MATENEK -TEACHER PROFESSIONAL DEVELOPMENT

Final Report

Friday, November 22, 2019













Executive Summary	3
Results and policy lessons	3
1. Introduction	4
1.1 Document purpose	4
1.2 Activity background	4
The importance of 'effective teachers'	4
Bilateral education reforms	5
Shifting to job-embedded professional development	5
13 Matenek program design overview	6
2 The Metersky rilet	0
	ō
2. I Program design	8 ہ
2. Product development research	9
3. Rapid prototyping and user-testing	9
4. Identifying appropriate professional learning and development content	10
2.2 Program Implementation	11
Ensuring fidelity of implementation	11
Advantages and disadvantages Challenges	12
	15
3. Monitoring, evaluation and learning	14
3.1 Methodology	14
Difference-in-differences	16
3.2 Pilot population and sample	
7 7 Data collection methods	10 17
Teachers	
School leaders	17
MoEYS staff	18
4. Findings	19
Outcome 1: More teachers are knowledgeable about content and pedagogy, which results in a chan	ige in
their classroom practice	19
Outcome 1.1 Preparation for class	19
Outcome 1.2 On-pace delivery of lessons and subjects	24
Outcome 1.4 Content and pedagogy skills	25
Outcome 1.5 Attitudes and behaviours	28
Outcome 2: More school leaders are able to understand teachers' needs and provide better suppor	t29
Outcome 2.1 Understanding of needs and support	29
Outcome 3: More MoEYS staff understand, value, and use Matenek and other ICTs	30
Outcome 3.1 MoEYS understand and value using ICTs and Matenek to achieve education outcomes	30
Outcome 3.2 MoEYS use of ICIs and Matenek to achieve education outcomes	52 77
Outcome 5.5 Mol 15 feet confident using ichs and Materiek to achieve education outcomes	
5. Cost effectiveness	34
Value for Money	30
6. Pathways to scale	39
Model 1: Grade One expansion plus 'over-the-top'	39
Model 3: Eskola integration & Grade 1 Expansion	40 40
Potential barriers to scaling	40
Beyond 2020 & Exit Strategy	41
7. Conclusion	42
8 Appendices	47
a uhananaa	-TJ

Executive Summary

Matenek is a digital learning platform and program designed to improve student outcomes by improving teacher abilities. When teachers learn more, their students do too. Matenek is a first-of-its-kind program and web platform for Timor-Leste, built through a successful collaboration with the Ministry of Education, Youth and Sport (MoEYS). It is aligned with the National Teaching Curriculum and Australian Embassy goals. Matenek was designed specifically for teachers with low digital literacy and limited access to reliable internet.

Matenek's design and launch happened against the background of a profound national education reform. This reform is rolling out a new child-centred primary education curriculum and changing the language of instruction. Matenek aims to support the MoEYS' effort to implement this reform, especially the curriculum roll-out.

The Matenek design took place from April 2018 to February 2019. Implementation of the pilot program, involving 14 teachers across 14 schools and over 500 students, is running from March – December 2019.

Results and policy lessons

Impact on education: Teachers used the Matenek program to prepare for class for 45 minutes each day, more than double the amount of preparation time pre-pilot. In addition to usage, initial research suggests that this converted into tangible and observable changes in their classroom behaviour, improving teacher effectiveness and enabling them to implement the national curriculum with greater fidelity. The additional preparation time enabled Matenek teachers to teach more effectively compared to teachers in the control group (second grade teachers not in the program) improving their readiness to teach, student readiness, and preparation of didactic materials.

Matenek teachers also taught their lessons more on pace and with more fidelity and implemented more classroom practices and strategies compared to control teachers. This was especially true in the area of responding to student questions, praising both male and female students, and putting student work up on the wall. There was also a reduction in all teachers' use of verbal and physical violence.

The research also showed the success of the pilot's impact on school leaders and MoEYS staff. School leaders reported Matenek teachers were more prepared for class, and school leaders were better able to see their teaching progress as it was clearly and visually tracked in Matenek.

Cost effectiveness: Based on our estimates, Matenek affords the MoEYS a cost effective, efficient, and impactful delivery mechanism for teacher training. These benefits are also seen across distribution and updates to curricular materials and teacher support, when compared to more traditional models. By using Matenek, the MoEYS can save money on training and distribution of materials, as well as save time by making it easier for school leaders to support teachers and track their teaching progress.

