

IMPLEMENTING PERSONALISED ADAPTIVE LEARNING IN SCHOOLS

Lessons from Procurement and PAL Proof of Concept in AP

July 2019



Technical Partner

Dalberg

TABLE OF CONTENTS

1) Executive summary and recommendations	02
2) Introduction to the playbook	05
2.1. What is Personalised Adaptive Learning (PAL)?	05
2.2. What is the purpose of this playbook?	06
2.3. How to use the playbook?	07
3) The Andhra Pradesh case study	08
4) Process for implementation	11
4.1. Define objective and scope	11
4.2. Identify funding sources and quantum	13
4.3. Determine governance structure and define stakeholder management	15
4.4. Select software vendor(s) and system integrator	20
4.5. Select and prepare schools	29
4.6. Prepare teachers	36
4.7. Establish project management systems and field support	43
4.8. Determine Monitoring, Evaluation and Learning (MEL) agenda	48
5) Contextualisation of PAL solution (software and hardware)	51
6) Learning agenda for future PAL implementation	53
6.1 Annexure 1: Structure of Department of School Education in Andhra Pradesh at State and District Level	56
6.2 Annexure 2: Roles and responsibilities of The Technical Support Unit (tSU) .	58
6.3 Annexure 3: School Selection and Preparation Survey	59
6.4 Annexure 4: School Checklist	61
6.5 Annexure 5: MIS Data Collection Metrics	62

1 | EXECUTIVE SUMMARY AND RECOMMENDATIONS

This Playbook provides lessons for scaling up Personalised Adaptive Learning (PAL) in Government schools across India.

Personalised adaptive learning (PAL) technology is one of the most promising educational interventions in India. It can scale massively wherever we can deploy and maintain technology infrastructure and requires basic human resources. Yet documented successes in Government schools have been in small and highly controlled environments so far, making it hard to predict how it may work at scale in resource constrained settings.

The ambitious roll-out of PAL in Andhra Pradesh (AP) is a bellwether on what works and what does not. Andhra Pradesh is the first state to roll-out PAL at scale, with plans to cover over half of all secondary schools starting AY2019/20. The AP Department of School Education (DSE) launched a Proof-of-Concept (PoC) phase over 1.5 months across 60 schools with three different PAL solutions. Through this PoC, the AP DSE identified quality PAL solution providers and built its own capacity to implement PAL. It also discovered several best practices to operating at scale and ensured vendors are ready to operate in the AP context.

Two of the largest challenges the PoC solved for were procuring high quality software vendors while maintaining a single point of accountability and decreasing dependence on field management staff to increase scalability and sustainability.

- **Innovating on procurement: A two-staged procurement process allows for both quality and accountability.** Typically, states tend to bundle software and hardware procurements to keep a single point of accountability. However, this way the emphasis falls on getting the cheapest hardware, to the detriment of getting good quality software. To separate the purchases is to risk losing end-to-end ownership by vendors. So, a two-staged process where the state first selects and empanels the software vendors, then selects the system integrator (SI)¹ who must work with empaneled software vendors allows for both quality and accountability. Setting a fixed price for software prevents the SI from simply purchasing the lowest cost software.
- **Validating a scalable model: 1 field management support (FMS) staff per 4 schools seems adequate, validating the potential for scale and sustainability of PAL.** The PoC tested for 1 relatively lower skilled FMS staff managing 4 schools, which was a break from the previous 1:1 intensive FMS implementation models. While impact on learning outcomes have not been measured yet, the teachers were comfortable with this level of support. The scale-up this academic year will test for gradual reduction of FMS staff from 1:4 to 1:6 over a six-month period, and potentially test for further reductions afterwards.

The PoC also demonstrated two success factors around the governance and accountability structures:

- **Top-level Government buy-in is a must-have.** The newness of PAL implementation at scale meant unexpected challenges for both the AP DSE and the key stakeholders. strong leadership within the AP DSE led to flexibility, speed and trust by external stakeholders in resolving these unforeseen issues.
- **Roles and responsibilities across all key stakeholders need to be clear with incentives aligned.** As PAL implementation requires heavy inter-dependency between stakeholders, roles and responsibilities need to be clearly demarcated. Mechanisms to hold each party accountable (e.g. interest penalties for delayed payments from government alongside penalties for delayed deployment by the SI), lay the foundation for an efficient roll-out.

¹SI brings together hardware, software and field management support

While this Playbook primarily focuses on Government officials as the main driver for PAL implementation, it also has useful takeaways for other key players:

PAL vendors

The PoC highlighted the potential ways through which PAL software can drive usage (refer to section no. 5 on Contextualisation of PAL solution).

- **Content should be available in English as well as regional languages.** If English is the primary medium of instruction, multilingual content is required to work around the common lack of proficiency in English.
- **Nudges play a strong role in driving student usage,** either through encouraging words or incentives that instill healthy competition.
- Questions should be a **mix of multiple choice and fill-in-the-blanks** to avoid random clicking.
- Examples should be locally **contextualised**.

PAL Funders

As the PAL ecosystem is growing, it is important for funders to build it further by supporting:

- **Evidence on best practices and success factors for effective usage:** Since there are still many open questions around effective delivery and adoption of PAL, funders can support rigorous monitoring, evaluation and learning activities (refer to Section 6 on 'Learning agenda for future PAL implementation').
- **Capacity building for FMS management:** Traditional system integrators have focused primarily on hardware delivery and support. Even PAL vendors may not have the capacity or the expertise to provide field management at scale. Funders can incentivize private/non-profit sector players to build this capacity.
- **Technical and advisory support to Government stakeholders:** Since governments will be rolling out PAL for the first time in most states, there may be need for technical support to help with initial strategy, capacity building of stakeholders, as well as selection and procurement processes. Technical partners can bring an external problem-solving lens, along with deep understanding of incentives and motivations of different players. Funders can support Governments by providing or funding the technical support.

Technical support partner/consultants

The technical partner can go beyond merely managing stakeholders. The key to a successful scale-up will lie in the technical partner taking on the position of a trusted advisor, ally and problem solver to bring out the best of each partners' capabilities. It is helpful to surface tensions and realign incentives as needed to ensure that everyone can work towards a common goal. (refer to Section 4.3 on 'Determine governance structure and define stakeholder management' and 'Select software vendors and procure system integrators')

As AP rolls out PAL at an unprecedented scale, there will be successes and failures along the way. Some of the most important questions to test include:

- **Process:** How do we best solve for implementation of PAL in schools where number of students in a classroom exceeds number of devices available? What are the ideal processes to ensure high engagement and utilisation by teachers and students?
- **People:** How do we successfully enable teachers to understand, buy-into, and deliver PAL effectively? What is the most economical utilisation of field management support (FMS) executives without compromising on the quality of support?
- **Product:** *Are the products contextualised for low resourced environments? What is the cost-impact trade-off between laptop and tablet models?*

Building on these learnings will allow us to harness PAL's rich potential to help solve India's education challenges.

2 | INTRODUCTION TO THE PLAYBOOK

2.1 WHAT IS PERSONALISED ADAPTIVE LEARNING (PAL)?

Personalised Adaptive Learning (PAL) is a promising EdTech solution. It has the potential to significantly improve student learning outcomes in India, where foundational skills are low and learning levels across students within a class vary. PAL emphasises the tailoring of instruction to the learning level of each child, thereby leading the child towards his or her unique learning trajectory. It uses a combination of both personalised and adaptive approach to build skills. The pedagogical approach involves diagnosing the child for gaps in basic competencies, instead of testing for knowledge on a broad topic. Once diagnosed, the child is led towards his or her unique learning trajectory through a finite number of carefully designed questions, remediating with appropriate content where needed.

For example, a specific subject could be broken down into key topics (e.g., whole number concepts), subsequently into clusters (e.g., counting and grouping up to 100), and later into questions in sequence of difficulty. This would provide a comprehensive understanding of each cluster to the student. The personalised approach is built on comprehensively detailed concept dependency maps. This means that a learner struggling with a concept will be directed towards formative concepts that could assist the student's learnings and mastery of a particular concept. The questions are challenging enough to engage students, but not so difficult that they give up.

The robustness of personalised adaptive learning algorithms depends on the following the ability of the software to:

1

Identify the child's baseline on the specific topic or concept and lead the child up a learning ladder

2

Decompose effectively the learning ladder itself and construct the learning pathway in terms of facilitating the most organic process of moving up the learning ladder

3

Remediate the child for each competency effectively with the most impactful content

There exists encouraging evidence from across the world on the use of computer-assisted adaptive learning to facilitate "Teaching at the Right Level" (TaRL). A paper by Philip Oreopoulos and Andre Nickow for J-PAL reviewed dozens of Randomised Controlled Trials (RCTs) involving EdTech. The research found that in nearly all of the 41 studies which compared pupils using adaptive software, with peers who were taught by conventional means, the software-assisted pupils received higher scores. In most studies, language scores achieved were higher, too².

An extensive review of existing studies from across the world on Computer Assisted Learning (CAL) interventions found that hardware focused interventions that provide computers at home or at school seem to have no positive impact on learning outcomes. Pedagogy focused CAL programs that allow

²The Economist, "Technology is transforming what happens when a child goes to school", July 2017

students to review grade-appropriate content at their own pace were found to do better, but the gains were modest and ranged from 0.1σ to 0.2σ. Finally, the interventions that delivered the largest gains appeared to be those that use technology to also personalise instruction (Muralidharan, Singh and Ganimian 2017)³.

Personalised solutions have been found to work for lower grades to build foundational skills, as well as for higher grades. In addition, a recent research evaluation through Randomised Control Trials (RCTs) of a personalised learning solution, Mindspark, in privately owned after-school learning centres in Delhi serving students of upper primary grades from Government schools, found large increases in learning outcomes in Mathematics and Hindi (Muralidharan, Singh and Ganimian 2017). The resultant increase in learning outcomes was found to be far bigger than any intervention anywhere else in the world in improving learning outcomes in a comparable period of program exposure.

Given the low levels of foundational skills among students in India, personalised adaptive learning is especially promising for building such skills early on, to promote higher learning and prevent students from increasingly falling behind later. Research has shown that teachers also benefit through the introduction of personalised adaptive learning approaches, as student specific diagnostics reduce the types of errors they make and the prevalence of these errors^{4,5}. Taken together, the positive outcomes of these studies suggest that personalised adaptive learning methods have the potential to significantly influence student learning outcomes in India, especially to prevent students from falling behind early on.

2.2 WHAT IS THE PURPOSE OF THIS PLAYBOOK?

This playbook serves two purposes:

2.2.1

SUMMARIZE KEY LESSONS AND BEST PRACTICES FOR

- Procuring Personalised Adaptive Learning (PAL) solutions.
- Implementing of PAL programs especially for government school systems in India, based on the existing literature on the subject and through a deep case study of the Andhra Pradesh (AP) experience from the initial proof-of-concept (PoC) phase and preparation for the scale-up phase.

2.2.2

PROVIDE DIRECTIONAL GUIDANCE AND PRACTICAL TOOLS FOR PAL SCALE-UPS

These are based on the proof-of-concept experience in Andhra Pradesh and other States, and that the scale-up should be tracked closely for significant additional learnings.

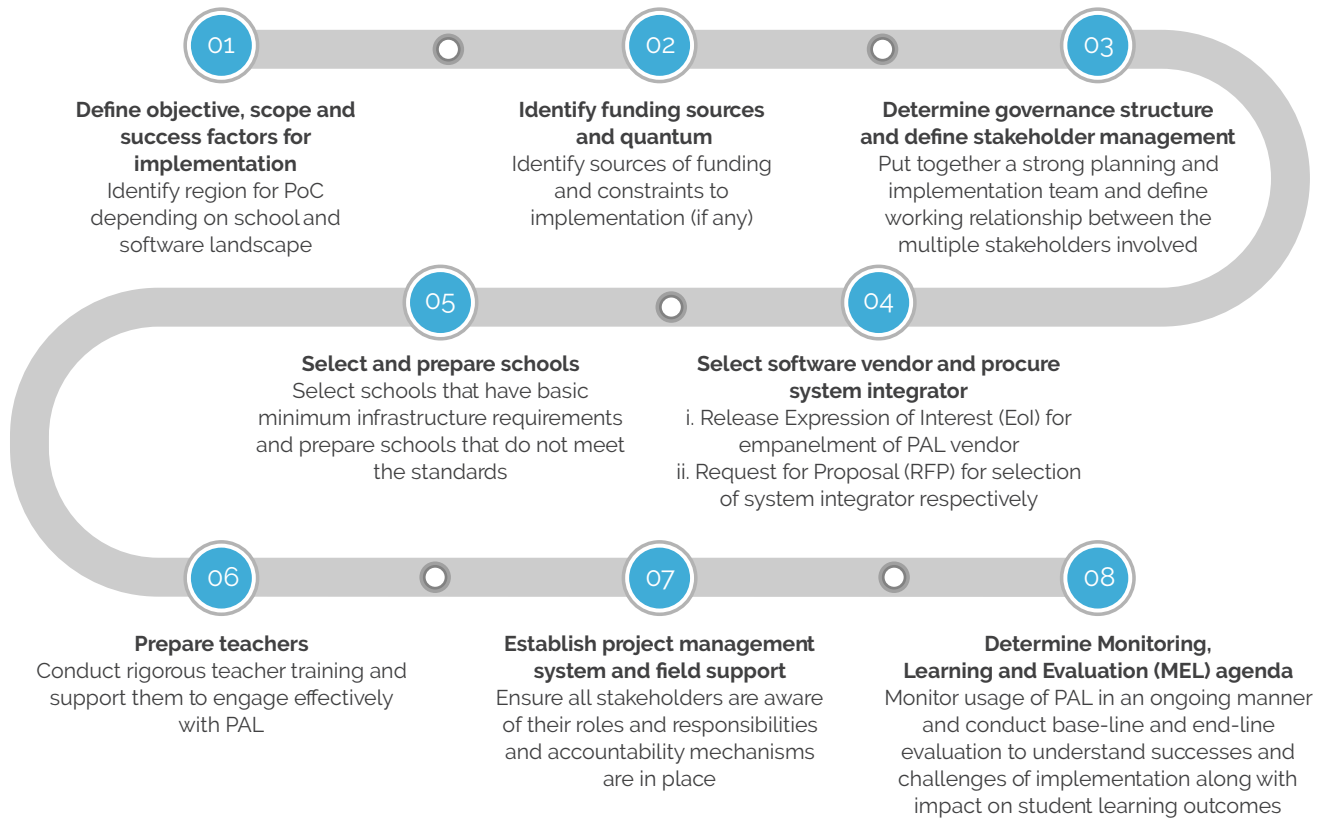
³Muralidharan, Singh and Ganimian, 'Disrupting Education? Experimental Evidence on Technology-Aided Instruction in India', July 2017

⁴Carpenter, Thomas P., et al. "Teachers' Pedagogical Content Knowledge of Students' Problem Solving in Elementary Arithmetic." *Journal for Research in Mathematics Education*, vol. 19, no. 5, 1988, pp. 385–401., www.jstor.org/stable/749173

⁵Hill, H., Ball, D., & Schilling, S. (2008). Unpacking Pedagogical Content Knowledge: Conceptualizing and Measuring Teachers' Topic-Specific Knowledge of Students. *Journal for Research in Mathematics Education*, 39(4), 372-400. Retrieved from <http://www.jstor.org/stable/40539304>

2.3 HOW TO USE THE PLAYBOOK?

There are 8 steps to PAL implementation:



This is a continuous process, depending on performance of stakeholders in each phase. E.g., PAL vendors may be selected again to allow new players to participate or allow for change of an implemented solution that is not apt for the context.

Figure 1: Process of PAL scale-up preparation

Implementing PAL is a continuous process, that depends on the performance of stakeholders across each step. For example, the process of identification of funding sources and quantum may take place even during PAL implementation to get resources for the following year or following phase. Similarly, as new PAL vendors/solutions enter the ecosystem, governments may want to select PAL vendors again to keep the process competitive, ensuring innovation and improved solutions by existing vendors.

This playbook provides both **learnings and challenges across each step of PAL implementation that various states have faced along with a case-study of the model followed in Andhra Pradesh** for the PoC and during the scale-up preparation. It provides implementation guidance for government stakeholders, PAL software vendors, system integrators, MEL partners, funders etc. depending on where in the lifecycle of PAL implementation they play a role.

3 | THE ANDHRA PRADESH CASE STUDY

The Andhra Pradesh Department of School Education (AP DSE) has embarked upon a strategic school transformation program called 'Badi Parivartana' whose vision is to move towards 'child-centric' school education with a goal to create an all-enabling ecosystem that can ensure 'happy, fulfilled, resilient and responsible students, who are future ready'. Under the ambit of the fourth strategic goal of Badi Parivartana, e-Paathshaalalu (Digital Schools), **Andhra Pradesh (AP) has been at the forefront of innovative EdTech and technology education initiatives in India.** The AP DSE recognises the potential for EdTech to enhance teaching and learning in its government schools. It has acquired valuable strategic capacity to scale promising EdTech initiatives through its Project Management Unit (PMU). Recent EdTech initiatives include the AP e-knowledge Exchange Portal (APEX), Janmabhoomi digital classrooms, virtual classrooms, biometric attendance tracker, computer-based tests and teacher recruitment tools, as well as a long tail of smaller-scale philanthropy-backed pilots. In addition, programs like ASPIRE in collaboration with tech companies and the Andhra Pradesh State Skill Development Corporation (APSSDC) have started to introduce vocational programs that teach coding, computational thinking, virtual reality, robotics and others across ~400 tribal and social welfare schools.

The Government of AP (GoAP) has been committed to Personalised Adaptive Learning (PAL) and wants to be the first state to implement PAL at scale by incorporating best practices from interventions in other parts of India and across the world. Given the success of PAL in other contexts in India, GoAP was keen to explore these in AP as well. While PAL has previously been implemented on a small scale in multiple states (e.g., Chhattisgarh, Rajasthan, Himachal Pradesh, Jammu & Kashmir), Andhra Pradesh has planned to implement PAL at scale, in over 2,600 schools. In order to set-up for PAL implementation at such a large scale, it was crucial that the government establishes a robust and transparent method to identify quality solutions and also design the at-scale program suited for AP's context. Hence, the Andhra Pradesh Department of School Education implemented a phased procurement process, starting with ~7-week proof-of-concept phase (PoC) in 56 schools before scaling-up to the rest of the schools. The PoC was conducted in the districts of Prakasam and Guntur for grades 6 to 9 in the subject of Mathematics for English medium students in the academic year of 2018/19 between February and April.

The objectives of the PoC were to:

- Get ready for scale-up by identifying high quality PAL solution providers, building capacity of the state, and ensuring vendors are ready to operate in the AP context.
- Drive the learning agenda forward by identifying the conditions under which PAL can succeed in government school settings (i.e., drivers that lead to high usage of, and interest in PAL products), and good practices in implementation, so that the PAL ecosystem in India becomes more robust, and ultimately improves student learning across the country.

