others it was difficult to ensure that all students participated.

Managing large class sizes and time constraints while teaching using tinkering activities poses challenges. I make efforts to handle this situation by creating large teams, with one team consisting of 8 students. However, it becomes difficult to closely monitor the participation of each student during these activities.

—MALE TEACHER,
NYAGATARE DISTRICT



Factors that Supported and Hindered Implementation



Supportive factors:

- **Coaching, Peer Learning, and Leadership Support.** Teachers reported that peer discussions in cross-school CoPs and occasional coaching visits from RTP staff helped reinforce training content and the exchange of ideas about classroom challenges and strategies. School leadership played a key role in sustaining PiP practices. Where headteachers actively encouraged PiP methods, teachers more consistently adopted student-centered approaches.
- **Resources and Materials.** Teachers with adequate access to resources, such as batteries, wires, robotics kits, laptops, or compatible software, were better able to implement PiP lessons.
- **Lesson Planning Resources.** Lesson planning resources shaped how teachers supported student agency. When student agency was part of the PiP model lesson, teachers were more likely to incorporate related activities. However, model lessons varied in their attention to critical thinking, SET competencies, student agency, and exploration, resulting in uneven practices.



Hindering factors:

- **Large Class Sizes.** Large class sizes made it difficult for teachers to manage group work and ensure active participation.
- **Limited Access to Materials and Technology.** Many teachers lacked essential tools—laptops, software, robotics kits, batteries, wire, and bulbs—which prevented them from fully implementing lessons and from engaging all students, especially in large classes.
- **Time Constraints.** Teachers reported insufficient time to plan and prepare PiP lessons—as a result, teachers often moved quickly through activities, resulting in limited depth of learning, especially for learners who needed more time to understand the concepts.
- **Inconsistent Follow-up Support.** While follow-up coaching and mentoring were helpful, they were not consistently provided, limiting reinforcement of training.
- **Curricular Misalignment.** Robotics was not yet part of the CBC at the beginning of the program, which posed challenges for teachers.



Student Experience

“We worked in a group to make a Christmas tree. Our group leader assigned tasks, and we discussed how to approach them. If someone encountered a challenge, another member of the group provided support. When we did not know how to proceed, we asked the teacher for help. Everyone enjoyed the activity, actively participating throughout the lesson.”

— FEMALE 5TH GRADE STUDENT, NYANZA DISTRICT

“I am not good at memorizing what we studied but because now we study using making and coding, my grades in SET have improved and my parents are happy with me.”

— MALE 6TH GRADE STUDENT, MUSANZE DISTRICT

- **Students reported increased engagement and enjoyment in PiP lessons compared to lessons before PiP.** Students found PiP lessons more engaging, enjoyable, and easier to understand than traditional instruction. They enjoyed the hands-on, interactive nature of PiP activities and appreciated being able to actively participate rather than just listen.
- **Students experienced ownership of learning and stronger collaboration with peers.** Students reported feeling more ownership over their learning, especially when experimenting or solving problems in groups compared to lessons before PiP. They also expressed increased confidence using technology, particularly in programming and robotics, due to collaborative group work.
- **Students faced barriers that limited full participation.** Although students appreciated group work, resource shortages and large class sizes often limited participation and varied access to opportunities. Some students had fewer opportunities than did others to engage directly with materials.



Conclusions and Implications

CONCLUSIONS

PiP helped teachers adopt more active, student-centered teaching methods, and students felt more engaged and took greater ownership of their learning. The Right to Play PiP project contributed to a measurable shift toward more student-centered, tech-integrated instruction aligned with Rwanda's competency-based curriculum. Teachers gained confidence, experimented with playful methods, and deepened their understanding of inclusive pedagogy.

Teachers incorporated tinkering, making, and hands-on activities in many SET topics and practice in basic programming, but need more support to ensure lessons focus on understanding and doing SET. Hands-on activities were sometimes disconnected from core SET concepts and competencies, and some teachers focused on completing tasks without clear connections to SET learning goals. Although teachers were able to shift to more student-centered practices, moving from traditional delivery of content to supporting conceptual development may take much more time, particularly in the context of large classes and limited resources. Because of the complexities in teaching robotics, many teachers required more materials and support to teach the topic.