Recommendations: Catalpa suggests the MoEYS and DFAT work in close partnership to take immediate steps to scale Matenek to more grades, more teachers, or both. This plan for scale should be both financially viable and strategic. Integrating with Eskola should be a path further explored in the future.

1. Introduction

1.1 Document purpose

This report provides an overview of the Matenek program, outlining the inception, design and implementation processes. It presents key implementation findings from the program's pilot, analysing its impacts from the perspective of teachers, school leaders and the broader MoEYS (specifically those departments engaged in the design and implementation of the program). It also provides a set of recommendations and next steps, followed by appendices.

The Matenek program is a partnership between the MoEYS, the Australian Department of Foreign Affairs and Trade (DFAT) and Catalpa International.

1.2 Activity background

The importance of 'effective teachers'

While the importance of good teachers may be obvious, over the past decade education research has begun to quantify the relationship between teacher quality and student outcomes. Research has shown that effective teachers have a substantial impact on increasing student learning outcomes.¹

The effect has been measured in Indonesia, in a study that demonstrated that for every 0.29 units of improvement in a teacher's knowledge, his or her students' performance will improve by one unit – a threefold return.² Moving from a low-performing teacher to a high-performing teacher increases student learning dramatically. Research also demonstrates that investing in teachers is more effective than simply decreasing the teacher-student ratio.³ And ultimately, effective teachers have a substantial impact on the long-term well-being of students, affecting not only their academic achievement and how far they will study, but their income once they enter the labour market.

"Effective teachers are teachers who combine deep content knowledge, high-quality practices, creativity and empathy to improve student learning today and in their lifelong learning trajectory."

Understanding the crucial role of the teacher is particularly pertinent to the Timor-Leste context. Following independence in 1999, the nature of schools and the function of teachers changed significantly with the departure of Indonesian school teachers, who made up the majority of the workforce. When schools were reopened, most replacement teachers were unqualified.

Research conducted in 2016 found that only about 60% of permanently employed primary teachers held a recognised bachelor level qualification, while many contract/volunteer teachers had only completed secondary school.⁴

¹ Evans, David K. and Yuan, Fei. "The Working Conditions of Teachers in Low and Middle-income Countries". *World Bank Background Paper*. 2018. Buhl-Wiggers, Kerwin, Jason T., Smith, Jeffrey A., and Thornton, Rebecca. "The Impact of Teacher Effectiveness on Student Learning in South Africa" *Working Paper*, 2017. Bau, Natalie, and Das, Jishnu. "Teacher Value-Added in a Low-income Country" *American Economic Journal*, [forthcoming].

² ibid

³ Ree, Joppe De. "How Much Teachers Know and How Much It Matters in Class: Analyzing Three Rounds of Subject-Specific Test Score Data of Indonesian Students and Teachers" *World Bank Policy Research Working Papers*, 2016.

⁴ DFAT Timor-Leste Sector Overview 2019

Understandably, student learning outcomes remained low — in a 2009 Early Grade Reading Assessment of students' reading ability, the Government of Timor-Leste found that 70% of Grade 1 students were not able to read a single word of the national language of Tetun⁵. The 2011 Early Grade Mathematics Assessment found that only one-third of students in Grade 1 were able to solve simple additions⁶.

Bilateral education reforms

To address this and other learning challenges, the MoEYS developed a new curriculum for preschool and Grades 1 to 6. It features scripted lesson plans in an effort to support teachers to improve student learning outcomes — an approach that has delivered good results in similar contexts.

The new curriculum incorporated a renewed focus on the importance of teacher training and was delivered to schools in the form of thick printed volumes of approximately 600-700 pages (the full curriculum for a single grade for one year consists of three such volumes). It combined lesson plans, suggested activities, a pedagogical guide, and a school schedule.

Additionally, the importance of having a skilled, qualified workforce is recognised in the MoEYS Timor-Leste National Education Strategic Plan (NESP) 2011-30. The NESP emphasises the improvement of teaching quality, and "Improving Teacher Quality" constitutes one of the Policy's seven Priority Program Areas.