For the PoC, three PAL software vendors (Educational Initiatives (Mindspark), Funtoot, and ConveGenius) were selected through a competitive process following an Expression of Interest (EoI). During the PoC, hardware was provided and delivered by GoAP, while on-ground Field Management Support (FMS) staff was recruited, trained, and managed by PAL software vendors at no cost to the government. Based on the performance in the PoC, all three vendors were empaneled for scale-up after a rigorous Monitoring, Evaluation and Learning (MEL) process. Simultaneously, a Request for Proposal (RFP) was floated to onboard a System Integrator to provide hardware procurement, delivery, support services along with recruitment and management of on-ground FMS staff for scale-up.

The figure below explains this process, with more details on the rationale for these in the following sections.

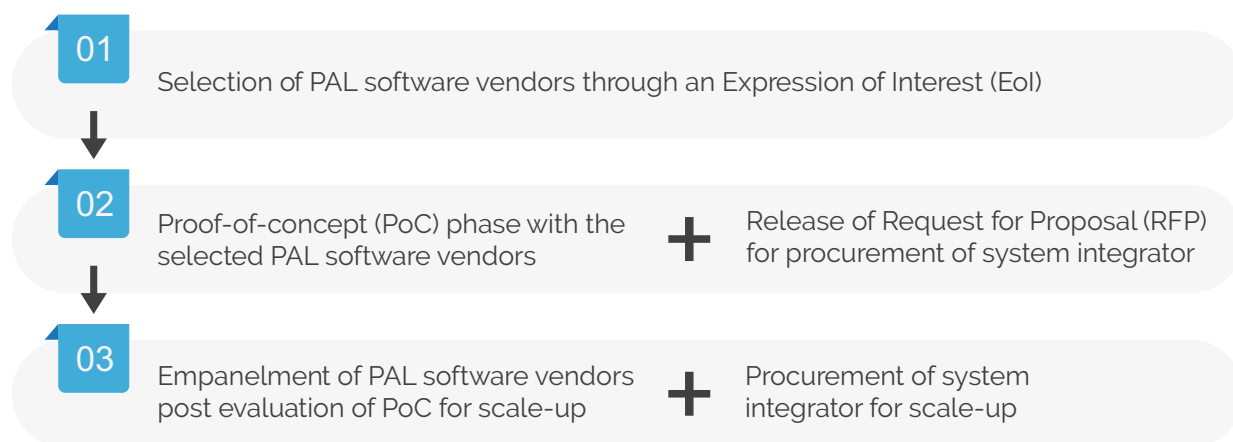


Figure 2: Key procurement and selection processes as part of AP PoC and scale-up

The PoC, despite being short (~7 weeks), demonstrated:

- The strong potential of scaling PAL in government schools.
 - The potential for procuring vendors with a single point of accountability without sacrificing quality, high student usage, positive user feedback.
 - The indicative success of the 1:4 model of Field Management Support (FMS) staff.
- a) States often bundle software and hardware procurements to keep a single point of accountability. However, this way the emphasis falls on getting the cheapest hardware, to the detriment of getting good quality software. To separate the purchases is to risk losing end-to-end ownership by vendors. The GoAP launched a two-staged process where it first selected and empaneled the software vendors who met the basic quality criteria in the PoC, then selected the system integrator (SI)⁶ who must work with empaneled software to allow for both quality and accountability. Setting a fixed price for software prevented the SI from simply purchasing the lowest cost software.
- b) PAL usage in the 7th week of the PoC was 70% of the weekly target, a significant jump from 15% of the target in the first week. This was made possible due to strong commitment of all stakeholders – PAL software vendors, Project Management Unit (PMU) and IT cell of the GoAP, on-ground team of district officers, headmasters, teachers and FMS staff.
- c) Teachers believed PAL to be useful in increasing student interest in math, with some teachers claiming a reduction in student absenteeism since PAL implementation. 92% of all teachers want to continue PAL in the next academic year as well, and expand it to other subjects⁷.

Finally, the first ever Field Management Support (FMS) staffing model⁷ of 1:4 (that is, 1 FMS staff for 4 schools) was proven to be successful, with no red flags/concerns around this model. In fact, ~84%⁸ of teachers surveyed as part of the AP PoC end-line evaluation, said they would be comfortable running PAL

⁶SI brings together hardware, software and field management support

⁷FMS staffing model refers to ratio of FMS staff to schools. 1:4 model implies one FMS staff for every four schools, while a 1:1 model is one FMS staff for every school.

⁸Sample size: 111 teachers. Note that since this was a government initiative, there may be a social desirability bias in the data towards continuing PAL. The analysis of the data was hence corroborated with on-ground qualitative interviews

classes without the FMS support/visits within 3 months of PAL roll-out. While the 1:1 model of FMS staffing to school has been followed for PAL implementation so far, it isn't a scalable model due to its resource intensiveness. By proving the efficacy of the 1:4 model, AP PoC has established the use case of a scalable PAL implementation model. In the POC, the FMS were closely monitored and trained by the PAL vendors. At scale, appropriate structures would be needed to ensure quality of FMS support.

d) However, despite the early success, there are key challenges that need to be solved for prior to scaling PAL in Andhra Pradesh:

- **Build a strong government-led team** with accountability mechanism to oversee PAL implementation at scale.
- **Generate teacher buy-in by:**
 - Developing and administering rigorous training modules.
 - Integrating the solution well with daily teaching-learning and solving for the pain points that were raised during the PoC (e.g., timetabling, lack of mapping of PAL content to SCERT curriculum, etc.).
 - Putting in place incentive mechanisms for sustained and high usage of PAL (e.g., teacher/school awards).
- Ensure all **schools can provide each student with adequate time on the device** (especially in schools with high student strength) through dynamic allocation of devices, working around school schedule and time, etc.

1	Objective	2
Get ready for scale-up by identifying high quality PAL content and solution providers, building capacity of the state, and ensuring vendors are ready to operate in the AP context.		Drive the learning agenda forward by identifying conditions under which PAL can function in government school settings (i.e., drivers that lead to high usage of, and interest in PAL products), and good practices in implementation, so that the PAL ecosystem in India becomes more robust, and ultimately improves student learning across the country.

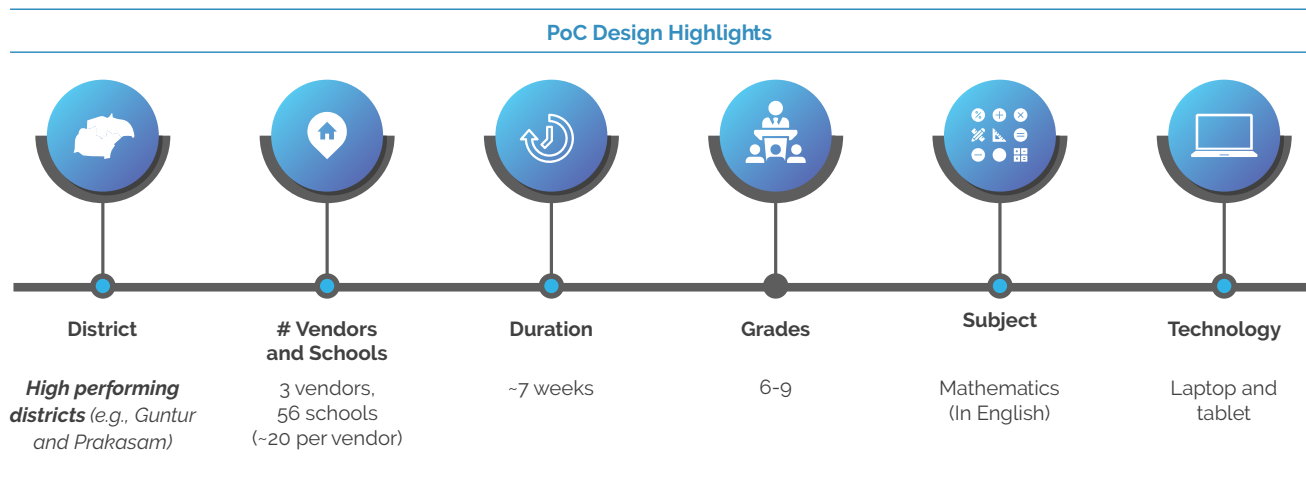


Figure 3: Proof-of-Concept (PoC) phase in Andhra Pradesh

The learnings that have emerged from the AP PoC along with preparation for scale-up have highlighted risks and challenges that impact PAL implementation as well as how to mitigate them. These learnings are generalisable to other government school contexts in India.

4 | PROCESS FOR IMPLEMENTATION

The following sections focus on the different processes that are part of PAL implementation. Each section focuses on challenges that either were faced in Andhra Pradesh or that one could potentially face when implementing PAL, along with solutions adopted; followed by open questions that still need to be answered and some good practices/principles to ensure before scale-up.

4.1 DEFINE OBJECTIVE AND SCOPE

Prior to PAL scale-up it is essential to define the purpose of the scale-up and determine basic level of readiness by answering a set of critical questions. While PAL has huge potential to improve learning outcomes with some early successes emerging across the globe, it is still a nascent solution with scope for innovation and new players to enter. While the PAL ecosystem is nascent, there may be a need to conduct PoCs to a) give an opportunity to new players to enter, b) learn about efficacy of different PAL implementation models/processes in different state contexts and, c) build capacity of on-ground government stakeholders to implement at scale. Each state should take a decision on whether there is need for a PoC depending on availability of solutions, on-ground context and maturity of market for the content.

The following are some questions to consider before implementing PAL:

1. *What is the right EdTech solution for improving education outcomes?*

Before deciding which EdTech solution to deploy, the government must answer three sub- questions:

a) **What is the scope of my problem and is EdTech the right solution?**

It is important to first define the problem statement that the solution aims to answer. A clear definition of the problem allows to make an objective decision on whether technology is the best solution and which learning outcome it can drive. Instructional EdTech is particularly helpful in situations where classroom instruction can be augmented with technology infrastructure and basic human resources for adoption.

b) **Is PAL the right technology to solve the problem in the target schools?**

There is a trade-off between impact and cost when it comes to PAL. PAL is best at tailoring instruction to the individual student learning level, which is most valuable when the learning levels in a classroom are highly varied. While being high impact in these situations, it is expensive to roll-out, especially in government schools that may need significant infrastructure (given PAL requires typically 1:1 device to student ratio) and human capital to accommodate the solution. This is especially costly in small and remote schools where there are great operational challenges.

c) **Which PAL solution makes most sense given the impact vs. cost tradeoff?**

Decision on the right PAL solution may require a proof-of-concept (PoC) phase before implementing at scale if there are multiple promising but unproven new solutions (e.g., laptop vs. tablet models). This was the case with PAL implementation in Andhra Pradesh, that tested new and innovative solutions during the PoC to give them a chance to scale-up. However, depending on the maturity of the market, there may not be a need for a PoC if there are proven PAL models and best practices for implementation at scale are known.

Case of Andhra Pradesh: The Government of AP (GoAP) has been committed to Personalised Adaptive Learning (PAL) as part of its ambitious Vision 2029 of “Transforming Education to Produce Future Workforce”. While GoAP has implemented multiple EdTech solutions in the past, it wants to be the first

state to adopt PAL at scale and generate learnings on how to accelerate student learning outcomes across a large cohort of school-going children. It thus had a clear learning agenda and understanding of PAL prior to implementation.

2. *Is there willingness among the top-level government stakeholders in the state to prioritize and commit resources for PAL implementation?*

Implementing PAL requires significant commitment of human and capital resources by the government department. The top-level government stakeholders hence must have strong conviction in PAL and commitment to execute it at scale, to be able to prioritize PAL and commit adequate resources to it.

3. *Does the government machinery have enough capacity and funding to implement PAL? And if not, how can the government work towards bridging that capacity gap in the near term and long term?*

Implementing PAL requires the coordinated effort of internal government stakeholders, as well as partnerships with relevant external stakeholders like PAL software vendors and system integrators. There is also a need for a dedicated team with project management skills to bring all stakeholders together and implement strong accountability mechanisms. Additionally, to implement PAL at scale, it is important to identify and seek sources of funding well in advance (preferably a year prior to implementation) to be able to leverage the multiple central and state channels of funding as well as external sources for all aspects of PAL implementation including hardware, software, field support, etc. If the government doesn't have readily available resources, it is important that there is willingness to leverage resources and find innovative solutions given the constraints.

Case of Andhra Pradesh: There is strong buy-in for PAL among the top-level state government stakeholders along with some existing internal capacity and funding to implement EdTech initiatives.

The AP Department of School Education recognises the potential for EdTech to enhance teaching and learning in its government schools. It has acquired valuable technical capacity to procure and implement EdTech through a Project Management Unit (PMU) that consists of members from the IT department, consultants, etc. For PAL implementation, the GoAP had already secured 60% central government funding through RMSA innovation and RMSA ICT budget with 40% commitment from the state government.

4. *Will the existing on-ground capacity of district teams, headmaster, teachers as well as infrastructure-availability in schools be able to support PAL?*

Willingness of top level-government stakeholders and capacity of implementing team needs to be complemented with on-ground willingness and basic capacity to implement PAL. This implies that the capacity of the district teams needs to be built to enable them to solve problems on-the-go and work around challenges. Headmasters' and teachers' basic digital literacy skills also need to be built (e.g., ownership/usage of smartphones at the least) along with an understanding of the objective of PAL implementation. While schools can be prepared for PAL implementation (e.g., procuring furniture, putting grills on windows, etc.) there needs to be some basic infrastructure-readiness that includes availability of electricity, extra classrooms, etc. Ensuring that schools can accommodate PAL is crucial, since a lack of basic infrastructure would only add to the already existing costs of rolling out PAL.

Case of Andhra Pradesh: For the districts and schools that were part of the PoC, the district teams were proactive. Headmasters and teachers had basic digital literacy and were relatively open to EdTech solutions to improve learning outcomes with roll-out only in schools having basic infrastructure readiness.

99%⁹ of teachers surveyed in AP had access to some form of technology at home. While they may not have been proficient in the usage of laptop/tablets, they were quick to learn basic hardware operating skills and could solve most repetitive hardware challenges without FMS staff support over the duration of the PoC. Almost all schools in AP have access to electricity with minimal power outage. District officers in Guntur and Prakasam were also proactive in getting schools ready to accommodate PAL - within a period of 2-4 weeks, all the PoC schools had furniture, grills, etc.

⁹Sample size: 111 teachers. Note that since this was a government initiative, there may be a social desirability bias in the data towards continuing PAL. The analysis of the data was hence corroborated with on-ground qualitative interviews

Based on the answer to these questions, governments can decide the scope and timeline of scaling PAL. For example, if the state of basic infrastructure in the state is low, governments may need to prioritize strengthening infrastructure before scaling the solution.

It is clear from the above examples that AP thus had a strong willingness to build the supporting ecosystem for successful adoption of PAL – well-defined learning agenda for PAL implementation, top-level government buy-in and funding support, willingness to identify and partner with the right stakeholders for supporting with capacity gaps, and positive attitude and cooperation from the on-ground team.

4.2 IDENTIFY FUNDING SOURCES AND QUANTUM

After defining the objective and scope, governments need to identify sources of funding and get adequate quantum based on the scope (for e.g., securing additional funding for PoC or carving out funding for PoC out of the scale-up funding). The government can think of securing funding in two steps:

- I. *How much*: Identifying the quantum of funding for different aspects of PAL implementation.
- II. *Which sources*: Leveraging multiple sources of funding both within the government ecosystem and externally.

4.2.1

How much: Identifying the quantum of funding for different aspects of PAL implementation

Funding in the current EdTech ecosystem focuses on hardware. While hardware forms majority of the implementation cost (~80%), success of the implementation also depends on the quality of software, which is generally not accounted for when creating PAL implementation budgets. Additionally, capacity building of the state and on-ground team, along with strategic support during the planning phase is equally important. Governments should hence find innovative methods to provide funding for non-hardware components of implementation and take them into account in the budget.

Constraints	Solutions (Andhra Pradesh and other states)
1. Lack of adequate funding for non-hardware components of PAL implementation	1. As per the ICT@Schools Policy, INR 6.4L is allotted per school to build secondary students' ICT skills. The GoAP obtained INR 3L per school for the Advanced DCR model (tablet) from the Samagra Shiksha Fund. The GoAP successfully secured this funding and incorporated software funding within this budget itself. Since the above mentioned budget could only cover for hardware, electricity, etc. It is also simultaneously seeking other sources of funding (details in section below) to complement the RMSA-ICT fund. GoAP has also been innovative in securing funding for thought partners and strategic advisors during the PoC phase and to prepare for scale. Thus, there is scope for governments to find innovative ways to fund non-hardware components. *Note that, to successfully get Central government funding, states should have strong commitment and proven track record with project objective linked to the overall vision of the state. While the MHRD released a Bluebook on PAL implementation and encouraged states to roll-out PAL,

Andhra Pradesh was able to secure funding because of their strong commitment to improving learning outcomes and digital education. The roll-out of complementary initiatives like Badi Parivartana and past success of EdTech projects like Digital Classrooms (DCR) and Virtual Classrooms (VCR) also bolstered their case for PAL funding. Additionally, there was also commitment that the state is willing and able to match the Central government funding in the ratio of 60:40.

4.2.2

WHICH SOURCES: LEVERAGING MULTIPLE SOURCES OF FUNDING BOTH WITHIN THE GOVERNMENT ECOSYSTEM AND EXTERNALLY

Multiple sources of funding can be leveraged both within the government ecosystem and externally, with the possibility of different sources for PoC and scale-up. While some funding sources may be earmarked specifically for PAL, there are often other funding sources that support EdTech/innovative/PAL-like solutions to improve learning outcomes. Governments should try to leverage more than one source of funding to allow them to test the solution before scaling up.

Challenges/ Constraints	Case study of Andhra Pradesh and learnings from other states
1. Relying on one source of funding can restrict the scope of PAL implementation, especially if the funding is inadequate	1. Within the government ecosystem, some budgets that can be leveraged for PAL include: a) RMSA innovation fund – it was created to enable states to enhance access and equity in the educationally backward blocks of the country, b) RMSA-ICT fund – it was launched to enable secondary stage students to build their ICT skills, c) NITI Aayog funding for aspirational districts¹⁰, and d) district funds such as DMF¹¹ and DIF¹². Similarly, Niti Aayog¹³ provides separate funding to tribal residential schools like Pota Cabin Schools in Chhattisgarh to provide quality education to tribal children. Additionally, unutilised funds within departments may also accumulate interest over time. Even if the original fund may not be eligible for use for any other purpose other than its inception project, the accumulated interest can be used as funds to cover gaps in funding initiatives like PAL. External sources of funding include grant or technical support from foundations, individual donors or CSR funding from large corporations. Since PAL requires laptop/tablets, CSR departments of large hardware companies may consider funding such projects. Additionally, as the PAL ecosystem is growing, there is increasing interest among funders and philanthropists to generate learnings and encourage innovation that governments can leverage. Governments thus need to be proactive and innovative to successfully secure funding for PAL implementation.