Supportive factors included teacher peer collaboration, school leadership encouragement, sufficient materials and technology, and access to model lesson plans.



Barriers included large class sizes, limited and incompatible technology, time constraints, inconsistent post-training support, and uneven emphasis on SET concepts in training and materials.



Conclusions and Implications

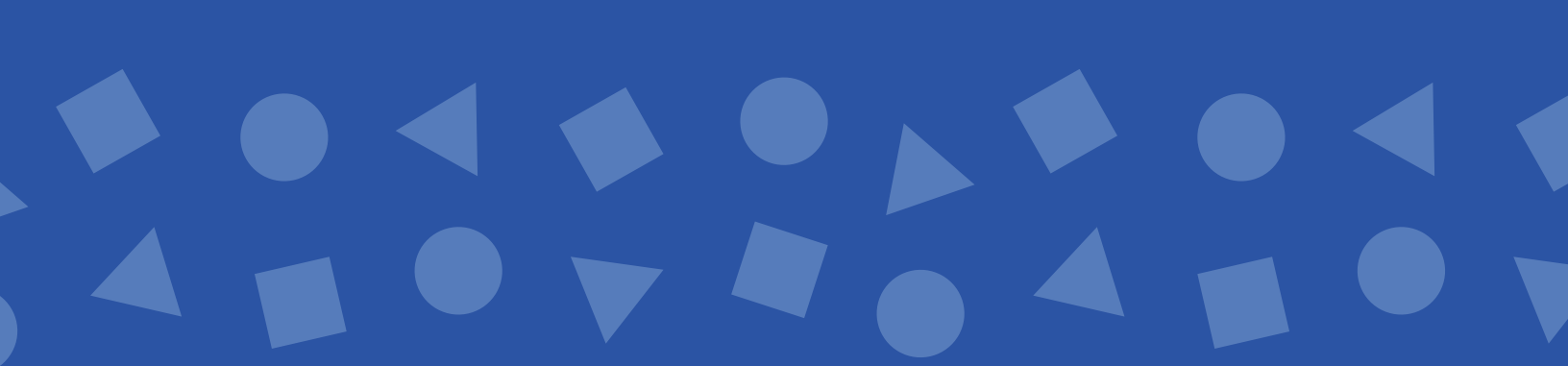
IMPLICATIONS

Findings suggest that **PiP has begun to shift Rwandan SET education**. The project successfully introduced student-centered, technology-integrated learning, aligning with Rwanda's curriculum goals for critical thinking and digital literacy. However, teachers require more support to fully implement the program.

- **Consider teachers' diverse needs, strengths, and trajectories in professional development design.** Design training and learning experiences that are adaptive to teachers' differing needs and levels of experience, such as small group work and break-out sessions.
- **Build system-level capacity to support teachers' transition to new instructional models.** Ensure time and training to ensure trainers and coaches have sufficient capacity to support teachers when implementing innovative programs.
- **Provide instructional materials, such as sequenced units and lesson plans, that support teachers in applying new approaches after training.** Ensure materials clearly show how learning goals build over time and provide tools for assessing student learning, such as model questions and rubrics.
- **Connect student-centered, active learning to conceptual understanding.** Assess students' skills and knowledge for constructing and applying knowledge during hands-on activities, rather than focusing on the end product. Use hands-on activities for open-ended topics and direct instruction for well-structured and foundational knowledge. Provide teachers with strategies to engage all students during group work and classroom discussions.
- **Ensure tech strategies and tools serve a clear instructional purpose and align with real classroom conditions.** Connect technology to curricular aims, and consider basic infrastructure, such as electricity, as well as more complex issues such as software compatibility.
- **Allocate time to pilot, learn, and adapt before scaling.** Strengthen innovative program design, such as new tech, through collaborative learning that leverages expertise in content, pedagogy, and the local context.

Many of the lessons from this study align with broader findings from the Tech & Play initiative across Kenya, Rwanda, and Brazil. Implementing partners may wish to consult the complementary brief and reflective tool, **Lessons Learned from the Tech & Play Initiative: Insights to Inform Program Design and Implementation**, which synthesizes cross-country insights on supporting teacher learning, designing effective instructional materials, aligning technology, dealing with classroom realities, and fostering continuous program improvement.

Together, these resources can inform efforts to design and implement education technology programs that lead to deeper learning outcomes for students.



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