DFAT's education support in Timor-Leste is also focused on improving learning outcomes, specifically literacy and numeracy in the early years, through building school leadership capacity, improved teacher practice and education sector policy and systems. A key focus is to support implementation of the MoEYS' child-centred basic education curriculum and to strengthen teaching practice.⁷

Shifting to job-embedded professional development

While research on teacher professional development broadly remains weak, a growing body of research suggests job-embedded professional development may be successful in changing teachers' classroom practice, pedagogy, and content knowledge.

Job-embedded professional development refers to teacher learning that is "grounded in dayto-day teaching practice and is designed to enhance teachers' content-specific instructional practices with the intent of improving student learning (Darling-Hammond & McLaughlin, 1995; Hirsh, 2009)"⁸. We know that effective teacher training needs to be sustained, targeted, and specific to individual teacher needs, and linked to a specific pedagogical method or tool. ⁹ ¹⁰ However, experience across the globe, from the United States to sub-Saharan Africa, shows that training is often too short, and it is disconnected from the specific requirements of the teacher.

Teacher training programs that were shown to have the largest average impacts (or effect sizes) were for programs that incorporate instructional materials (0.08), computers or instructional technology (0.15), and teacher training (0.12)¹¹.

⁵ ibid

⁶ ibid

⁷ The Government of Australia Aid Investment Plan 2015/16 to 2018/19, which focuses on supporting the Government of Timor-Leste to provide quality basic education.

⁸ Croft et al. "Job-Embedded Professional Development: What It Is, Who Is Responsible, and How to Get It Done Well" Issue Brief, 2010.

 ⁹ "Learning to Realize Education's Promise" A World Bank Development report, 2018.
 ¹⁰ Evans, David K. And Popova, Anna. "What Really Works to Improve Learning in Developing Countries? An Analysis of Divergent Findings in Systematic Reviews" World Bank Policy Research Working Paper 7203, 2015.

¹¹ McEwan, Patrick J. "Improving Learning in Primary Schools of Developing Countries: A Meta-Analysis of Randomized Experiments" *Review of Educational Research*, 2015.

Leveraging digital technologies

Global research advocating the use of smartphones as a tool for teacher development continues to increase. In 2017 UNESCO published a major study conducted in four countries, outlining how teacher development is enabled by mobile technology — by improving the reach, scalability and flexibility of teacher professional development¹².

In Timor-Leste in January 2019, it was estimated that 42% of the country accesses the internet on a regular basis. This was a 37% increase over the year prior. If this rate of growth continues, it is anticipated that 80% of the country will have access by 2021, making mobile an impressive future channel for delivering professional development and e-learning content.

The MoEYS also recognises the importance of incorporating information and communications technology (ICT) to achieve its education system reforms, at both the school and Ministry level. An overall goal of the NESP is "to fully develop and install the ICT infrastructure and technical support needed to implement and sustain modern pedagogy and effective education management and planning." In addition to its alignment with the ICT priorities of the NESP, technology enables curricular changes to be swiftly and cheaply disseminated from the MoEYS to participating teachers and schools.

Matenek seeks to incorporate into its program design the above listed approaches of a focus on teachers, aligning to bilateral education reforms, shifting to job-embedded professional development, and leveraging digital technologies.

1.3 Matenek program design overview

Matenek is a one and a half year education project, being piloted as a teacher learning tool in fourteen primary schools across two municipalities of Timor-Leste.

It was designed to support the Timor-Leste government's commitment to improve student learning outcomes and strengthen the implementation of the country's new curriculum for basic education.

Headline goal:

"To increase teachers' effectiveness by improving their knowledge and practice"

The headline goal of the Matenek program is to improve student outcomes by improving teachers' classroom practice, increasing access to lesson plans, enhancing preparation, pedagogical skills, classroom management techniques, and confidence.

The goal is consistent with those identified in the NESP, and the two main long-term priorities established in the National Education Policy 2007-12, those being to 'improve the quality of education' and to 'reform teacher training policy and career progression'.

The program's headline goal is underpinned by the following key intermediate outcomes:

- 1. More teachers are knowledgeable about content and pedagogy which results in a change in their classroom practice
- 2. More school leaders are able to understand teachers' needs and provide better support
- 3. More MoEYS staff understand, value, and use Matenek and other ICTs.

¹² Miao et al. referenced in "Technology-supported professional development for teachers: lessons from developing countries" Tony McAleavy, Alex Hall-Chen, Sarah Horrocks, Anna Riggall, 2018.