¹⁰<http://www.niti.gov.in/content/about-aspirational-districts-programme>

¹¹[http://www.arthapedia.in/index.php?title=District_Mineral_Foundation_\(DMF\)](http://www.arthapedia.in/index.php?title=District_Mineral_Foundation_(DMF))

¹²<https://doe.gov.in/financecommission/guidelines-district-innovation-fund>

¹³<http://www.niti.gov.in/best-practices/pota-cabins-residential-schools-children-lwe-affected-areas-chhattisgarh>

Learnings

- Show strong commitment to learning outcomes and link project objective to the overall state vision when applying for Central government funding.
- Apply for funding at least one year before PAL implementation to secure adequate funding and prepare for scale-up.
- Budget for PAL software content and field support when applying for funding (e.g., the new ICT@Schools scheme provides flexibility in adopting the right implementation and cost model, and all states are encouraged to think about the different aspects of PAL implementation that need funding).

Open questions

- What are the current funding constraints, and how can state governments be innovative about leveraging funding for PAL software, capacity building, and strategic support?

4.3 DETERMINE GOVERNANCE STRUCTURE AND DEFINE STAKEHOLDER MANAGEMENT

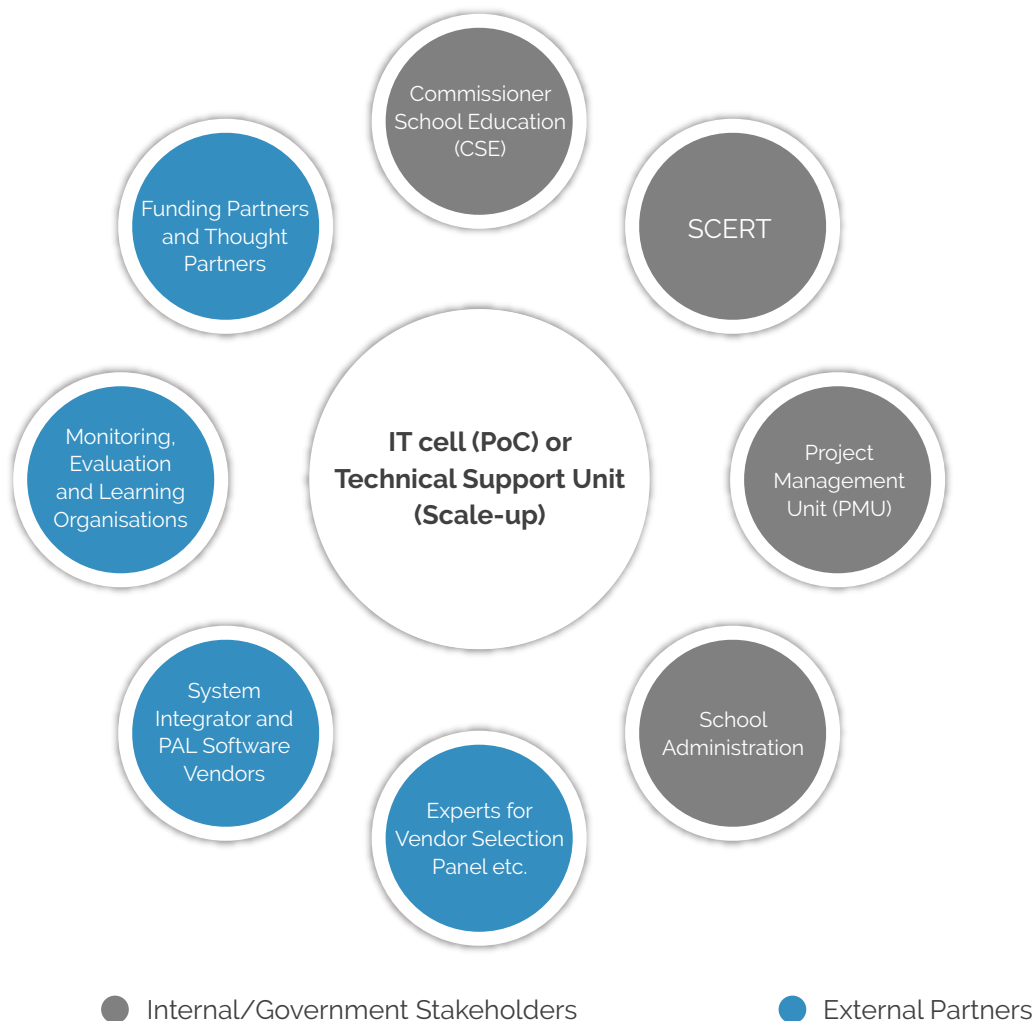


Figure 4: Stakeholders part of PAL implementation in AP

PAL implementation requires multiple stakeholders to work together, both within the government ecosystem and externally, requiring a strong working relationship among these stakeholders. Within the government ecosystem, PAL implementation requires buy-in from top-level decision makers as well as cooperation of on-ground district teams, headmasters and teachers. It also requires working with other government departments that may have overlapping functionalities (e.g., SCERT for curriculum and IT cell for hardware).

Externally, stakeholders in the education sector may be involved over different stages of implementation. This includes funders, MEL partners, experts, etc. in addition to PAL software vendors. At scale, the system integrator will play a primary role in both planning and execution. For successful implementation, all these different players - government and external - need to have a strong working relation.

The figure no. 4 shows the different stakeholders involved.

The following factors need to be optimised for effective PAL implementation:

- **Dedicated and skilled government-led strategy and managerial team** (with execution team in case of PoC).
- **Accountability mechanisms** through communication channels, defining deliverables, milestones, etc.

4.3.1

DEDICATED AND SKILLED GOVERNMENT-LED STRATEGY AND MANAGERIAL TEAM (WITH EXECUTION TEAM IN CASE OF POC)

*Given multi-stakeholder involvement in PAL, there needs to be one government led team to manage coordination among these different stakeholders. This team must have a set of dedicated members who have a) **soft skills required for day-to-day management** (e.g., work-planning, contingency planning, etc.) to flag issues and co-solve problems, b) **context of on-ground realities**, c) **relationships with players in the education ecosystem** to synchronise expertise and share learnings, and d) **ability to drive the learning agenda** for the implementation and incorporate learnings on the go.*

Challenges/ Constraints	Case study of Andhra Pradesh and learnings from other states
1. While the government may have multiple departments heading different initiatives, it seldom has a dedicated strategy team . Even if this team does exist it may need capacity building support on:	1. In Andhra Pradesh, the Commissionerate of School Education (CSE) has a Project Management Unit (PMU)¹⁴, a dedicated strategy team that supports the CSE to plan initiatives, define their scope, and support in early stages of implementation. The PMU planned and led the PAL PoC with support from the IT cell on hardware and the state IT coordinator (structure of IT cell in the annexure). The system integrator is implementing the scale-up with oversight from a Technical Support Unit (TSU) embedded in the IT cell (roles and responsibilities of the TSU in the annexure). <u>Proof-of-Concept phase</u> While GoAP set up a PMU, with Central Square Foundation (CSF) as a thought partner, the state also engaged a technical partner to support the PMU in the design of the PoC and to develop a robust implementation roadmap for scale-up. Since this is the first ever large-scale PAL implementation in India, there were many unknowns that could affect the success of the PoC – for e.g., whether to invest in Telugu product or only focus on English products, which types of schools, grade levels and subjects, how many schools/classes/students to target and over what time period, etc.

¹⁴Most states do not have a PMU and hire an external PMU from 2% of project costs

a) Developing project management skills, including delegating roles and responsibilities, developing work plans and contingency plans b) Developing relationships with players in the education sector, and c) Defining and driving the learning agenda for the PoC and/or scale-up	Besides providing strategic advice and support, the technical partner also helped build the capacity of the PMU and prepare the implementation team (TSU) for scale-up. The PMU and IT cell teams were proactive and ambitious about the PAL project with strong on-ground context. However, it was spread thin over multiple (20+) projects and couldn't always give dedicated time to PAL implementation. Over the course of the implementation, CSF and the technical partner worked collaboratively with the PMU and IT cell on the following: a) Developing relationships with players in the education space: The EdTech and education expertise of CSF and the technical partner allowed both stakeholders to leverage existing relationships (e.g., with hardware and software players to understand the space). b) Defining and driving the learning agenda: Scaling up without a robust Monitoring, Evaluation and Learning (MEL) during the PoC would deliver limited insight resulting in sub-optimal implementation during scale-up. The technical partner supported the PMU to define key questions to test during the PoC as well as determine open questions for the scale-up. c) The AP experience suggests that any organisation providing strategic support to the government should audit the capacity of existing teams prior to implementation. Based on the audit, there may be a need to involve an implementing organisation/representative of an implementing organisation in the initial stages of implementation. This organisation can support execution and build the capacity of the government teams in the first year and slowly transition out over time. However, even if an external implementing organisation is leading the execution, government stakeholders should play a supervisory role to hold the implementing organisation accountable. <u>Scale-up phase:</u> The Technical Support Unit (TSU) within the IT cell will need the following skills to monitor implementation: <i>Robust project management to ensure efficient and effective delivery</i> • Hold vendors accountable to time and quality milestones • Track progress daily • Hold periodic in-depth reviews • Identify and mitigate risks in real time • Manage budget • Collect feedback from the field and course-correct as needed
--	---

Deep understanding of state-specific context and government infrastructure

- Ensure contextualisation of delivery
- Mobilize internal resources across government agencies

Convene and synchronize external expertise

- Bring in external expertise where relevant (e.g. to conduct an RCT on learning outcomes, optimize classroom design, etc.)
- Ensure various initiatives are operating synchronously (vs. in silos)

Ability to define and drive the learning agenda

- Identify key questions across stakeholders
- Deploy resources to design and deliver MEL
- Ensure global learnings (not just operational ones) are being captured on ongoing basis

4.3.2

ACCOUNTABILITY MECHANISMS THROUGH COMMUNICATION CHANNELS, DEFINING DELIVERABLES, MILESTONES ETC. AS WELL AS TEAM STRUCTURE

In-built accountability and monitoring mechanisms help ensure that responsibilities of different stakeholders are upheld, and roles are executed effectively. Accountability can be ensured through:

- a) A well-structured PMU/TSU led by an individual with decision-making authority and an execution mindset who delegates roles and responsibilities and sets milestones, deliverables, etc.
- b) Efficient communication channels that allow for frequent check-ins and updates.
- c) Well-defined milestones and deliverables among internal team members and contractual agreements with external stakeholders.

Challenges/ Constraints	Case study of Andhra Pradesh and learnings from other states
1. Accountability mechanisms if not put in place at the start of the project can affect the overall efficiency of the implementation. Some of the roadblocks to an effective accountability mechanism are: 1.1 Ad-hoc availability of decision-making authority for key decision points of the project resulting in lack of clearly defined deliverables and milestones	1.1 Over the duration of the project, PMU identified players essential for smooth implementation and ensured to engage them on key decision points. This was done by flagging to the CSE key risks involved without the involvement of the decision makers. The PoC also highlighted the need for a dedicated and involved decision-making personnel in the scale-up TSU. The following structure was hence suggested to the CSE for the scale-up TSU and is being put in place:

1.2 Lack of effective communication channels for check-ins/ updates	a) Deputy Director EdTech as the decision-making authority (<i>spread over multiple projects with ability to dedicate at least 1 day every fortnight for PAL</i>) b) One member with strong project management capability (<i>dedicated to PAL project</i>) c) 2-3 members with technical and pedagogical skills (<i>spread over multiple projects with ability to dedicate at least 1-2 days per week for PAL</i>) 1.2 Andhra Pradesh displayed strong communication channels that allowed check-ins with large groups of people. At the start of the PoC, daily stand-up calls were scheduled at 9 am (between PMU, IT cell, CSF and the technical partner) before other meetings or commitments to check the progress of small but crucial tasks (e.g., placement of hardware order, school preparation etc.). GoAP scheduled and led these stand-up calls using its communication system. During these calls, milestones for every week were set, timelines were discussed and different stakeholders were held accountable for their roles and responsibilities. Another example of their strong communication is the ability to schedule calls with on-ground stakeholders at scale. For example, GoAP scheduled a call with all the headmasters and teachers who were part of the PoC (~100+ attendees) to nudge them to use PAL and get feedback on the software and implementation process. In addition to these communication channels, the following systems were also put in place a WhatsApp group of all the stakeholders (since, government stakeholders in AP are very responsive on WhatsApp), weekly steering committee calls with decision-makers from each of the organisations to discuss strategic direction, and frequent in-person check-ins to co-create solutions and develop the implementation plan. Note that the daily stand-up calls, especially in the initial few months of the implementation, played a crucial role. It ensured that roles and responsibilities of the different stakeholders were clear and a strong working relation was established.
2. Lack of well-defined contractual agreement, misaligned incentives, and unclear ownership of implementation between the government, PAL software vendors, and	2. Implementation success depends on the performance of PAL software vendors and the system integrator (if they are different players). This in turn depends on how well-aligned the incentives of the different players are. For example, if multiple PAL software vendors are engaged for the scale-up with differing software costs, then the system integrator may choose to work with the PAL software vendor with the lowest cost. During the PoC there was an agreement between the PAL vendors and GoAP since there was no system integrator involved. However, for the scale-up, GoAP would sign a contract only with the system integrator (selected through a competitive bid) to streamline accountability and hold the system integrator liable for all implementation deliverables. This contract holds the system integrator accountable for PAL implementation

system integrator can hamper the efficiency of PAL implementation

(software and hardware) with all payments and penalties (if applicable) directed from the GoAP to the system integrator. Since the system integrator is responsible for procurement and delivery of hardware, integration of hardware and software, and management of on-ground staff and resolution support, the state prefers to give ownership to this organisation.

In turn, there is hence a **contract between the system integrator and each of the empaneled PAL vendors** to ensure a defined working relation between the two parties. The system integrator hence directly makes the payment to the PAL vendor¹⁵ (each vendor has the same software cost to remove perverse incentive for the SI) based on the number of schools and a pre-determined payment schedule. There is also an empanelment contract between the GoAP and the empaneled vendors.

Learnings

- Put together a strong government-led planning and execution team.
- Leverage and institutionalise external partnerships to support the government team and build capacity, if necessary.
- Articulate roles and responsibilities, streamlined and aligned across all different stakeholders.
- Define contractual agreement between system integrator, PAL software vendors and government to allow single point of ownership and streamlined accountability.

Open questions

- How can we innovate on accountability mechanisms in a decoupled model (i.e., PAL software vendors and system integrator as separate entities), where PAL software vendors have different pricing models?

4.4 SELECT SOFTWARE VENDOR(S) AND SYSTEM INTEGRATOR

Software and hardware solutions can be procured for PAL implementation in different ways (non-exhaustive):

- **Hardware provider** serves as the system integrator and provides the software solution (either own or partners independently).
- **Software provider** serve as a system integrator and partners with a hardware provider/government for hardware.
- **Independent party/hardware provider with system integration experience at scale** serves as a system integrator and partners with government selected software provider.
- **Software and hardware are procured separately** and clear roles and responsibilities are defined.

Currently, there is little evidence on which mode of procurement is most efficient at scale. Additionally, the mode of procurement may change as the sector matures in the future. For example, while currently PAL software vendors do not have economies of scale, this may change in the future allowing them to play the role of a system integrator.

In the case of Andhra Pradesh, since there was uncertainty about which software is the most effective, the **process of procurement of hardware and software was decoupled, and the third model was followed (option 3)**. This is because in traditionally implemented ICT projects, procurement processes put a higher weightage on hardware due to its high cost (hardware constitutes ~90+% of the total cost) vs. content or

¹⁵Each PAL vendor is paid ~INR 30,000 per school (for 6 to 9th Telugu, English, Math in English and in Telugu, with eventually also for 10th standard content)

software. However, hardware is now commoditised and minimum specifications can ensure its quality. Quality of software on the other hand is much more difficult to ascertain and forms a lower percentage of the overall cost, but is what ultimately can influence the impact of any digital learning initiative such as PAL. Procuring hardware and software together hence runs the risk of basing the decision of procurement on the quality of hardware and not software. **Decoupling hardware and software procurement solves this problem by allowing for separately purchasing quality software, but does not provide a single point of accountability.** In case issues arise, the government may find that software and hardware vendors place the responsibility on one another.

The GoAP thus adopted a two-stage procurement where it first empaneled software vendors who meet quality criteria as demonstrated through the PoC, and then procured a system integrator separately to provide hardware and end-to-end service delivery, and work with the empaneled software vendors. In addition, a system integrator as the lead party allowed for efficiency at scale. Since the system integrator has experience and networks to implement at scale, it was cost-effective for them to own the implementation process and provide on-ground support.

When procuring for the system integrator, it was important to give enough weightage to the field management support quality, given it is a key quality differentiator aside from software while it is a much smaller proportion of the overall contract cost relative to hardware. Then GoAP had to ensure the relationship between the software vendor and the system integrator was well defined to align incentives. For example, GoAP prevented the system integrator from purchasing lower quality, cheaper software by fixing the cost of software to INR 30,000 per school.

However, the process of soliciting bids and selecting a System Integrator takes around 3-4 months. As the hardware needed to be set up quickly in the POC, the IT cell of the GoAP managed the hardware procurement and supply through Government e-Marketplace (GeM). Field Management Services (FMS) which is a 'service', cannot be procured in a hardware order which is listed as 'product' on GeM, hence these services need to be procured separately or provided by the PAL vendors. There are two methods of procuring hardware through GeM:

(1) Direct Purchase (This was the method used to procure hardware for the POC)

- Each government employee who is involved in the project could procure hardware up to a limited amount (up to INR 5 lacs as per 2018 revised GeM guidelines). Several days of gap is needed before the employee could place another order.
- If the order is more than the allowed limited value, multiple government employees involved in the project are required to apply for procurement, which may require permission from top-level state officials.
- In case of PoC schools, after order placement, it took ~15-20 days for the hardware to be supplied to a central location (Hyderabad in this case). Post-delivery to the central location as well, there were multiple points of delay till the hardware was finally installed in schools due to unclear process (e.g., in some cases headmasters personally collected the hardware).

(2) Bid request

- For order value > INR 25 lacs (as per 2018 revised GeM guidelines) government can place a single order on the GeM that includes the quantity, delivery location, hardware specification and additional conditions on the profile (revenue, experience, etc.) of the supplying organization.
- Any seller on the GeM can submit their proposal for the request within the stipulated time (~2-3 weeks). Once the government receives the bids, the bid with the lowest cost (L1) that meets the criteria of the technical qualifications (TQ) specified by the buyer is awarded the work order.

Table 1: Methods for procuring hardware through GeM

¹⁶Note that only individuals on government payroll (not contractors) can apply for procurement on the GeM portal

The **Chhattisgarh PoC followed a bundled process for hardware and software procurement**. This allowed the government to hold a single system integrator delivering all services (hardware deployment and maintenance, PAL software solutions and FMS) accountable and expedited the process. Some risks of this approach include:

- Since the hardware cost is much more than the software cost, this could lead to cheaper and poor-quality PAL software (either brought in-house or subcontracted), especially since there is little evidence on which are the effective solutions.
- One-time procurement of PAL software solution for 5 years implies that there is no scope to introduce a better PAL solution in future. This is especially problematic since the ecosystem is nascent with potential for multiple new and promising solutions.

Given the above context, there are three factors that are important to optimize for PAL implementation at scale, while selecting the software vendor(s) and procuring system integrator:

- Quality of PAL software vendors
- Quality of field support provided by system integrators, particularly for an L1 bid
- Working relationship and incentive alignment between the PAL software vendor and system integrator

4.4.1

QUALITY OF PAL SOFTWARE VENDORS

Improvement in learning outcomes depends on the quality of the PAL solution. While a good PAL solution can make a drastic impact on the learning levels of students, an ineffective solution is a huge waste of resources and can also be detrimental to student learning. The selection process of PAL software vendors must hence test for quality.

Challenges/ Constraints	Case study of Andhra Pradesh and learnings from other states
1. Since the PAL ecosystem is still nascent, there are multiple challenges with ensuring the software quality and selecting the right vendor. The solutions may also need to be contextualised to make them relevant to the state context. 1.1 It is still unknown which PAL software solutions are the optimal given different state contexts due to little evidence on the impact of the PAL solution on learning outcomes¹⁷	1.1 Since the PAL solutions are relatively new and untested in the AP context, the empanelment of PAL vendors took place after a proof-of-concept phase, where the solutions were tested for quality and scale. The purpose of the PoC was to a) provide opportunity to new players and encourage innovation in the ecosystem, and b) test the quality of different PAL solutions for the AP context and generate learnings for scale. For the PoC, PAL vendors were selected through a competitive process (i.e., through release of an Expression of Interest). Only those vendors who were part of the PoC could be empaneled for the scale-up based on the performance in the PoC. Note that this process allowed for testing of the solution and its applicability in the AP context before scaling to ~2600 schools.

¹⁷Mindspark by Educational Initiatives is the only PAL software that has rigorous evidence (J-PAL conducted an RCT) of impact on learning outcomes.

1.2 **PAL vendors may not have readily available capacity to implement at scale** and would need adequate incentive to conduct the PoC

1.2 **External stakeholders engaged PAL vendors prior to drafting the EoI to understand their capabilities and gauge interest** to take part in the PoC based on willingness to gather adequate resources (capital, human resources, etc.) to deliver PAL. This was particularly important since the PoC did not involve any payment to the software vendors thus having the potential to discourage newer and smaller players to participate.

EoI process:

GoAP launched an Expression of Interest (EoI) to select PAL software vendors for the PoC with potential to be empaneled for scale-up based on performance in the PoC. The EoI was drafted keeping both the PoC and scale-up in mind. It hence:

- a) **Included minimum qualifications that are relevant to check for capacity to scale**
- b) **Involved non-monetary incentives to encourage participation**
- c) **Asked for relevant information useful for scale-up**

For example, asking for pricing data while not relevant for the PoC helps benchmark and set a common price for the software across vendors in the scale-up.

PAL software vendors who responded to the EoI were invited to present their solution to a panel of education experts. The experts included individuals with significant experience in the education and Edtech sector across government, private sector and non-governmental organisations.

Additionally, incentives were put in place by guaranteeing empaneled PAL vendors a minimum allocation of schools, at a common price (per school). The common price was set by a) building a detailed cost model for the allocated budget, and b) accounting for software delivery costs including content creation (vendors had to create Telugu language content and translate the Math content to Telugu) and implementation support (e.g., training of FMS staff). This analysis resulted in **a common price per school for each PAL software vendor at INR 30,000 per school.** Note that this was an iterative process as typically costs are at a per student basis and hence difficult to implement and schedule payments. Since marginal costs for the PAL software vendors were not changing per school, it was appropriate to have a fixed common per school pricing model. Along with a fixed pricing, **they were also guaranteed a minimum of 300 schools once empaneled.**

Along with a minimum of 300-schools guarantee on empanelment, PAL is being scaled up in a gradual and phased manner to encourage and reward quality performance and to provide enough time to build capacity. PAL vendors have an incentive to maximise the number of schools due to the fixed price of INR 30,000 per school. The scale-up is hence being done over two phases. While in Phase I they are guaranteed 300 schools, the allocation of schools for Phase II is dependent on performance in Phase I. This also gives enough time to PAL vendors to build capacity, develop contextualised content, and iterate their solution in the Phase I.

2. **There may be bias in selection of software vendors if the government has rolled out other EdTech ventures (non-PAL) in the state**

2. **A competitive process was followed for selection of PAL software vendors with an independent panel of experts making the final decision on the selection.** The Expression of Interest (EoI) was followed by vendor presentations to test for adaptivity of the solution through a panel of education experts. The experts included individuals with significant experience in the education and EdTech space across government, private sector and non-governmental organisations (e.g., Omidyar Network, Central Square Foundation, Tata Trusts, etc.). These experts were chosen to ensure that there is transparency and accountability in the selection procedure of the PAL software vendors.

4.4.2

QUALITY OF FIELD SUPPORT PROVIDED BY SYSTEM INTEGRATORS, PARTICULARLY FOR AN L1 BID

In an L1 bid, the bid with the lowest cost is the winning bid. Since field support forms the least percentage of the total implementation cost, its quality may be deprioritised over hardware to save costs. However, on-ground handholding support, especially during the initial phases of implementation determines the long-term usage. It is hence important to find innovative ways to give as much weightage to quality of field support as hardware when selecting the system integrator.

Challenges/ Constraints	Case study of Andhra Pradesh and learnings from other states
1. A pre-determined budget cap for the implementation complicates the bid process a) Mentioning the budget cap will make L1 redundant as bids will have similar commercial values (i.e., most of them will be close to the cap) b) Not mentioning the cap could result in the lowest commercial bid being above the budget cap At the same time QCBS¹⁸ (instead of L1) is not feasible due to:	1. The bidding process for system integrator selection in AP followed the L1 bid, with the budget cap mentioned in the RFP along with a qualification criterion that controlled for quality. An L1 bid was followed because: a) It is often complicated to get approval for QCBS for projects with a strong hardware component, which was the case in PAL. b) There were no clear and objective metrics to measure quality of FMS support through the bid submission. The RFP mentioned the budget cap to avoid bids above the cap and followed a three-stage bid to control for quality. The bid included: • A pre-qualification round • A technical qualification round • A commercial bid round: The technical qualification round controlled for quality, so that only those bidders who clear the basic minimum standards in the technical round can make it to the commercial bid round. <u>RFP process in AP:</u> <u>Pre-qualification round:</u> This round checked for the basic minimum criteria

¹⁸Unlike an L1 bid, in a QCBS (Quality and Cost Based Selection), the decision on the winning bid is based on both the technical and financial proposal, which implies that the winning bid needn't be the lowest cost bid

i) Lack of clear metrics for field support

ii) Government procedures disincentivizing its use for projects with strong hardware components

that a bidder must fulfill to be eligible to apply (i.e., human capital resources, financial capabilities, legal standing, experience in similar projects etc.). These criteria were based on a benchmarking of system integrators in the field, referencing of RFPs for similar projects, and government policy guidelines (e.g., Ministry of Electronics and Information Technology (MEITY) guidelines for Model RFP, e-Governance projects and AP Procurement Policy for e-Governance)

Technical qualification round: The technical proposal was opened for organisations that cleared the pre-qualification round. In this round, the evaluation committee scores the technical proposals based on a weighted rubric. This rubric had three categories – **hardware** (specifications of laptop/tablet models, ability to procure a minimum quantity over the given period), **hardware support** (ability to install software and deliver hardware to remote locations within a reasonable amount of time) and **field management staff (FMS) support** (ability to provide quality field staff and on-ground support for resolution of issues). The FMS support category had the highest weightage of ~60% followed by hardware support of ~30% and hardware of ~10%. This is because, while hardware and hardware support form majority of the cost, the success of scale-up depends heavily on the quality of FMS support. To clear the technical round, the bidder must have more than 60% score on each of the categories and an overall minimum score of 70%.

Commercial bid round: Among the bidders that clear the technical qualification round, the bidder with the lowest commercial bid wins the bid for all the 2000+ schools.

Note that during the RFP process, **key external stakeholders - technical and legal experts - were also involved** to ensure that there are no loopholes in the RFP process and all incentives and guidelines are as per government requirements.

RFP process in Chhattisgarh:

Chhattisgarh followed a three-staged process for procurement of both PAL software and hardware solutions through a bundled tender.

Pre-qualification round: Potential bidders were asked to qualify pre-qualification criteria which involved parameters such as company's turnover, experience, team capacity, breadth of digital content available etc. like the AP case but with additional metrics on software. In addition, the pre-qualification criteria had hardware compliance rubric with minimum hardware specifications that the System Integrator must provide as a necessary condition to participate in tendering process.

Technical qualification round: Bidders qualifying the pre-qualification stage were given a chance to conduct a **Proof of Concept (PoC) of the content (digital content + PAL platform) and hardware solution for a period of 1.5 months in at least one school each**. Performance on PoC was one of the evaluation criteria in the technical qualification. The other criteria were quality and breadth of content, PAL solution platform, deployment approach and methodology etc.

	<i>Commercial bid round:</i> The bidders getting at least 75% score on the technical qualification rubric were called for financial bid opening which was the last stage of the tendering process. At this stage, the bidder with lowest cost (L1) for the hardware & software solution wins the tender for all 4000+ schools.
2. Field management support is often de-emphasised and is likely to be procured without the necessary criteria ensuring FMS quality during the procurement process because: 2.1. Hardware has typically been considered the most important part of the procurement because it forms majority of the cost (both for the government and system integrator), resulting in field support receiving little focus 2.2. It is also much more difficult to ensure quality of field support during the bidding process, as compared to hardware quality. While minimum specifications can ensure hardware quality, there are no clear and objective metrics for	2. A higher weightage was given to quality of FMS staff as part of the bidding process in the technical qualification round of procurement. To ensure that the SI provides quality FMS staff (which is often a much smaller cost implication to the SI as compared to hardware), it is essential that: a) The nature of field support is well-defined in the RFP b) The technical qualification round gives adequate weightage to this role c) The technical qualification round asks for documents to prove quality, such that it can be assessed effectively (e.g., references of past organisations where FMS staff was recruited, job description of FMS staff, etc.) Some of the metrics used to ascertain quality of FMS staff includes: a) Experience in hiring, deploying and monitoring at least 200 FMS staff in one year over the last three years b) Ability to get on board at least 200 high-quality FMS staff in no more than 2 months c) Robustness of performance tracking system and effectiveness of incentive structure (including base salaries) and non-performance penalties for FMS staff d) Reporting structure for FMS delivery model and thought-out team sizing (ratio of FMS staff to FMS managers)

quality of field support. This also makes the possibility of a QCBS bidding process difficult (as mentioned above).

4.4.3

WORKING RELATIONSHIP AND INCENTIVE ALIGNMENT BETWEEN THE PAL SOFTWARE VENDOR, SYSTEM INTEGRATOR AND GOVERNMENT

Since the PAL software vendor(s) and SI have to work closely throughout PAL scale-up, it is essential to have incentive structures and accountability mechanisms that ensure commitment and strong working relationship between the two parties.

Challenges/ Constraints	Case study of Andhra Pradesh and learnings from other states																																										
1. Since the SI owns the implementation process including software and hardware integration, it is crucial for the SI bidders to know about the landscape and players they will be working with to inform their bidding. However, this was not possible in the case of Andhra Pradesh where tight timelines resulted in PAL vendor empanelment happening parallelly with the SI selection process.	1. The PAL vendor empanelment in AP took place parallelly with SI selection. This meant that the SI did not have complete clarity on the empaneled vendors and implementation plan at the time of bidding. The RFP solved for this by - a) Mentioning the lower and upper limit of schools where PAL would be implemented; and b) details of each of the PAL vendors to allow SIs to engage individually with them prior to bid submission. The bidders hence engaged with the PAL software vendors in the pre-bid stage itself. The RFP also provided standardised hardware specifications across the three PAL vendors – this was particularly important as it reduced variability in hardware provision making it more scalable. It took multiple rounds of iterations with the vendors for standardisation as each PAL vendor had to make some changes to their hardware requirements to arrive at common specifications. Finally, the RFP required the bidder to submit one price each for one laptop model and two tablet models with the lowest bid calculated as a weighted average of the two costs. This can be avoided and simplified in any future procurement processes by specifying the exact technical specifications for the hardware and the associated scale for those, without ambiguity. For this, empaneled vendors should be identified before the SI procurement to outline the hardware specifications and scale accordingly. The figure below shows the AP timeline. <table><tr><th></th><th>Dec 2018</th><th>Jan 2019</th><th>Feb 2019</th><th>Mar 2019</th><th>Apr 2019</th></tr><tr><th></th><th>03, 10, 17, 24</th><th>31, 07, 14, 21</th><th>28, 04, 11, 18</th><th>25, 04, 11, 18</th><th>25, 01, 08, 15</th></tr><tr><td>Selection of PAL software vendor for</td><td colspan="5"></td></tr><tr><td>PoC phase</td><td colspan="5"></td></tr><tr><td>RFP process (launch and procurement)</td><td colspan="5"></td></tr><tr><td>Evaluation of PoC phase</td><td colspan="5"></td></tr><tr><td>Empanelment of PAL software vendor</td><td colspan="5"></td></tr></table>		Dec 2018	Jan 2019	Feb 2019	Mar 2019	Apr 2019		03, 10, 17, 24	31, 07, 14, 21	28, 04, 11, 18	25, 04, 11, 18	25, 01, 08, 15	Selection of PAL software vendor for						PoC phase						RFP process (launch and procurement)						Evaluation of PoC phase						Empanelment of PAL software vendor					
	Dec 2018	Jan 2019	Feb 2019	Mar 2019	Apr 2019																																						
	03, 10, 17, 24	31, 07, 14, 21	28, 04, 11, 18	25, 04, 11, 18	25, 01, 08, 15																																						
Selection of PAL software vendor for																																											
PoC phase																																											
RFP process (launch and procurement)																																											
Evaluation of PoC phase																																											
Empanelment of PAL software vendor																																											

Figure 5: SI was procured before the empanelment of PAL vendors for scale-up due to tight timelines

2. If the SI has to work with multiple PAL software vendors with differing original software costs, it could create misaligned incentives between the two parties (e.g., SI might prefer one PAL vendor over any other)	2. A common price was set for all the PAL vendors to reduce perverse incentives for the SI to prefer any one of the vendors over the others. PAL vendors were guaranteed 300 schools in Phase I of scale-up. This was accompanied by a fixed per school cost to incentivize roll-out in a greater number of schools in Phase II, thereby encouraging quality services during Phase I. The payment schedule was also relatively easy as it was a per school model and not cumulative or per student. Additionally, scale-up over two phases, incentivizes PAL vendors to cooperate with the SI, since allocation of schools in the second phase depends on performance in the first phase. The first phase of scale-up can be considered as an iterative phase to bridge all information asymmetries and uncertainties to de-risk the implementation.
3. Since multiple stakeholders are involved – PAL vendors, SI, and government, it can be difficult for the government to hold both the PAL vendors and SI accountable for the implementation efficacy as it can lead to a lack of clear ownership of the implementation process	3. GoAP would sign a contract with the SI who is held accountable for the PAL scale-up. This contract holds the system integrator accountable for PAL implementation (software and hardware) with all payments and penalties (if applicable) directed from the GoAP to the system integrator. Since the system integrator is responsible for procurement and delivery of hardware, integration of hardware and software, and management of on-ground staff and resolution support, it is appropriate to give ownership to this organisation. In turn, there shall be a contract between the system integrator and all three empaneled PAL vendors, to ensure a defined working relation between the two parties. The system integrator shall directly make the payment to the PAL vendor¹⁹ (all of whom have the same software cost to remove perverse incentive for the SI) based on the number of schools and a pre-determined payment schedule. The GoAP also entered into an empanelment contract with the software vendors.

| Learnings |

- Ensure that quality PAL software is given significant weightage in procurement separately and field support is also given adequate weightage over hardware which is relatively easier for quality control. Ensure quality of:
 - PAL software through EoI and Monitoring and Evaluation during PoC in schools.
 - Field support by providing higher weightage in RFP technical qualification rubric.
 - Hardware by clarifying quality hardware specifications in RFP and compatibility testing during PoC.
- If the software vendor and system integrator are different players:
 - Select software vendors for scale and finalise implementation plan before procuring system integrator (two-staged process).
 - Define incentive structure and contractual agreement between both players, such that it allows the government to hold only one player accountable.
- If the PAL implementation budget is constrained, there may be need to find innovative solutions around hardware (e.g., working with PAL vendors to consider lower certain non-necessary specifications that have a high implication on cost) to be able to include all project components within the allocated

¹⁹Each PAL vendor is paid -INR 30,000 per school (for 6 to 9th Telugu, English, Math in English and in Telugu, with eventually also for 10th standard content)

budget.

- While building cost models, it is preferable to keep some margin for the SIs to generate interest.
- It is also necessary to include relevant experts in the committee that reviews vendors at the EoI phase.

Open questions

- What procurement processes (for software and SI) would be most efficient for different states, given different state contexts?
- How can we energize the ecosystem while also solving for challenges with the government's procurement processes, in order to ensure that the potential bidders consider government as a feasible pathway to scale, and participate in the procurement process despite the associated concerns like project sustainability, comfort with payment schedule, smaller profit margins, etc.?
- What is an optimal process of price discovery for PAL software?

4.5 SELECT AND PREPARE SCHOOLS

For both the PoC and scale-up, schools need to have some basic infrastructure enablers in place. This implies that schools should either be selected based on existing infrastructure availability or be prepared prior to implementation. In most cases selected schools will also have to be prepared to meet the minimum requirements. Prior to roll-out, government needs to ensure optimal:

1. Selection and allocation of schools
2. Preparation of schools

4.5.1

SELECTION AND ALLOCATION OF SCHOOLS

Since the PoC serves as a test-bed for scale-up it is essential that a) schools have minimum prerequisites for PAL implementation which will be ensured during scale-up (e.g., availability of a room, electricity etc.), and b) the external factors that cannot be controlled for and effect implementation are as close to the scale-up schools as possible (e.g., school size, urban-rural split, language, student-teacher ratio, etc.).

Similarly, the scale-up schools must also have basic enablers (e.g., availability of rooms, electricity, etc.) in place or fixed before PAL roll-out.