Matenek uses mobile technology to increase teachers' access to lesson plans, curricular resources, and micro-learning professional development content over their smartphones. By using Matenek, teachers are supported to prepare for class whether through instructions on how to make materials or by learning related content.

Matenek embeds professional development content inside lesson plans from the national curriculum. Teachers receive notifications, mark progress of completed lessons, and access micro-learning content to help them learn difficult topics. The professional development (micro-learning) content consists of short, locally made videos in order to build teachers' capabilities, and digital flashcards that support the development of new skills and understanding of concepts. Field research, interviews, surveys and data collected through Matenek ensure the project meets teachers' and government needs.



Image 1: Photos from the Matenek pilot

2. The Matenek pilot

2.1 Program design

While Catalpa has previously partnered with the MoEYS in Timor-Leste, Matenek marks the first collaboration on design and direction of a project from the outset. The project concept was presented to the MoEYS in March 2017, who were immediately supportive and aware that collaboration was the best way to achieve project aims. The Matenek project team worked closely with four departments within MoEYS, those being IT, Curriculum, Basic Education and Media Education.

The program design relied on observation, in-context interviews, qualitative research and quantitative analysis. Integral to all Catalpa programs is the belief that projects should be designed with, not for the people that need it most. In the education context, "teacher 'buy-in' is a key determinant of the success of professional development interventions"¹³. To determine the scope and requirements of Matenek, the team focused on the following four areas.

1. Formative research

The project team consulted extensively with teachers and school leaders. These activities were crucial in determining the factors affecting implementation of the new curricula as well as broader factors related to teachers' methods, abilities and effectiveness.

The program team alongside MoEYS representatives visited four schools across Dili and Liquiçá, two municipalities in Timor-Leste. Thirteen teachers were observed teaching over 20 lessons, and two school leaders participated in interviews.

Key findings from these formative research visits, listed below, were used to inform the next phase of research:

- Teachers are using the national curriculum but they're not implementing lessons with fidelity
- Teachers have time to prepare but often forget to plan ahead for class, or don't bring the lesson plan book home given its size and weight: this significantly reduced lesson planning and preparation time as teachers would consult their guides only at the time of class
- Even though all teachers were using the national curriculum, their implementation looks different in different classrooms based on: access to materials, teaching methods, classroom management techniques, and condition of classrooms/school facilities (poorly maintained, overcrowded, insufficiently furnished, and other factors including reliable water access)
- Teachers lack pedagogy and content knowledge.

The visits also assessed teachers' overall digital literacy and their self-efficacy, and found that they lacked digital literacy skills. For example, many had used Facebook but only passively, meaning they would read Facebook content but not post content themselves.

¹⁵ McAleavy, Tony, Hall-Chen, Alex, Horrocks, Sarah, and Riggall, Anna. "Technology-Supported Professional Development For Teachers: Lessons From Developing Countries" *Education Development Trust Report*, 2018.

Matenek - Final Report - Catalpa International Ltd

2. Product development research

In May 2018 the program team conducted three design workshops, 27 classroom observations, and three interviews using a unique 'photo journal' method at three schools in Dili. This combination of research methods enabled a better understanding of how teachers might use technology for their own improvement. Findings also revealed insights around:

- Motivation: Teachers see their career as a calling and a duty to improve the future of the nation
- Time: A range of responsibilities outside of school dictate when teachers can engage in learning and preparing for lessons
- Support: Teachers want more support to understand subject matter content and manage their classrooms
- Feedback: Teachers want to know what they're doing well and where they need to improve.

Designing with teachers



Image 2: Photos of teachers participating in the design process

3. Rapid prototyping and user-testing

A prototype was built and refined following feedback sessions with teachers and the MoEYS staff. In July 2018, Catalpa and MoEYS staff ran usability testing interviews with 14 teachers from nine schools across Dili and Liquiçá. From this, a basic functioning app known as a "minimally viable product" (MVP) was created. The MVP included the basic app elements while providing a solid technical base upon which to build more features.