Challenges/ Constraints	Case study of Andhra Pradesh and learnings from other states
1. Funding may be earmarked for specific category of schools (e.g., social welfare, Educationally Backward Blocks etc.) resulting in PoC schools having a different typology as compared to scale-up schools, thereby making it difficult to test for scale	1. In AP, a two-stage process was followed to select schools for the PoC, where PoC schools were different from schools eligible for scale-up. The set of schools for the PoC and scale-up were different due to differing funding sources. While scale-up schools consisted of 2,600+ schools of which 1,600+ were eligible for 'ICT labs' and 1,000 were eligible for 'advanced DCR' for the 2019-20 academic year, the PoC was to be administered in a set of 56 schools out of the 2446 Educationally Backward Block (EBB) schools. The figure below explains the different school sets.

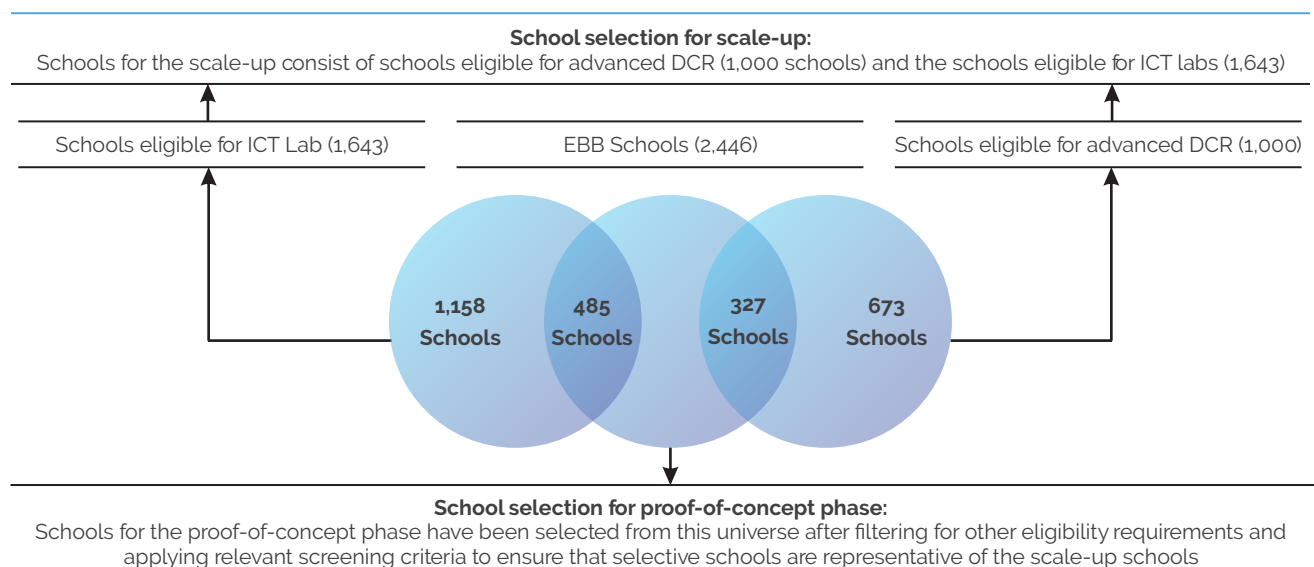


Figure 6: School selection universe in AP

Stage 1

Included filtering out schools that did not meet the GoAP's eligibility criteria.

Stage 2

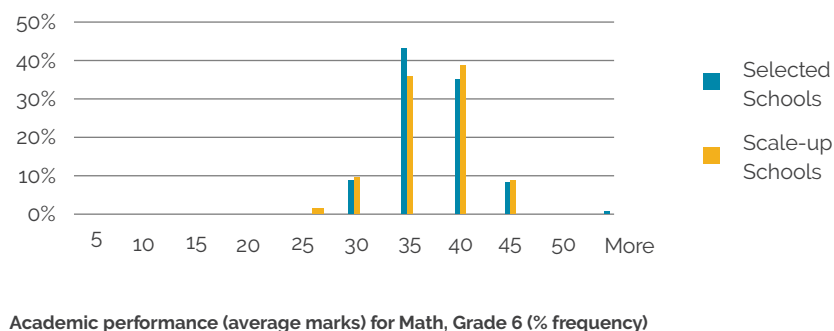
Included screening the filtered schools for basic minimum prerequisites for successful implementation and representativeness to scale-up schools. The process followed is shown below:

The 2,419 schools were screened using the following criteria:

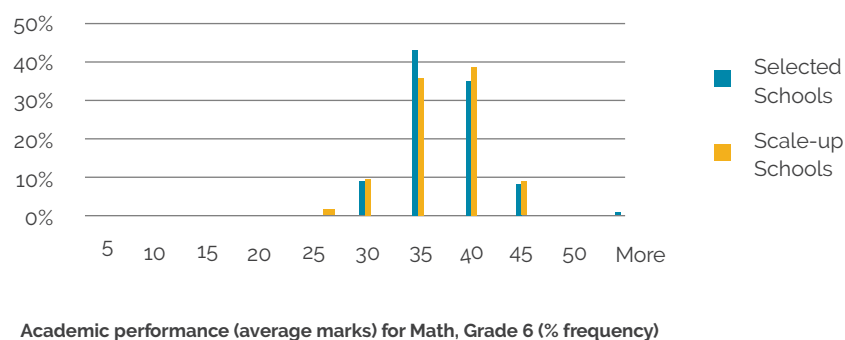
- Should have **both English and Telugu** as mediums of instruction.
- Should have a **minimum level of infrastructure**:
 - Consistent access to **electricity** (removed schools with no or non-functional access).
 - **Reasonable building condition** (removed schools with no building, dilapidated building, and building under construction).
 - **Adequate number of classrooms**, for which the minimum requirement of classrooms was calculated as one more than the number of grades offered in the school (removed schools that did not meet this minimum number of classrooms calculation).
- Should have **adequate student attendance**, for which mandal-wise drop-out rates of less than or equal to 15% was used in lieu of non-availability of student attendance data.
- **Teacher availability** to be representative of scale-up schools and ensure adequate usage possibility in schools.
 - **Teacher attendance should be at least 70%** as ~93% of the scale-up schools have teacher attendance that falls within 70-90%.
 - **Student-teacher ratio should be less than or equal to 35** as ~94% of scale-up schools have a ratio of equal to or less than 30.
- **Student enrollment and class size** to be representative of scale-up schools:
 - **Student enrollment in English medium (across grades 6-10) should be at least 100 students** per school as the scale-up schools have a larger total enrollment in these grades in English medium.
 - **Average class size (across grades 6-10, all mediums) should be greater than or equal to 15** as the scale-up schools have a smaller average class size across these grades and all mediums.

Finally, schools allocated to PAL vendors considered the following criteria to ensure PAL vendors are allocated a similar spread of schools that are also representative of scale-up schools:

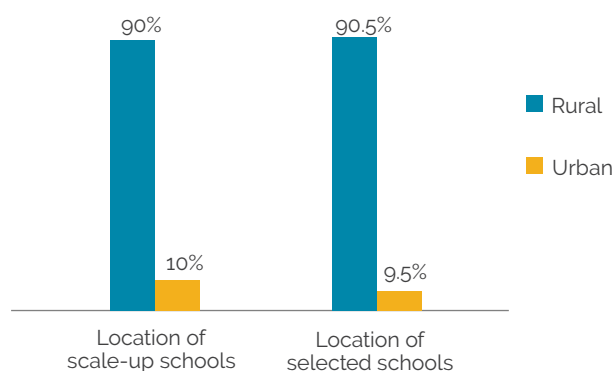
Slightly over-index on smaller schools during allocation because, across grades 6-10 and all mediums, the scale-up schools are smaller (have lower total enrollment) than the schools in the PoC phase. Additionally, ensure that the allocated schools cover three main categories of average class sizes, i.e., less than 45, 45-90 and 90-135.



Allocate schools (out of Guntur, Prakasam, Vizianagaram) that have similar academic performance at an aggregate level (as far as possible) to scale-up schools.



Ensure that the split of rural to urban schools for each vendor is approximately 90:10, in order to be representative of the scale-up schools. This means, of the 20 schools allocated to each vendor, about 2 schools are urban.



Note: Selected schools refer to the shortlisted 201 schools.

Figure 7: Criteria for allocating schools to ensure they are representative of scale-up schools

2. Ground realities may be different from what the data represents (e.g., U-DISE)	2. While government data can provide information on electricity availability, building conditions and classroom availability, school visits are required to confirm the data and check for availability of other infrastructure availability that may not be captured through data (e.g., power back-up, internet, etc.). For uninterrupted usage of PAL, the three most important hardware prerequisites include – power back-up, internet and safety of devices (can be ensured through preparation – explained in the section below). The former two are important to a) reduce teachers' irritation during PAL classes if devices switch-off due to power failure and, b) reduce FMS staff time spent on data syncing to free up time to support teachers during the PAL class and troubleshoot their issues and/or build their capacity to solve problems in class. In AP, for the 201 shortlisted schools, a survey was conducted to understand school readiness and verify basic infrastructure status. Only schools that were deemed ready for PAL after understanding the following aspects were considered for allocation to PAL vendors (Survey attached in the annexure): a) Is there availability of a room for setting up PAL hardware? b) What is the condition of the identified room? i) Room size ii) Is there any rooftop leakage? iii) Is there adequate security (number of windows, locks on windows and doors, recent thefts)? iv) Are there adequate plug points? c) Is there access to internet? i) What is the source (wired or mobile network) of internet access? ii) If mobile network is being used for internet, what type of network is available (2G, 3G, etc.)? d) Is there access to consistent electricity during school working hours? i) Are there any power cuts, and for how long? ii) Does the school have power back-up and stabilizer?
3. District officers may not devote adequate mindshare to school readiness if a small percentage of schools in their district get the PAL solution	3. It is preferred that both for the PoC and scale-up, schools be clustered in a few districts (v/s spread over multiple districts). For example, AP PoC was rolled out in only two districts, even though there were other districts that could accommodate the solution. Geographical concentration in PAL implementation thus allows district officers to dedicate adequate resources and effort in the schools.

Throughout the selection and allocation process, some assumptions were made that are critical to highlight because they form the rationale for selecting the schools. These assumptions were:

- The datasets shared by GoAP that have been used for selection and allocation are recent and reflective of ground reality.
- Drop-out rates can be considered as reflective of student attendance.
- Submission of e-Hazar data by schools is indicative of adequate access to mobile hotspot.
- Headmasters have accurately submitted data for the school readiness survey.

4.5.2

PREPARATION OF SCHOOLS

Once schools are selected and allocated for PAL implementation, they need to be prepared to accommodate PAL both from an infrastructure and design perspective as well as from a class scheduling perspective.

1. *Infrastructure and Design:* In terms of infrastructure, while schools can be shortlisted to meet basic minimum requirements, these may still need to be prepared to absorb PAL (for e.g., while shortlisted schools may have an available classroom, this classroom will need furniture, plug points etc. to deliver PAL). In terms of design, elements of the classroom like colour of walls, arrangement of furniture, etc. need to be prepared such that it motivates students to attend the classes and reduces any external discomfort while using PAL.
2. *Class scheduling:* Schools also need to be prepared to integrate PAL classes within their timetable as well as Schedule the classes such that all students get optimal exposure to the PAL software.

Challenges/ Constraints	Case study of Andhra Pradesh and learnings from other states
1. Infrastructure: Trade-off between standardisation and efficiency in preparing infrastructure in schools using a centralised/ decentralised²⁰ process.	1. A centralised process for school preparation allows for standardisation, which may take longer due to government procedures. On the other hand, decentralizing the process makes it faster, allowing schools to only provide for the specific requisites that are lacking (v/s standard procurement across schools). While decentralisation is the preferred mode during PoC due to lesser number of schools, a centralised model may be more effective for at-scale roll-out to maintain the quality of the infrastructure across the schools. However, if the decentralised mode is followed, cluster resource persons should visit schools to ensure that quality infrastructure has been provided. <u>AP PoC process</u> For school preparation, the district IT cell was provided with a checklist of school readiness and preparation to complete prior to PAL roll-out.

²⁰ Centralised process refers to the state government owning and managing the process, while in a decentralised process, the district teams are accountable for it

(1) Checklist for school readiness survey before PoC begins

- Availability of room for setting up PAL lab.
- Room identified has no rooftop leakage, broken windows or safety concerns (or funds are available for repairs).
- Availability of internet (wired/ wireless, internet speed and duration) in the school to facilitate data synchronisation, program updates and remote sessions with the IT team.
- Availability of electricity throughout school working hours, power backup (of at least two hours) and electrical earthing to prevent power fluctuations.

(2) Checklist for preparing PAL Labs before PoC begins

- Minor repairs to the PAL room, if needed based on the school readiness survey, are completed.
- Availability of ~30 chairs and desks (for laptop model).
- Availability of ~31 (1 extra for teachers' use) devices and headphones as per PAL vendors' specifications, ensuring that hardware is compatible with PAL software.

The district team was supported and monitored by the state IT cell, that oversaw the entire process and provided support to resolve issues.

Table 2: Checklist for school readiness and preparation

2. **Design:** There are multiple aspects of classroom design and layout that could affect student usage of PAL with negligible learnings on best practices.

2. The AP PoC did not actively test for classroom design elements, however there were learnings during the PoC that highlighted the importance of classroom design for PAL usage. For example, in one of the PoC schools, teachers did not want to continue PAL because the classroom windows had to be kept shut to keep the devices from being stolen, making the classroom stuffy and dark.

Over future PAL implementations, there is scope to test for how classroom design elements affect PAL usage and identify some good practices to nudge students and teachers to increase usage.

3. **Class scheduling:** One of the challenges to dedicated PAL time for each child is fewer devices compared to student strength (more than 30 per section in the case of AP) in the school.

3. Dedicated time with the PAL solution requires the device to student ratio in the classroom to be 1:1. However, this may seldom be the case as schools have differing student strengths and it may not be possible to maintain this ratio in schools with high student strength. Additionally, it is also a logistical burden on teachers to manage two batches of students with only one half using the PAL solution. Across the PAL ecosystem different solutions have been tried:

- a) Change in PAL delivery model: Some vendors have a 2:1 model in schools with high student strength. Learnings on whether this model is as effective as the 1:1 model of delivery is yet to emerge.
- b) Dynamic allocation of devices: Since schools have varying student strength, devices from schools with lower student strength can be transferred to schools with higher student strength. Thus, instead of all schools having 30 devices, the allocation would depend on the number of students.

c) *Other solutions:*

- i) Grouping students by learning levels/concept gaps to allow teachers to remediate students not using the devices during the PAL class.
- ii) Providing teachers with worksheets based on learning levels/concept gaps to provide to students not using the devices during the PAL class.
- iii) Providing PAL content only to students who need remediation (v/s all students in the class).
- iv) Redefining and narrowing scope of PAL implementation, e.g., reducing the number of subjects or grades covered etc.

Depending on the appetite of the state, systemic changes can also be adopted to effectively deliver PAL. For example, instead of administering PAL at the grade level, students can be grouped by learning levels so that the classroom instruction and PAL together remediates the students.

Note that, this is still an open question and states should continue exploring optimal solutions to sustained usage of PAL.

Learnings

- For the PoC, select schools that have:
 - Minimum prerequisites for PAL implementation which will be ensured during scale-up (e.g., availability of a room, electricity etc.)
 - The external factors that could impact successful implementation are as close to the scale-up schools as possible (e.g., school size, urban-rural split, language, student-teacher ratio etc.)
- For scale-up, select schools that have basic enablers (e.g., availability of rooms, electricity, etc.) in place or can be fixed before roll-out of PAL.
- School selection should be done using a combination of data analysis, and on-ground verification through surveys and school visits.
- Classroom design elements should encourage PAL usage.
- PAL classes should be scheduled such that each child gets adequate time on the software.

Open questions

- How can PAL classes be scheduled to optimise usage for each student?
- How can classroom design elements be leveraged to optimise PAL usage?

4.6 PREPARE TEACHERS

Teachers play a crucial role in the delivery of PAL. Despite being student-centric, PAL's potential for impact on learning outcomes is amplified if the teacher effectively uses the solution and is engaged during the PAL classes. For this, teachers need to be motivated and incentivised to conduct PAL classes and integrate the solution with their classroom teaching. For effective adoption, teachers must see PAL as a tool that reduces their burden and assists teaching. To get teacher buy-in, the government needs to invest in the following two aspects:

- *Training and on-going support: Quality teacher training and on-ground support through need-based refresher trainings and assistance in resolution of issues.*
- *Sustained engagement: Continual effort to nudge teachers to use the solution. This depends on both implementation ease as well as how the PAL software supports and nudges teachers to drive usage.*

4.6.1

TRAINING AND ON-GOING SUPPORT

Teachers need to be trained on both the foundational and functional components of PAL as well as on classroom management. Foundational understanding of the purpose of PAL is critical to teachers' perception and usage of PAL in classrooms. At the same time, functional knowledge of how to use the software and hardware equips the teacher with practical tools to support students' PAL usage. Finally, classroom management training ensures that teachers understand what their role is during the PAL class and how to plan for it. There may also be a component of change management required to encourage teachers to use ICT / PAL.

Teacher training is one aspect of preparing teachers. The other equally important aspect is on-going support in the form of refresher trainings and frequent check-ins. For effective buy-in, teachers should feel that they are being heard and the problems they face during implementation are being addressed.

Challenges/ Constraints	Case study of Andhra Pradesh and learnings from other states
1.1 Foundational: Since PAL is a new solution, it is difficult to explain the personalised and adaptive aspects of the solution to teachers, who may not have come across such a solution	1.1 Given the tight timelines over which the PoC in Andhra Pradesh was implemented, the problem of foundational knowledge of PAL was not actively solved for during the training stage. While 94%²¹ of teachers who were part of the PoC in AP claimed to understand PAL, qualitative interviews and FGDs in a sample of schools show that teachers didn't understand the purpose of PAL. The lack of understanding of PAL is clear because of multiple different perceptions that teachers had of PAL: a) <i>Teachers in almost all schools interviewed considered PAL as a revision/evaluation tool</i>. They found it particularly useful to administer PAL after the syllabus was over as they believed that students can use the PAL class to refresh their concepts and do questions which they otherwise would do during the class. This implied that they had concerns

²¹Sample size: 111 teachers. Note that since this was a government initiative, there may be a social desirability bias in the data towards continuing PAL. The analysis of the data was hence corroborated with on-ground qualitative interviews

before. This is also **particularly difficult since trainings are often done over ~1-2 days** with limited time spent on the concept and purpose of PAL.

about rolling out PAL at the start of the academic year as they believed that students wouldn't know the concepts well enough to use the platform.

"PAL is not useful for teaching, it helps in practicing questions. We finish concepts in class and then students solve those questions in the PAL lab."