Two rounds of MVP testing were held in November and December 2018 to develop a fully functioning app that included the following core features:

Feature	Benefit
Login and onboarding	Teachers can log in with a unique username and password, and onboarding cards are used to help teachers understand the purpose of Matenek and core functionalities during first login
Discipline list	Shows all the different subjects on tiles with images that are easy for teachers to navigate
Lesson list	Includes all of the lessons for any given subject across the three school calendar periods per year
Lesson plans with embedded micro- learning content	These mimic the content in the MoEYS lesson plan books, making it easy for teachers to navigate the print and digital media but also include videos and flashcards to support teacher professional development
Profile	Teachers can see their learning progress and activities record
Notifications	Teachers receive notifications prior to upcoming difficult lessons, and reminders when they have not been active or have not clicked "done teaching" in three days

4. Identifying appropriate professional learning and development content

The national curriculum is very detailed, providing teachers with complete lesson plans. However, given teachers' lack of pedagogical and content knowledge, and basic reading comprehension, we found many teachers struggled to understand different concepts in the curriculum without additional support.

To identify lessons that would require supplementary teacher support content, the project team reviewed and rated the difficulty of Grade 1 Mathematics and Tetun Literacy lesson plans. Based on this rating, almost one Mathematics and Tetun Literacy lesson per week had supplemental flashcard or video content created for it.

Content ideas were drafted by the Catalpa team then presented for feedback to the Curriculum department, and the Basic Education department conducted a final review. The Media Education department was involved for all video-based content. This co-development process ensured that the MoEYS made active decisions about content, standards, and quality.

Catalpa also partnered with CARE and UNICEF to modify their learning content for delivery via Matenek. Content was adapted from CARE's *Lafaek* education magazine, and from UNICEF resources around child-friendly practices.

At each stage of development, and particularly before project pilot, Matenek was carefully translated into Tetun to ensure not only the content but all the buttons and features made sense.

2.2 Program Implementation

The pilot program, involving 14 teachers across 14 schools, is scheduled to run for nine months. The pilot was launched in March 2019 by the Minister of Education Dulce de Jesus Soares. Participating teachers were issued smartphones or tablets with credit and data pre-loaded. They then received four hours of training that covered how to use the phones, an overview of the Matenek application, and an explanation of the aims of the Matenek pilot. Training was carefully designed to make teachers comfortable and began with a growth mindset activity to increase their confidence. Teachers were guided through the training manual in small groups, with a training lead and support person in each group. Most teachers had never used a smartphone and required significant support during this initial session.

Ensuring fidelity of implementation

To improve fidelity of implementation, we focused on teachers' sense of efficacy through training and support. Throughout the pilot teachers could proactively message or call the project team during business hours via a dedicated phone line. If their problem was not easily solved by phone, project team members would visit the teacher at their school site and provide in-person assistance.

In addition to these 'by-request' support visits, using a design-based implementation research (DBIR) approach we proactively identified teachers who were having difficulties in using Matenek by asking structured questions and reviewing Google analytics data. We gave priority to teachers who were identified as struggling when scheduling visits. On these visits Catalpa and MoEYS staff would ask questions about their app use and any challenges they faced, and have them show the different features they were supposed to be using. If the teacher was unable to demonstrate the use of a feature, they were given additional on-the-spot training. Each teacher was visited at least three times throughout the pilot for this additional monitoring and support.

Image 3: Screenshots of the Matenek mobile application



Incentivising learning by making it fun, simple and rewarding



Images above illustrate the various features of the Matenek mobile application

Advantages and disadvantages

Matenek is a technology-based program, enabling different kinds of content delivery and teacher training. Below is a detailed comparison of Matenek with traditional curriculum and training methods, highlighting both advantages and disadvantages of this technology-centric approach.

Feature	Matenek	Traditional curriculum & training
Teacher training	Job-embedded professional development and micro- learning content means teachers are learning close to the time when they need to use that knowledge in the classroom, making it more likely that they use and apply what they learn	Teacher training delivered in-person requires travel time and leave time. Also, what teachers learn might not be immediately useful in their classroom, increasing the risk of forgetting what they learned by the time they need to apply it.
Technology	Increased use of ICTs aligns with NESP and MoEYS priorities	Continues with print medium
Access	Portable, easy to access, designed for low digital literacy and limited access to reliable internet	Teachers shown to keep lesson plans at school due to size and weight of volumes, resulting in minimal class preparation time
Delivery of content	Requires internet pulsa or data	Requires printing and delivery
Notifications/ reminders	Can send reminders to teachers anytime, anywhere to encourage preparation	Requires time from school leader and can only take place during the school day
Curriculum reform	Efficient delivery mechanism for distribution and updates to curricular materials	Curriculum manually delivered, in person, to all schools across Timor-Leste, printed curricular time- consuming and expensive to update

Table 2. Comparison of Matenek with traditional curriculum and training

Challenges

Challenges throughout the project centered on the changeover in Timor-Leste national government, technical hurdles, and balancing outcomes against capacity development.

Government changeover

In April 2018, during the inception phase of Matenek, the Government of Timor-Leste failed to form a governing coalition, which resulted in a new round of national elections. In June 2018, the new MoEYS Minister and Vice Minister were sworn into office. The change in leadership resulted in difficulties accessing both of these key decision-makers for the approval of the Matenek pilot, as they were engaged in taking up their new roles. This pushed back the pilot window by a few months, as a formal letter of approval from MoEYS did not arrive until 14 February 2019.

Catalpa moved quickly after approval to complete baseline research and subsequently launched the pilot on 2 March, training teachers across 14 schools – a huge achievement given the timeframe. However, the delays reduced the anticipated project pilot period. Because of these delays, Catalpa was granted a 6-month no-cost extension and a subsequent costed extension from DFAT Post so teachers could finish the full school year with the support of Matenek, and implement the program for six months before endline data was collected (a long enough period for rigorous evaluation).

Technical difficulties

Despite being assured of the availability of original, machine-readable copies of the curriculum, only PDF copies could be supplied by MoEYS. This resulted in data being entered manually into the Matenek platform, a two-month long process completed by two additional temporary staff hired for this specific task.

During training teachers signed a user agreement outlining what content is appropriate to access on their phones, which especially focused on our child protection policy. There was no evidence that the child protection policy was broken, however, one teacher was issued a written warning from the MoEYS after it was determined they had accessed inappropriate content on their device. The decision was then made to 'lock down' phones, making it more difficult for participants to access inappropriate content.

Despite original software that allowed images and other content to be stored in Matenek, connectivity was such that Matenek was quickly overwhelmed by the amount of synced content and new code had to be written to protect from future overloading. With this switch, we further developed a better mechanism for updating the app.

Connectivity issues also arose from weather and geographical location. For example, the main telecom provider engaged for the pilot did not have connectivity at one school that was in the shadow of a mountain, which resulted in one teacher having to swap providers.

Balancing outcomes and capacity development

While the main focus of Matenek was to deliver development outcomes, primarily improving teaching and learning, the program also sought to build the capacity of the MoEYS to value, understand, and use ICTs for education. Matenek was successful in bringing along the MoEYS staff to participate in a range of program activities including all phases of research, training on how to upload and edit content and add users to the system, and support during evaluation including completing classroom observations and taking notes during interviews. The MoEYS participation in these activities resulted in improvements further detailed in the results section of this report.

While there were observable improvements, the MoEYS staff would need additional training and support to lead the strategic design of new technologies, develop new digital content, and evaluate program outcomes.

3. Monitoring, evaluation and learning

The monitoring, evaluation and learning (MEL) framework was developed to understand how the Matenek program might impact teachers, school leaders, and MoEYS staff, and to also evaluate the quality of its implementation.

The framework prioritised the analysis of both qualitative and quantitative data through surveys, interviews, classroom observations and in-platform utilisation data, collected over the duration of the pilot. Analysis of this data forms the basis of this report's findings.

The MEL was also reviewed by other education specialists in Timor-Leste, including staff from the HANDS¹⁴ program, Care International, and an educational lecturer at the University of Technology Sydney. The evaluation process was also independently observed by the MoEYS and the Partnership for Human Development program.

3.1 Methodology

The Matenek program implemented a DBIR methodology¹⁵. DBIR focuses on real-world problems of practice, uses a co-design approach, and employs repeated cycles of data collection and analysis in order to support iterative improvement of the intervention, collaborative learning by all stakeholders, and the creation of a reliable evidence base for evaluating impact over time.

DBIR was developed in response to the limitations of more traditional models of education research and evaluation, which have tended to focus on assessing fidelity to pre-designed solutions and typically involve long timeframes between data collection and feedback to users. This becomes especially problematic when research outcomes are not available in time to support budgeting and strategic planning. Many education pilots don't focus on this continuous improvement methodology, and many projects fail because teachers are not able to implement¹⁶ the intervention with fidelity¹⁷.