- Teacher, ZPHS Nekarikallu

- b) *In majority of schools interviewed, teachers considered PAL to be more useful in improving subject learning for high performing students as compared to low performing students.* While the purpose of PAL is to bridge the learning gaps, this perception is evidence that teachers didn't understand how PAL improves learning outcomes. They hence felt that increasing PAL dosage would not help low performing students learn math better. This may be because the content was in English and weaker students have lower proficiency in English as compared to high performing students. However, teachers did believe that PAL helps increase interest in the subject, with some teachers claiming that there was an improvement in attendance and in one instance, reduction in student drop-outs.
- c) *Similarly, teachers felt that PAL could not help students learn concepts/basic math skills* from solving problems as math is a logical subject and requires someone to explain it to the students and clear doubts in person. While they did believe that students could improve math skills once their concepts were strengthened, they did not see PAL as a software that could teach concepts. However, some teachers felt that PAL (along with video content) would be a useful tool for teaching subjects such as Science.

This resulted in teachers seeing PAL as a useful add-on only after the curriculum/syllabus was covered, as against a tool to help students bridge the learning gap and supplement their classroom teaching by helping identify which students need remediation.

While role-plays, dedicating more time to the basics of PAL etc. may help teachers understand the purpose of PAL and its importance, **there is very little evidence on what leads to behavior change among teachers in integrating PAL with classroom teaching** and viewing it as a tool for improving learning outcomes. Hence, there is scope to learn more about this through future implementations of PAL.

1.2 *Foundational:* Additionally, some teachers in government schools have poor perception of technology as a tool to aid learning, and may not be bought into new EdTech solutions

1.2 Prior to explaining PAL and its purpose, **there is a need to first expand teachers' perspective on education through technology and change their mindsets on its effectiveness. This could be either done by the state or PAL vendors or a combination of both.**

2. **Functional:**
Within functional training there are two components:

2.1 **Software (how to use the platform):** Most trainings on software usage stop at the basics of using the platform (logging in, signing out etc.) and **do not focus on tools that may allow teachers to integrate PAL – e.g., dashboard usage**

2. While foundational training is critical for long term usage of PAL, functional training is necessary for the teacher to practically conduct the PAL classes.

2.1 Teacher training took place over ~1-2 days during the AP PoC. During this training, ~50% of the time was spent on orienting teachers to the software, with different approaches adopted by different vendors. One of the vendors for e.g., allowed teachers to take the tablet home so that they could spend more time navigating and getting comfortable with the platform. While all vendors informed teachers about dashboards and its utility, it was evident through the qualitative interviews and FGDs, that teachers had very limited understanding of the purpose of the dashboard. For e.g., across the different teachers that were interviewed and claimed to view the dashboard regularly only about 1 in 10 knew how to actionably use it. Similarly, **70% of the teachers who were part of the PoC in AP and got a ~1-2 day training claimed to require more training to be confident to use the PAL software.**

2.2 **Hardware (how to use the laptop/tab/key board etc.):** It is often assumed that teachers know how to use technology/laptops/tablets and most trainings do not focus on this; however, lack of technology knowledge is often a pain point for teachers

2.2 **99% of teachers used some form of technology at home and 95% of teachers used smartphones regularly across the different schools in AP where qualitative interviews and FGDs were held. However, only one teacher or lesser per school was comfortable with using technology in classroom.** One of the contributing factors could be that very few of those who used some form of technology at home, used a laptop/tablet (63% of teachers did not use a laptop/tablet/computer at home. Analysis of the teacher survey shows that while 95% of those who use at least a laptop/tablet/computer want PAL in the next academic year, the statistics is 90% for those who use only smartphones (see figure below).

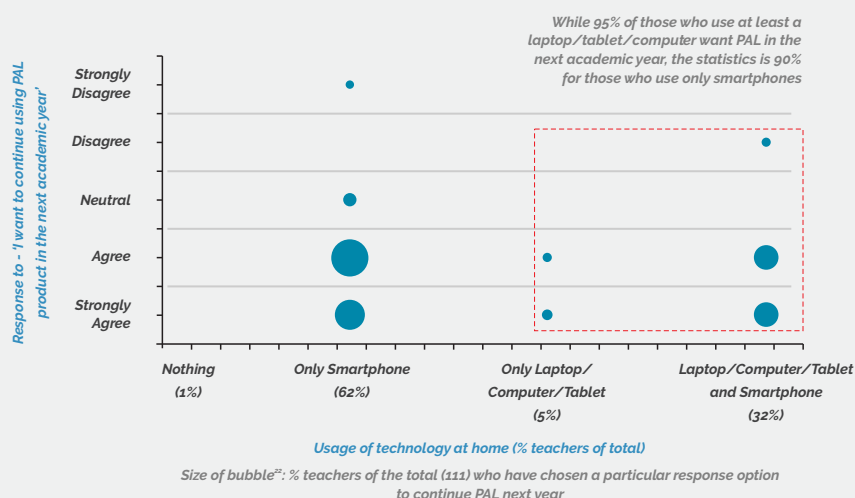


Figure 8: While fewer teachers use laptop/tablet/computer the likelihood to continue PAL next year increases with regular usage at home

²²Sample size: 111 teachers. Note that since this was a government initiative, there may be a social desirability bias in the data towards continuing PAL. The analysis of the data was hence corroborated with on-ground qualitative interviews

Most teachers during the qualitative interviews also showed interest in a) getting practical training on how to use laptops/tablets, b) gaining knowledge about the common hardware issues they are likely to face to be able to troubleshoot problems themselves.

Teachers' understanding of PAL and ability to help students with usage also affects students' perception and interest in PAL. Students are more likely to want to use PAL if teachers are able to support them.

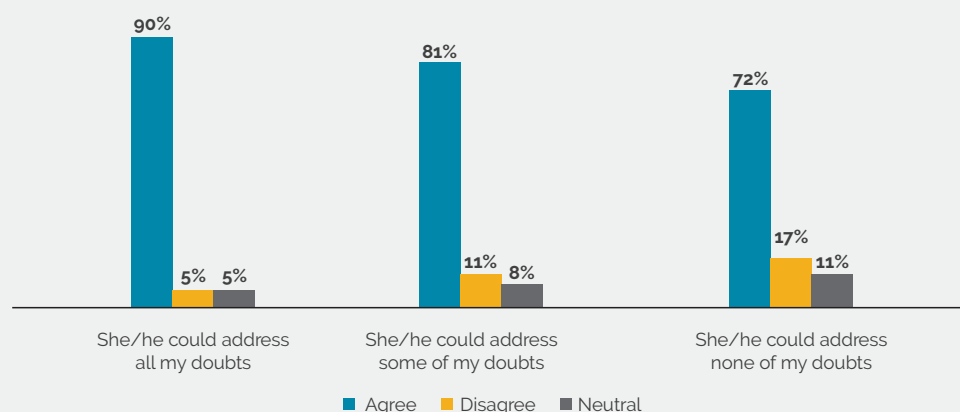


Figure 9: Percentage students' response to the question on whether they would like to use PAL for other subjects based on teachers' ability to solve their doubts

3. Classroom management: While teachers may understand how to use the software/hardware, they often struggle what the steps are once students are taken to the PAL lab, resulting in reduced time spent on using the device

3. Trainings also need to focus on what is the teachers' role once they enter a PAL class. For example,

The teacher needs to be trained on exact instructions to be given to students upon entering a PAL classroom, and on the ways to leverage students' technological skills to assist her in resolution of basic hardware issues, etc.

Effective classroom planning and management makes the teachers feel confident and in control of the class. Additionally, as part of the training, sample time-tabling should also be done in the presence of trainers who can provide support to guide teachers on the different ways in which they can schedule for PAL classes. The teachers may also have to be provided with behaviour change training so that they become more open to usage of ICT/PAL in their classrooms.

In the PoC, PAL vendors provided each PAL class with a Standard Operation procedure (SoP) module, that teachers could refer to in case of any queries. Additionally, in some schools Dos and Don'ts of PAL usage was written on the board in the room along with how to login and log-out.

4. Refresher training does not address teacher needs

4. The aim of refresher trainings should be to identify and address pain points teachers have been facing during PAL usage and to train them on newly launched features (if any) of the PAL solution. These pain points can be identified both through FMS qualitative feedback as well as through a short survey with teachers before every refresher training. Refresher trainings should be seen as opportunities to increase PAL usage by motivating teachers and working collaboratively with them to solve implementation challenges.

5. Delivery of teacher training is as important as the quality of content. Often teacher trainings do not take into account good practices on delivery, resulting in ineffective dissemination of information and limited intake by teachers.	5. Some good practices to keep in mind about the delivery are: a) Hands-on, where teachers run mock classes and use software in the training sessions. b) Engaging, e.g. Q&A based, in real computer labs, etc. The quality of training delivery staff is also very important. Since this can be difficult to ensure at scale, one solution is pre-recording high quality training content. Across the different PAL software vendors during the PoC, some good practices that vendors followed in terms of delivery include – a) Group activities for teachers during training to problem solve for challenges they may face in the classroom, thinking about timetabling and possible issues which may emerge. These group activities also included FMS staff who helped guide the discussions. b) Letting teacher take the device home with some homework to give them enough time to understand the interface.
---	---

Training for teachers should span over ~3-4 days to allow significant time to cover the above-mentioned three components of training and be delivered in the regional language. Ideally, during scale-up system integrators should also ensure that there isn't a lag of more than one week between training and roll-out. One solution to this is that the batch of teachers, once trained, can immediately start implementing the program in their schools, resulting in a staggered roll-out.

4.6.2

SUSTAINED ENGAGEMENT

Sustained teacher engagement can be ensured through two channels:

Implementation: ensuring that the PAL implementation processes provide intuitive support to teachers on the teaching learning process, reduce the burden on teachers and encourage them to adopt and use PAL effectively. This includes ensuring that the PAL classes are integrated well with the timetable, teachers have clarity and comfort with their roles, and the content is mapped to SCERT curriculum.

PAL solution: The PAL product can also drive teacher engagement by nudging teachers to use the software, and helping them see a link between PAL and classroom teaching.

Note that, there are other ways (besides the above two) to drive teacher engagement as well, that have not been explored yet. For example, there may be a case for selected students supporting the teacher with managing and setting-up classrooms, driving teacher engagement and usage of PAL.

Challenges/ Constraints	Case study of Andhra Pradesh and learnings from other states
1. Implementation: There are two critical pain points that teachers face when implementing PAL in classrooms:	

1.1 *Timetabling and syllabus completion:* Teachers felt that the PAL classes were reducing time for syllabus completion through regular classroom teaching. They also found it hard to implement PAL if the classes were not integrated

1.1 Since teachers believed that PAL could not teach basic math skills, which can only be taught in classrooms, they felt that PAL classes were eating into the teaching time. They preferred to finish a concept in class and then get students to the PAL class to practice questions on the same concept. Since the PoC was implemented at the end of the academic year, most teachers had finished the syllabus. However, they had concerns over using PAL in the next academic year due to lack of adequate time to complete the syllabus.

The GoAP is actively solving for this in the scale-up and is planning to reduce the SCERT syllabus by 30%, thereby indicating to the teachers that they need to shift the focus from syllabus completion to strengthening conceptual clarity.

If it is not possible to reduce the syllabus over the short-term, another potential solution includes identifying classes in the current timetable that may be replaced by PAL. For example, DCR/VCR classes may be replaced by PAL.

Additionally, lack of scheduled PAL classes was also an issue for teachers that affected their perception of PAL. Teachers who felt that the PAL classes weren't integrated with the time table were more averse to PAL as compared to teachers who felt they were. The figure below shows this.

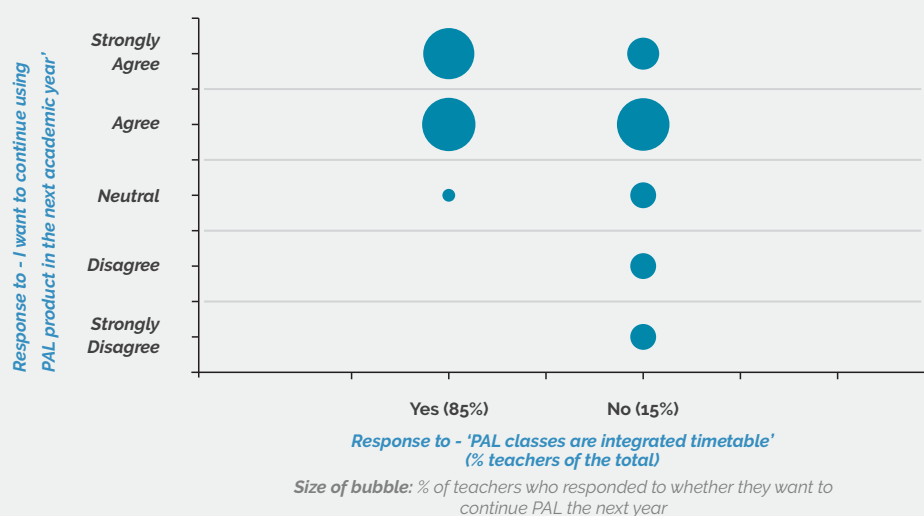


Figure 10: Teachers who believe the PAL classes are integrated with the timetable are more likely to want to continue PAL

1.2 *Quality of content:* Teachers have raised concerns over the content not being mapped to SCERT syllabus

1.2 Since the PoC was immediate and short-term, PAL software vendors rolled out the NCERT curriculum. However, **for the scale-up they will be tailoring the PAL content to the state curriculum.** It is important to ensure that the type and level of content provided in the PAL software is mapped to state curricula and contextualised. This may need SCERT approval, and PAL vendors and states should ensure that the content is ready well in advance to get the approvals before roll-out at scale.

2. PAL solution: Some challenges to teacher engagement due to the software include: 2.1 Teachers find it difficult to see the link between PAL content and classroom teaching. This makes it difficult for them to effectively engage with the PAL content 2.2 Teachers do not know how to actionably engage with the dashboard and use it to bridge student learning gaps	2.1 Since the PAL content aims to remediate students and bridge their learning gaps, it is difficult to have a clear mapping between classroom teaching and the PAL content. However, some potential solutions that are being explored during the PAL scale-up in AP include: a) Providing worksheets at the end of each PAL class, that relate to the chapter being taught by the teacher outside of PAL classes b) Allowing teachers to choose chapters (back-end control) that they may be currently teaching, so that each child is doing the same chapter, but the level of questions can differ for each student Note that, these solutions are not exhaustive and there may be other ways to improve teacher engagement in terms of PAL content. 2.2 Engaging teachers through PAL dashboard nudges is still an open question and is being explored across the different PAL implementation models. There are two aspects of PAL dashboard that need to be considered to engage teachers – a) Design of the dashboards, and b) delivery of the dashboards. While design is still an open question, one possible delivery model could be through smartphones due to its high prevalence (e.g., ~95% of teachers surveyed in AP had a smartphone). Using smartphone as the delivery model allows teachers to access the dashboard at homes, giving them enough time to understand it and use it actionably. However, no best practices have yet emerged on building use-cases of PAL. Future implementation models should aim to answer this question to improve teacher engagement.
3. Push back from teachers across different PAL projects on introducing PAL for grade 10 students	3. AP is rolling out PAL only in grades 6-9 in the first year of scale-up (and not grade 10). This is because students in grade 10 sit for a national level exam, and it is considered a crucial year for students. It is also easier to get teacher buy-in for lower grades for introduction of PAL. If possible, it is preferable that implementation start with only grades 1-8 in the first year and then slowly increase a grade each year. This means in the second year PAL dosage will be given to grades 1-9 and then the third year onwards grades 1-10.

However, despite some of the challenges mentioned above, the **overall the feedback from the AP PoC was positive and teachers wanted to continue using PAL in the following academic year. The following are some positive learnings in AP –**

- Teachers' **outlook towards PAL was positive** and they believed that it helps students practice math questions and encourages self-learning
- Teachers **preferred PAL to DCR/VCR** and find it more useful in improving students' math skills
- Most school had at least **one teacher who was technologically savvy** and assisted other teachers
- Teacher **comfort with solving technical issues improved over the ~7 weeks** as some common problems kept repeating
- Teachers found it **easy to manage students in the PAL classroom** and answer students' doubts

"We come from rural backgrounds and didn't get such opportunities, but our students should get exposure, and hence I stepped forward to take this opportunity"
- Headmaster

"Students can't use VCR without the presence of teachers, but PAL allows for self-learning"
- Teacher

Learnings

- Content: Training for teachers must cover both the foundational and functional components of PAL implementation as well as classroom management
- Delivery: Training for teachers should span over ~3-4 days, be interactive and hands-on and delivered in the regional language
- PAL classes should be integrated with the school timetable with the content mapped to SCERT curriculum
- PAL should be rolled out gradually starting with lower grades and specifically avoid grade 10 in the first year of implementation

Open questions

- How can be PAL and other education interventions be integrated for streamlined intervention in schools?
- What have been some successful solutions to solving the imbalance between devices and student strength?
- How can teacher engagement be improved through top-down messaging, bottoms-up buy-in, and training?
- How can the PAL software improve teacher engagement? What are good practices when preparing dashboards for effective PAL usage?

4.7 ESTABLISHING PROJECT MANAGEMENT SYSTEMS AND FIELD SUPPORT

The success of PAL implementation depends on the motivation and involvement of headmasters, teachers in schools, District IT Coordinator (DIC) and District Education Officer (DEO) at the district level, and finally the FMS staff recruited by the system integrator. These are players who will be involved on a day-to-day basis and actively solve issues on the ground. There are multiple models of recruiting FMS, with scope to explore each of these models in future PAL implementation:

- **Software vendors recruit FMS staff** – Since usage in the early stages of implementation depends on efficacy of the FMS to support the teacher, allowing software vendors to recruit and hold them accountable ensures that usage is sustained. This worked well during the AP PoC, where the scale was small (~20 schools per vendor) and it was feasible for the vendors to recruit FMS staff. However, at scale this may not be feasible, given the current ecosystem.
- **System integrator recruits FMS staff** – Since the system integrator has economies of scale, it is easy for it to hire and manage a large cohort of on-ground staff. However, it is still an open question on how best to align the incentives of the FMS staff to ensure sustained and high usage.
- **Government provides FMS staff** – Governments have strong on-ground support staff like cluster resource persons, with deep context of the school landscape. Since these resource persons have existing relationship with teachers, there is potential to leverage them as FMS staff. However, given that they also have other administrative duties, and no background with technology the feasibility of this model will have to be developed in the long-term.

Given the current landscape of the PAL ecosystem, the AP PoC adopted the second model, with the system integrator recruiting the FMS staff.

4.7.1

ENGAGED GOVERNMENT STAKEHOLDERS

Successfully engaging government stakeholders is critical to the success of the implementation. While there may be buy-in from top-level government stakeholders, without engagement of on-ground stakeholders the implementation would not be possible. It is hence important to ensure that these stakeholders understand the purpose of PAL as well as have clarity on their roles and responsibilities. Finally, there should be accountability mechanisms that hold these government stakeholders accountable to their roles.

Challenges/ Constraints	Case study of Andhra Pradesh and learnings from other states
1. Engagement of district officers and on-ground team can be negatively affected because of any of the following reasons: 1.1 Ineffective or lack of top-down messaging to prioritize PAL implementation	1.1 There must be clear messaging from the State Education Department that PAL implementation is a priority. Additionally, if the implementation is in a very small percentage of their schools, the district officers may not devote adequate mindshare to it. They focus on schemes/initiatives that cover all schools in their territory. So, it is recommended that PAL be implemented in geographical clusters leading to high concentrations in schools under their purview.

1.2 **Lack of buy-in of the district officers** because of no bottoms-up engagement

1.3 **Lack of clarity on roles and responsibilities and milestones for district teams resulting in ineffective accountability**

Prior to roll-out of PAL PoC, GoAP sent out a notice to District Education Officers (DEOs) of Guntur and Prakasam about PAL implementation with instructions to get a PAL classroom ready along with integrating PAL with the timetable. This notice helped decentralize the process of school readiness and ensured that DEOs and thereby headmasters in schools prioritised PAL over other EdTech solutions (DCR/VCR) so that these solutions did not reduce the classroom teaching time for students.

1.2 **Top down messaging alone doesn't ensure that DEOs and DICs are involved, there also needs to be efforts to create buy-in the PAL solution for them to stay motivated and engaged.** Buy-in can be generated by conducting an on-boarding workshop with all DEOs/DICs to explain the purpose of PAL, scale and expectations. The roll-out should initially be done in districts where the DEOs/DICs are convinced about PAL and enthusiastic about implementing it.

In the case of AP, the PoC was implemented in districts with enthusiastic DICs with strong buy-in on EdTech initiatives. While no trainings/on-boarding sessions were held for them, the scale-up will have an on-boarding session for the district officers.

1.3 There are three aspects of accountability that should be ensured for effective accountability of district teams. The first is, **defining roles and responsibilities for the different players.** The roles should also be defined keeping in mind capabilities of different stakeholders and how they may complement each other. These roles and responsibilities should preferably be shared by the state government through notices for government employees.

While on-boarding district teams and defining roles and responsibilities it is important **to convey that their role is not just to push schools to achieve high usage metrics, but also to understand the reasons for low adoption.** They also need to provide ongoing support to schools and teachers to resolve the adoption challenges they may be facing in schools, and be the link between the schools and the state level decision makers for this problem solving.

The table below lists roles that each of the players will play during the scale-up in AP.

District level	Schools
District Education Officer - Provide notice to schools on timetabling - Prioritisation of PAL - Liaising with SI and FMS staff - Support DIC in coordinating with SI	Headmaster - Escalate hardware and software issues that can't be resolved at the school level - In consultation with the teachers, create the school timetable with dedicated PAL classes
District IT Coordinator - Oversee and support hardware set-up and operations by SI - Alert problems to DEO as and when required	Teachers - Conduct timetabling and conduct PAL classes

Table 3: Roles and responsibilities of different stakeholders

	The second aspect is defining deliverables and milestones according to the roles, as well as KPIs to track progress against these milestones. The milestones should be realistic and preferably prepared in collaboration with district teams. Finally, review mechanisms should be set-up to track these KPIs to regularly review progress, and ensure that the way progress is measured is reliable and transparent.
2. Lack of pre-existing mechanisms/communication channels to hold on-ground stakeholders accountable	2. Once roles and responsibilities, deadlines and milestones, as well as KPIs are defined, accountability can be ensured through regular check-ins and systems that allow for easy escalation of issues through multiple channels. GoAP already had some pre-existing channels that they used on a frequent basis to get updates on status of schools and other initiatives. For example, GoAP was able to conference call over 90+ headmasters and teachers who were part of the PoC to get feedback on the PAL implementation. Similarly, they actively use WhatsApp groups, a channel that was leveraged during the PoC as well. For example, a separate WhatsApp group was created with each PAL software vendor that included the District IT Coordinator (DIC), on-ground team of the PAL software vendors and GoAP PMU team. This group was used to provide updates on school readiness, raise any school-related issues that vendors may be facing and for the GoAP PMU team to communicate with the vendors directly. Some PAL vendors also had a WhatsApp group with all school headmasters, FMS staff and district IT coordinator for the ~20 schools to manage operations and check progress. Weekly MIS usage data was sent to the GoAP PMU. This was analysed by the technical partner and weekly calls were held between the PAL vendors and the GoAP PMU team. This weekly call was conducted to track the usage in classrooms and problem solve for barriers to consistent and high usage – for example, classes not being conducted by teachers, devices malfunctioning etc. MIS data that was collected for the AP PoC can be found in the annexure.

4.7.2

EFFICIENT FMS STAFF

Field Management Support (FMS) staff play a crucial role in supporting teachers to implement PAL and drive usage. Hence, it's important to ensure good quality of FMS staff. At scale, it is more difficult to maintain the quality standards. Hence, it is important to solve for the possibility of reduced quality through optimal ratio of FMS staff to schools as well as the nature of their role.

Challenges/ Constraints	Case study of Andhra Pradesh and learnings from other states
1. There is a need to create an appropriate system to ensure quality FMS staff at scale	1. Typically, FMS support provided by software vendors has a high FMS to school ratio (usually 1:1 or 1:2 ratio of FMS to schools), and includes intensive academic and pedagogical support, technical support for scheduling and hardware and software support for troubleshooting. While this might be feasible to do at a small scale, it is not possible to implement such an intensive model for large scale interventions. Innovations are thus required to find a solution for scalable and quality FMS support. The PoC in AP was the first time where a 1:4 FMS model was followed. However, it did not have any significant negative impact on the implementation of PAL. With a 1:4 model FMS staff was able to visit the schools at least twice a week with 40% teachers saying that they visited more than twice a week. Additionally, ~84% of teachers said that they would be comfortable running the PAL classes without the FMS support/visits within 3 months of the roll-out of PAL. This hence implies that reduced need for FMS staff makes PAL a more implementable solution. While rolling-out PAL one could consider a gradual scale down from 1:4 to 1:6 after six months, possibly followed by 1:10 after a year. However, it is important to note this FMS staff was recruited and trained by the PAL software vendors at a small scale for the PoC. The PAL vendors had an incentive to recruit FMS with good qualifications and a salary that is significantly higher than the minimum wage (which is unlikely at scale). While the PoC does indicate that the 1:4 model could potentially be feasible at scale, we are yet to prove the efficacy at scale, as the quality of FMS may reduce if the SI tries to cut costs. At scale, it is also important to arrive at the most feasible set of roles and responsibilities such that it doesn't require high-skill and is feasible to monitor, given the ratio of FMS staff to school. E.g., it may be difficult if FMS staff is expected to provide academic/pedagogical support to teachers with 1:10 ratio of FMS staff to school. For the PoC, the following were the roles and responsibilities of the FMS staff: • Provide ongoing PAL support to teachers including query resolution, refresher trainings, review meetings • Conduct teacher training and support on timetabling • Visit every school 1-2 times a week based on the agreed upon schedule prepared by Headmasters and PAL vendors

2. **There is a need to define optimal accountability mechanisms for FMS staff**

2. While the PAL vendors monitored the ~5 FMS staff, which was easy to do through a WhatsApp channel, the process becomes complicated at scale.

However, it is easier to track FMS visits if there is a pre-determined schedule of visits. For example, SIs can make a monthly schedule based on which schools need most support for the FMS staff to visit. Additionally, the state government can feed in FMS data in the school biometric system so that they can track FMS visits as well. Since FMS staff supports and encourages teachers to use PAL, they must have both technical background and some experience in the education sector. This not only helps them support teachers better for both hardware and software but also makes it easier to build credibility with teachers. The RFP mentions the minimum qualifications of the FMS for the scale-up.

While this is one approach to an accountability mechanism for FMS staff, there is scope to explore other options and create learnings on what works well.

Learnings

- Managing day-to-day activities and monitoring usage of PAL in schools requires coordination among the multiple stakeholders involved on-ground through top-down messaging, bottom-up buy-in and well-defined roles and responsibilities.
- Accountability can be ensured through:
 - Well-defined roles and responsibilities
 - Clear milestones and deliverables
 - Regular review systems with KPIs to track progress
- There is scope and need to experiment with nature and ratio of FMS staff to schools at scale.

Open questions

- What is the optimal nature and ratio of FMS to school at scale? Is it possible to eventually implement PAL without FMS staff?
- What form of communication strategy optimally engages on-ground government stakeholders?

4.8 DETERMINING MONITORING, EVALUATION AND LEARNING (MEL) AGENDA

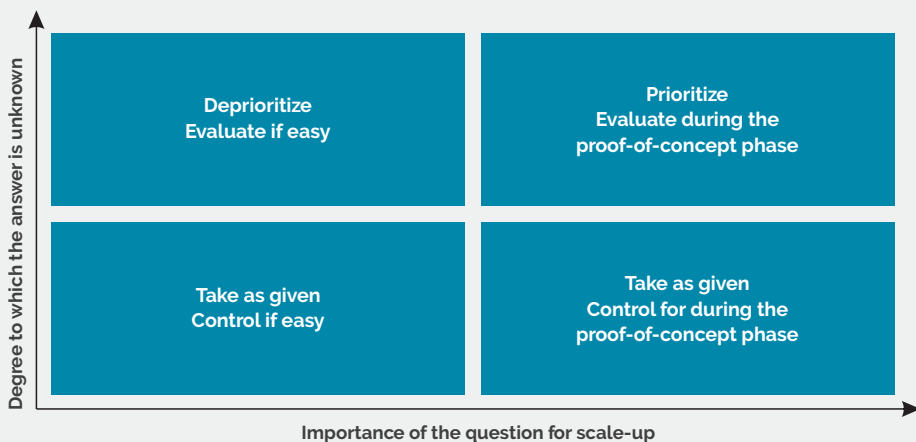
PAL implementation is in its early stages, and as such there remain several critical un- or under-answered questions (e.g. laptop vs. tablet effectiveness, implementation management models, cost effectiveness, teacher training method etc.). Any implementation must therefore identify top learning priorities and adopt MEL tools such that these are adequately answered. There are hence two steps involved in evaluating the PAL implementation (either PoC or scale-up):

- Determining the key questions to be answered through the implementation
- Developing indicators and defining the MEL methodology to test these questions

4.8.1

DETERMINING THE KEY QUESTIONS TO BE ANSWERED THROUGH THE IMPLEMENTATION

The decision on what to test for is important to determine before implementing PAL. This decision should be based on what the scope and objective of the implementation and externalities that may enable or limit testing of certain questions.

Challenges/ Constraints	Case study of Andhra Pradesh and learnings from other states
1. While the aim was to test for scale through the PoC, the time period over which the PoC was implemented was limited, constraining the questions that could be tested	1. Given the constraints under which the MEL could be conducted in PoC, the questions to test for were prioritised based on a) criticality for scale, and b) feasibility to measure over the short time period. The framework below captures how key questions were determined for the PoC:  Figure 11: Prioritisation framework used for AP PoC Based on the prioritisation the questions focused on: Formulating an effective governance structure Gauging readiness for roll-out Deploying the PAL solution in classroom There were some known factors for the success of PAL – e.g., early buy-in of headmasters is crucial for PAL success, schools must have some basic infrastructure readiness, 1:1 student to device ratio is optimal, etc. These known factors were controlled for when rolling out PAL to ensure that

existing learnings are incorporated into the PoC. Given that the PoC was over ~7 weeks, most of the prioritised questions focused on implementation parameters that could be feasibly collected/observed over this period. These included:

- a) **Formulating an effective governance structure:**
 - What is the **frequency of engagement** and role of key stakeholders in the Department of State Education and across vendors for successful implementation?
 - How can vendors effectively manage roll-out with **limited implementation support**?
- b) **Gauging readiness for roll-out** (teachers, students and infrastructure):
 - What are some efficient ways for **teacher training** and engaging/motivating teachers to use PAL in resource constrained settings?
 - What are some efficient ways for **integrating and contextualizing PAL to school requirements** in resource constraint settings?
- c) **Deploying PAL solution in classrooms** (hardware and software):
 - What is the **relative importance of PAL vendors' content, engagement platform and support** in effecting usage and interest?
 - What are good practices for **MIS data collection**?
 - How **many grades lower is the learning level** of students (6-10) in AP?

4.8.2

DEVELOPING INDICATORS AND DEFINING THE MEL METHODOLOGY TO TEST THESE QUESTIONS

Once the learning agenda and key questions are finalised, MEL indicators and methodology need to be identified. The indicators that need to be measured determines the methodology. Depending on availability of resources, sample size and rigor of indicators that need to be measured, methodologies can range from surveys and interviews to RCTs.

Challenges/ Constraints	Case study of Andhra Pradesh and learnings from other states
1. Given that the intervention was government led, there was potential for social desirability bias in the survey with teachers and students.	1. Since the sample size of schools was also small, the data from the survey was corroborated with on-ground interviews and FGDs. The questions were tested both in an ongoing manner through the weekly check-ins. The MEL was led by the technical partner and built on the CSF EdTech Lab Rapid Evaluation Toolkit. The surveys were conducted with 30 headmasters, 111 teachers, ~6000 students across the 56 schools. Out of the 56 schools, interviews were conducted in 12 schools across the three vendors, with four schools for each vendor. The team spent 2-3 hours in each school speaking to headmasters, teachers and students to understand their experience with PAL usage, pain points and success factors. Learnings from the survey and interviews have been incorporated throughout the document.

5 | CONTEXTUALISING PAL SOLUTION (SOFTWARE AND HARDWARE)

For consistent usage and impact on learning outcomes, it is important to ensure that the PAL solution is tailored to the students' context and has an interface that is easy to use and motivates students to use it. Through the AP PoC the following learnings emerged:

- **Language: Even if English is the language of instruction, provide the solution in the mother tongue along with English for the grades where English is being introduced for the first time.** For example, in AP while there was a separate section for English medium students, most students studied English for the first time in grade 6. Hence, their competency was low and they didn't understand the questions. While we may want to encourage English, it is important that students understand the questions for their learning outcomes to improve. Hence, the PAL solution should be bilingual to encourage comprehension in English and be able to provide support through translation into the language the students are comfortable with.

"Students need to be very good in English to understand the questions on PAL. Since English is introduced for the first time in grade 6, students struggle."

- Teacher, Zilla Parishad High School, Madala
- **Nudges: Students are more likely to use the software if there are nudges that build confidence/ encourage students to learn.** Some example of nudges that teachers believe were helpful include:
 - **Grades/scores:** Software that provide students with scores/marks for solving questions correctly fosters healthy competition between students as they want to get the highest score. It was interesting to see that in one of the solutions during the AP PoC where students could trade marks to unlock games, few or no student played games since they wanted to collect the most marks and compare across the class.
 - **Encouraging words/animation:** Software that provides positive reinforcement to students on solving questions correctly was seen to motivate students to put in effort to solve the questions (v/s choose or enter a random answer). Some encouraging words noticed in one of the solutions was – "Extraordinary", "Well done", "Keep it up" along with an animated child jumping with joy every time the answer is correct.
 - **Games:** Students tried to use paint/type on MS word when they were bored of solving questions. This suggests that building in these as gamified activities within the PAL product may nudge students to use the software more. This can be tested in future PAL interfaces.
- **Type of questions:** The questions on the PAL software should be a combination of multiple choice and fill in the blanks with solutions and explanation after every question. Only keeping multiple choice questions results in students randomly clicking on an option without solving it, hence a combination of different types of answers is preferable. Providing solutions and explanations allows students to understand the steps followed to arrive at the answer and learn new approaches to solving the same question.
- **Context:** Questions should also be context/location specific (e.g., the software shouldn't use English names, have references to food items that the student may not be aware of like pasta, pizza etc.).
- **Hardware/device control issues:** There are some minor device related learnings that could be easy fixes for efficient classroom usage:
 - Some students saved their login IDs and password making it difficult to the next batch of students to enter theirs. The software should hence not allow students to save password.
 - Teachers also found some answers/questions to be wrong or grammatical errors in the solution. The software should hence allow teachers to provide ongoing feedback on content through the laptop/tablet itself.

In addition, there is need to build the solution such that it nudges teachers to drive PAL usage. While PAL software vendors have dashboards that provide teachers with data on student performance and learning levels, this data is not actionable and user-friendly. As software vendors innovate, they must consider both students' and teachers' needs.

— Open questions —

- How does the cost v/s impact trade-off of laptop and tablet model differ?
- How can the PAL software improve teacher engagement? What are good practices when preparing dashboards for effective PAL usage?
- How can the PAL data on student learning levels and performance inform other government initiatives?
- What are the elements of product contextualisation required?

6 | LEARNING AGENDA FOR FUTURE PAL IMPLEMENTATION

While the Andhra Pradesh PoC tested for some unknowns that will inform the scale-up of PAL, nascent stage of the ecosystem implies that there are a lot more unknowns that we still need to test for to implement PAL optimally. AP PoC was among the early testing grounds for PAL implementation, and future PoCs should aim to control for factors/incorporate learnings based on the PoC and continue testing for the unknowns. The unknowns in PAL implementation fall under three main categories:

- **Process:** How can the process of PAL implementation from procurement to roll-out in schools be made more efficient?
- **People:** How can the relationship and accountability between the multiple stakeholders involved be improved for streamlined roles and responsibilities?
- **Product:** How can the product improve teacher and student engagement to drive PAL usage and effectively bridge students' learning gaps remediate students?

PROCESS

a) When should the proof-of-concept phase be conducted to ensure it is representative of scale-up?

The PoC conditions should be as representative of scale-up as possible. However, implementing it at the beginning of the academic year may result in resistance from teachers who may feel that they are unable to complete the curriculum (the AP PoC took place towards the end of the academic year and teachers had completed the syllabus and hence may have been more receptive to the product).

b) What are the current funding constraints, and how can state governments be innovative about leveraging funding for PAL software, capacity building, and strategic support?

Currently the focus of funding for PAL is on hardware (since it forms majority of the cost). However, success of PAL implementation also depends on the software, capacity building of all stakeholders involved, as well as strategic support in the early stages of implementation.

c) What procurement processes (for software, hardware and field management services) would be most efficient for different states, given different state contexts?

While AP followed a decoupled process for procurement, and Chhattisgarh followed a coupled process, the state should think about which process to follow given state context and maturity of the PAL ecosystem.

d) What is an optimal process of price discovery for PAL software?

Since most PAL solutions are new and untested it is difficult to determine their prices and understand cost v/s impact implications. However, as the ecosystem matures there will be need for a scientific and rigorous process to determine software costs, similar to hardware.

e) How can we energize the ecosystem while also solving challenges with the government's procurement processes, in order to ensure that the potential bidders consider government as a feasible pathway to scale, and participate in the procurement process despite the associated concerns like project sustainability, comfort with payment schedule, smaller profit margins, etc.?