We employed a mixed-method approach, which included a quasi-experimental design to measure the impact of the program by comparing a 'treatment' to a 'control group'. Using this methodology, we examined the effects on two different groups:

- Treatment Year 1 teachers in the program
- **Control** Year 2 teachers who were not in the program but in the same school as Year 1 teachers

Alongside these groups, we examined:

- **Treatment** MoEYS staff working with Catalpa on the program
- Control MoEYS staff not working with Catalpa on the program

For Matenek the treatment included training for participating teachers and their school leaders on how to use a smartphone or tablet, the basic functions of Matenek, and periodic support.

The treatment for MoEYS staff included close collaboration on design, monitoring, content development, and research.

Matenek - Final Report - Catalpa International Ltd

¹⁴ Halimar, Aprende, no Deskobre Susesu, A program in Timor-Leste growing quality preschool education through capacity building, infrastructure, school management, and professional development

¹⁵ Design-Based Implementation Research is an approach to organising research and development intended to address the challenges in designing effective, scalable, and sustainable policies and programs in education. http://learndbir.org/

¹⁶ "Learning to Realize Education's Promise" A World Bank Development report, 2018.

¹⁷ MDRC webpage. "What is Implementation Research?" https://www.mdrc.org/what-implementation-research

Table 3: Matenek MEL Framework

Activity	Outputs	Impact Indica	itors

Activity (what did the program do?)	Outputs (what was the outcome?)	Impact Indicators (how was the outcome measured?)
Providing digital access to lesson plans	 Teachers are more likely to access lesson plans to prepare for class Teachers are more likely to be on or near expected pace of teaching 	 Matenek usage (in-platform data) Perceptions of access & self-efficacy (survey, interview) Self-report of use (survey, interview)
Providing digital access to supplemental materials	• Teachers are more likely to teach the lesson plan with fidelity	 Matenek usage (in-platform data) Perceptions of access (survey, interview) Self-report of use (survey, interview)
Publishing videos & flashcard resources	• Teachers are better skilled in both content and pedagogical knowledge and can use these skills in the classroom	 Self-efficacy, attitudes & beliefs (survey) Matenek usage (in-platform data) Content knowledge (survey) Pedagogical knowledge (survey) Time on task (observation)
Creating culturally responsive motivational content	 Teachers understand the importance of their role as a teacher Teachers feel understood and valued 	 Usage (in-platform data) Teacher on-time arrival (observation, survey) Attitudes & beliefs about teaching (survey, interview)
School leaders engaged in training and monitoring	• School leaders can better understand teacher progress and provide better support	 Leaders' sense of teacher efficacy (interview) Leaders' net promoter score (interview)
MoEYS staff and leadership participate in the design and development of Matenek	 MoEYS staff and leadership value the process and outcome of design and receive regular updates about progress MoEYS staff understand the value of using technology to support teacher training MoEYS gain confidence using ICTs MoEYS value partnering with local & international NGOs 	• Attitudes, beliefs, & self- efficacy about design, technology, & collaborations (survey, interview)

Difference-in-differences

The program further applied an evaluation technique called 'difference-in-differences'. Difference-in-differences is one of the most widely applied methods for estimating the causal effects of programs, when the program was not implemented as a randomised control trial.

Simple comparisons between pre- and post-tests ignore existing trends. Difference-indifference analysis is a way of examining how a participating group (treatment) performs in comparison to a control group, acknowledging trends. The goal is to identify whether the treatment group has increased by a higher number of points than the control group.

Whilst the research methodology was rigorous, the size of the intervention (14 schools and 12 MoEYS staff) was not large enough to produce a 'statistically significant' result. As such, the program team collected qualitative and implementation data to provide a greater depth of information to assess the impact of the program.

3.2 Pilot population and sample

Teachers and school leaders

The MoEYS selected 14 schools (see Appendix 1) to participate in the Matenek pilot program. Schools were selected based on their enrolment in the ALMA program¹⁸ and their geographic cluster (or area).

For example, if the Basic Central School (Ensino Básico Central, EBC) was chosen, at least two Basic Filial Schools (Ensino Básico Filiál, EBF) in the same cluster were included. The only criteria imposed by Catalpa was the schools had to be within a one and a half hour drive of Dili. This constraint would allow the program team to provide ongoing monitoring and support. Therefore, all pilot schools were located in either Dili or Liquiça municipalities.