Uncertainties in external environment may affect RFP bidding, and there is scope to learn about how these uncertainties can be mitigated or trust is built in the government ecosystem among bidders.

f) How can we innovate on accountability mechanisms in a decoupled model (i.e., PAL software vendors and system integrator as separate entities), where PAL software vendors have different pricing models?

The current accountability mechanism is structured to provide system integrators a supervisory role over PAL vendors and ensuring all vendors have the same pricing. However, as the ecosystem grows

and some solutions are more expensive than others due to quality factors, the relationship between the two parties should be defined such that there are no perverse incentives.

g) How can PAL and other education interventions be integrated for streamlined intervention in schools?

PAL may be one among many interventions that the government is implementing. If it doesn't complement other intervention (both EdTech and non-EdTech), it could increase burden on teachers and overwhelm students. For example, for the AP PoC, the Digital Classroom (DCR) initiative was deprioritised.

h) How can PAL classes be scheduled to optimise usage for each student?

- For PAL to effectively bridge learning gaps, students need to be given adequate dosage on the software. However, budget constraints and high student strength could be a barrier to optimal usage. While implementing PAL in the future, one should test for the efficacy of different models to optimize usage, e.g., 2:1 ratio of student to device, afterschool extra classes, etc.
- Additionally, PAL is implemented in government schools by replacing some of the subject periods with PAL periods. This results in resistance from teachers. There is scope to learn if other models of scheduling (one hour before and after school hours; replacement of non-subject periods; only for students who need remediation etc.) may be more effective.

PEOPLE

a) What are the different models of accountability between system integrators and PAL software vendors if the pricing model of vendors differ?

The AP PoC standardised costs between the three software vendors to remove any incentives for the SI to prefer any one vendor over the others. However, as the market matures and there may be a situation where a more established vendor might have higher costs than a new vendor. In such a situation, which other incentive mechanisms may work besides standardizing costs?

b) What is the optimal nature and ratio of FMS to school at scale? Is it possible to eventually implement PAL without FMS staff?

The need for quality FMS staff to support teachers for PAL implementation reduces the scalability of the solution. However, as the AP PoC shows that it may be possible to move from 1:1 to 1:4, future PAL implementations should test for the feasibility of a higher ratio, and eventually building capacity of teachers and on-ground government stakeholders (cluster resource persons, district officers etc.) to implement PAL without FMS staff.

c) What form of communication strategy optimally engages on-ground government stakeholders?

Similar to the problem with teacher engagement, there is little known about how on-ground district teams can be effectively leveraged and motivated to drive PAL usage. Currently, the messaging is primarily top down and does little to generate buy-in.

d) How can teacher engagement be improved through top-down messaging, bottom-up buy-in and training?

Currently teachers are focused on syllabus completion and not on improving learning outcomes. There needs to be messaging from the government on shifting the focus to learning outcomes. However, it is not yet known how this can be done effectively. Additionally, teachers do not understand the purpose of PAL, and there is scope to learn how trainings focus on the foundational aspect of PAL. Some of the unknowns with respect to teacher engagement include:

- Communication strategy from the government
- Teacher training content and delivery models
- Reporting and incentive structure to increase PAL usage

e) How can classroom design elements be leveraged to optimise PAL usage?

Elements of the classroom structure and design can also affect PAL usage. E.g., how should the furniture be structured to maximise student engagement and make it easy for the teachers to manage the class?

PRODUCT

a) How does the cost v/s impact trade-off of laptop and tablet model differ?

In terms of cost, while tablets are cheaper, their durability may be lesser than laptops. However, it is yet unknown if there is any difference in the remediation effectiveness of laptops v/s tablets. Knowledge on the cost v/s impact trade-off is important to make the right decision for scale.

b) How can the PAL software improve teacher engagement? What are good practices when preparing dashboards for effective PAL usage?

Besides messaging from the government and training, the product can also increase teacher buy-in. However, there is scope to learn how the dashboard and interface can help teachers understand the purpose of PAL and use it to remediate students and complement their classroom teaching.

c) How can the PAL data on student learning levels and performance inform other government initiatives?

The PAL data has potential to inform education interventions if optimally leveraged. However, little is known about the different use-cases of the data.

ANNEXURE I

STRUCTURE OF DEPARTMENT OF SCHOOL EDUCATION IN ANDHRA PRADESH AT THE STATE AND DISTRICT LEVEL

The proof-of-concept phase and preparation for scale-up at the state level was primarily managed through the Information Technology (IT) cell and Project Management Unit (PMU), with strong decision-making and project management support from the state IT coordinator. In AP, the Commissionerate of School Education (CSE) is the autonomous government body that plans and executes all projects related to primary and secondary education. Under the CSE, there are various departments led by Additional Directors/Joint Directors that report directly to the Commissioner. One such department is the ICT department that has the IT cell as its implementing body. IT cell is responsible for procuring hardware either directly or through tenders, ensuring delivery of hardware in schools etc.

At the same time, most projects are also supported by the Project Management Unit (PMU), which has ~4-5 members who are involved in multiple overlapping projects. The PAL project was primarily run by the PMU with ~1-2 representatives from the IT cell supporting on the hardware/technology front, with the state IT coordinator providing oversight, problem-solving and decision-making support to the PMU team throughout the project.

At the district level, the district IT cell under the District Education Officer (DEO) was the primary body responsible for on-ground implementation. Each DEO has ~10 cells/departments that work on multiple projects depending on the scope. IT cell, that looks after Digital Classroom (DCR) initiative, Virtual Classroom (VCR), School Information Management System (SIMS), etc. is one of the many departments. It is led by the District IT coordinator, who has a team of ~3-4 district nodal officers, block level nodal teachers along with a nodal teacher in each school. Each nodal officer is responsible for one project/initiative. For e.g., there is one nodal officer each for DCR and VCR. For the purpose of the PoC the DCR/VCR officers also managed the PAL project, but for scale-up, a dedicated PAL nodal officer has been appointed.

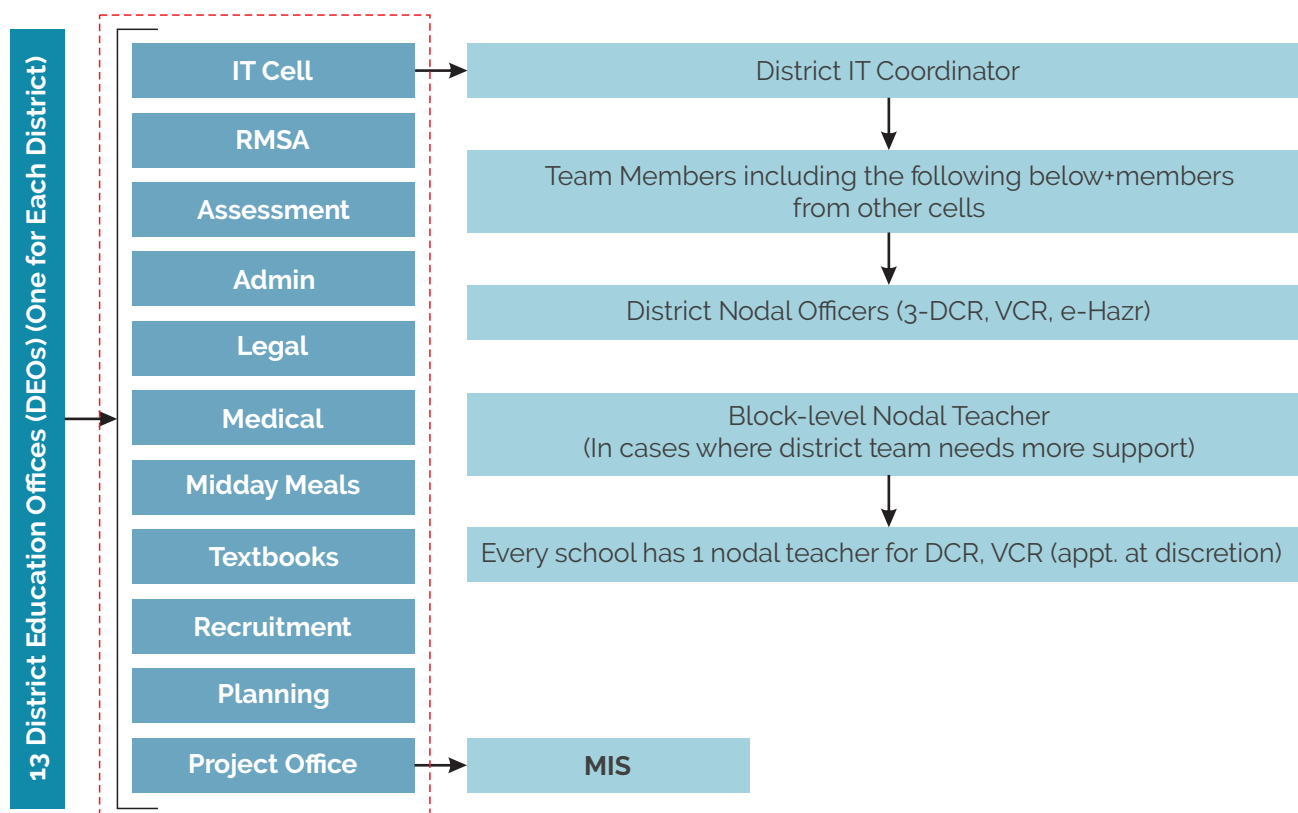


Figure 12: District organization chart for School Education in AP

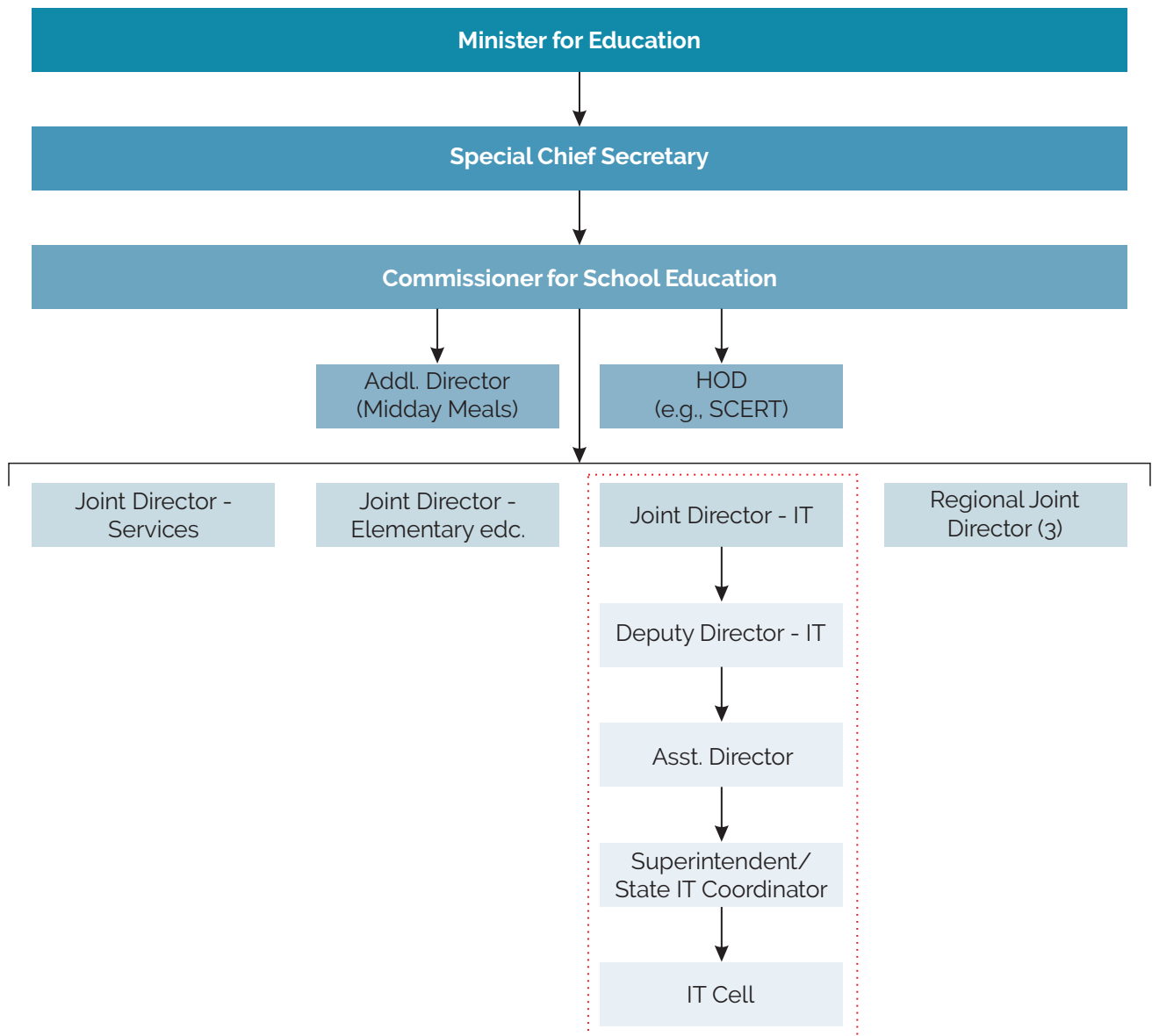


Figure 13: State organization chart for School Education in AP

ANNEXURE II

ROLES AND RESPONSIBILITIES OF THE TECHNICAL SUPPORT UNIT (TSU)

- 1. Strategic support** to state for planning EdTech interventions work closely with the GoAP and software vendors to:
 - a) Analyse weekly MIS and Mobile Device Management (MDM) data to track technology up time, usage, student progress, etc.
 - b) Develop reports on project progress and ensure the submission of relevant fortnightly/ monthly/ quarterly reports to GoAP.
 - c) Generate actionable for stakeholders involved.
- 2. Program design** for each PAL solution:
 - a) Study previous EdTech interventions and gather lessons from past PAL implementation experiences - from within and outside government context - to arrive at an understanding of what programmatic parameters lead to successful implementation.
 - b) Gather learning from pilots and implementation of PAL in AP for all three solution providers, and also from past evaluation reports of the solution providers.
- 3. Program implementation:**
 - a) Create the necessary structures and processes to manage delivery, accountability and incentive structures for effective program implementation.
 - b) Work in close collaboration with the PMU/Core Group and CSF to develop implementation plans for all the empaneled solutions, covering all the key components of the program, including school set-up, deployment, teacher training, field management support and ongoing troubleshooting.
 - c) Set up a system to seamlessly collect feedback and complaints from field staff. Support GoAP by keeping track of SI's ticket management system to ensure all queries are getting resolved on time.
 - d) Provide supervision and guidance to the System Integrators and vendors as they prepare their systems and processes.
 - e) Conduct sample school visits and sample teacher surveys to verify data & processes.
 - f) Collate and document learnings from the scaling and implementation process and insights from field. Share 'Best Practices' and Challenges with GoAP via monthly/quarterly program review meetings.

ANNEXURE III

SCHOOL SELECTION AND PREPARATION SURVEY

Checklist for school readiness survey to assess extent of repairs required (for schools using separate identified room for the PAL lab)

District name _____

Mandal name _____

U-DISE code of the school _____

Condition of the identified room where the PAL lab will be set up:

1. What is the size of the room? _____ (L*B*H)
2. Does the roof of the identified room need any repairs to prevent rooftop leakage? ☐ Yes ☐ No
3. How many windows does the identified room have? _____
4. Does the identified room have any broken windows? ☐ Yes ☐ No
5. If yes, then how many broken windows are there? _____
6. Can all the windows be locked from inside? ☐ Yes ☐ No
7. How many windows do not have bolts or locks? _____
8. Do all the windows have grills? ☐ Yes ☐ No
9. If no, then how many windows need grills installed? _____
10. How many doors does the identified room have? _____
11. How many doors do not have functional locks? _____
12. How many functional fans are there in the room? _____
13. How many functional tube lights are there in the room? _____
14. *The PAL lab will require at least five wall-mounted plug points. These wall-mounted plug points should be spread out across the room – each wall should have at least one of the wall-mounted plugs.* How many functional plug points does the identified room currently? (Please check if plug points are working before answering) _____
15. *The PAL lab will require a cupboard, desks and chairs for 30 students, and one desk and one chair for the teacher.* What furniture does the identified room currently have that is in a usable condition?

Number of cupboards _____

Number of desks _____

Number of chairs _____

Other _____

16. Based on the requirements in question 15, what additional furniture is needed for the PAL lab?

Number of cupboards _____

Number of desks _____

Number of chairs _____

17. Based on your answers above, please list out the **approximate amount of funds required** for carrying out the following repairs (if necessary) to the identified room:

Rooftop repairs _____

Repairing windows _____

Purchasing and installing bolts/locks on windows _____

Purchasing and installing grills on windows _____

Purchasing and installing locks on doors _____

Installing additional wall-mounted plug points in the room (up to 5) _____

Purchasing 3 extension cords (6 sockets per extension cord) _____

Purchasing furniture _____

Total cost of repairs to the room (please add all of the above) _____

18. Please take 5-7 photos of the room from different angles, windows, door, roof and send them to the DCR district nodal officer

Availability of mobile network (internet) in the school to facilitate data synchronization, program updates and remote sessions with the IT team:

a) What are the approximate monthly internet charges for the school? _____

Access to electricity:

a) Does the identified room have a functional UPS device? ☐ Yes ☐ No

b) If not, please list out the approximate amount of funds required for purchasing a UPS device : _____

d) Does the school have electrical earthing to prevent power fluctuations?

☐ Yes ☐ No ☐ Don't Know

d) If no, please list out the approximate amount of funds required for doing earthing: _____

ANNEXURE IV

SCHOOL CHECKLIST

Kindly ensure that the schools have the following available in the PAL lab and ensure repairs are done if required

Sr. No.	Description
1.	Availability of a room minimum size of 25 feet by 25 feet
2.	Roof is fixed and does not leak
3.	All windows can be locked from inside
4.	Any windows are not broken
5.	All windows have grills installed
6.	External lock installed on all doors
7.	Availability of at least one cupboard with lock in the room
8.	Availability of at least 30 desks in the room
9.	Availability of at least 30 chairs in the room
10.	At least one functional fan and tube light
11.	At least 5 wall mounted plug points available in the room (one on at least each wall)
12.	5 extension cords, each with at least 6 sockets
13.	Functional UPS device available in the room
14.	Earthing available in the school

ANNEXURE V

MIS DATA COLLECTION METRICS

For each metric, targets were established upfront and progress against these targets was tracked.

Category	Metrics
Implementation	Number of total students with unique IDs assigned
	Number of times devices are able to sync with local server for data upload and download
	Number of PAL periods conducted
Usage	Total usage (by all students, in hours)
	Number of students logged in
	% software uptime
	% hardware uptime
FMS	Number of FMS staff hired for all schools

For further information on the EoI for the PAL software vendor and RFP for System Integrator, please reach out to Central Square Foundation at info@centralsquarefoundation.org.