A total of 28 teachers were part of the research, 18 females and 10 males with 14 of the cohort aged 46 or over, five in the 36-45 age bracket and nine in the 26-35 age group. According to the 2012 School Survey, "61 percent of Timor-Leste's Basic School/Primary school teachers are male with a median age of 41.17"¹⁹ showing our sample is more female and slightly older.



Figure 1: Grade 1 (treatment) and Grade 2 (control) age breakdown (source: teacher survey)

Matenek - Final Report - Catalpa International Ltd

¹⁸ The Professional Learning and Mentoring Program/ Apoiu Lideransa Liu Hosi Mentoria no Aprendizajen (ALMA) program, launched in 2016. Using technology, ALMA strengthens and lowers the cost of school management in Timor-Leste.

¹⁹ "Build Evidence, Shaping Policy: Findings of the 2012 Timor-Leste Education Survey" World Bank Report, 2013.

The team also engaged with two municipal directors from Dili and Liquiça and three EBC directors from EBC 1.2.3 Cassait, EBC 1.2.3 Manleuana, and EBC.1.2.3 Hera. Eleven school coordinators were frequently engaged across eleven EBFs.

MoEYS staff

The Matenek project team worked closely with four departments within MoEYS, those being;

- 1. Department of Information and Technology
- 2. Department of Curriculum for Preschool Education, Basic Education, and Recurrent Education
- 3. Department of Strengthening for Access and Quality of Basic Education
- 4. Department of Radio and Television.

At least six MoEYS staff and six MoEYS senior leaders from these departments were involved closely in the program.

3.3 Data collection methods

Teachers

Baseline data was collected in the two weeks prior to the program launch and training of Matenek, in February and March 2019. Endline data was collected before the October school break, over September and October 2019.

Staff from Catalpa and MoEYS visited schools to collect survey data, and conduct classroom observations and interviews. During this process the Partnership for Human Development also took part in one day of data collection activities. Teacher and MoEYS surveys can be found in Appendix 2 and 3 respectively.

A classroom observation protocol was developed to test the fidelity with which teachers were implementing the national curriculum. Before visiting a classroom, Catalpa staff would confirm what lesson the teacher intended to teach. This enabled the observers to compare how the lesson was written with how the teacher implemented it. The full observation protocol can be found in Appendix 4.

Interviews were conducted with a total of 14 teachers (six male, eight female) over a two and a half week period. The interviews took place in the schools and followed structured protocols. Interviews sought understanding around how:

- 1. teachers used Matenek to improve their classroom preparation and practice
- 2. Matenek impacted teacher's attitudes and behaviours
- 3. the frequency with which teachers used Matenek.

The interview protocol is available in Appendix 5.

School leaders

The program team interviewed school leaders to gain a deeper understanding about how leaders assessed Matenek's impact on their teachers and on their work.

Interviews were conducted with a total of 14 school leaders (ten male, four female) over a two and a half week period at the end of the pilot. The interviews took place in the schools and followed structured protocols. The interview protocol is available in Appendix 6.

MoEYS staff

Representatives from the MoEYS were surveyed in order to understand their:

- 1. use of technology at home and at work
- 2. confidence with different technologies
- 3. understanding and application of how to utilise a human-centered design process
- 4. attitudes towards the potential for education technologies in MoEYS and the broader education system.

With MoEYS survey participants, baseline surveys were conducted in June 2018. The same survey was repeated again in September 2019 with changes in responses recorded. At total of 18 employees were surveyed during baseline and 14 of those completed surveys at endline. Four of those surveyed worked closely with the Catalpa team on the Matenek pilot. For MoEYS staff, the initial survey responses were at the higher end of the question scale, leaving little room to show a significant change at endline.

We also interviewed MoEYS senior leadership to understand how the program impacted their understanding of education technologies and understand its utility within an education system. MoEYS interview protocol can be found at Appendix 7.

Interviews with six senior leaders took place in September 2019 and followed structured protocols, and focused on their views around:

- the purpose of Matenek and their involvement in the pilot
- its impact on teachers, the MoEYS and themselves
- what was done well, and what wasn't
- continuing or growing Matenek.

4. Findings

The following sections provide details of findings related to the program's intermediate outcomes, through the aggregation of data from surveys, interviews, and application utilisation statistics.

Outcome 1: More teachers are knowledgeable about content and pedagogy, which results in a change in their classroom practice.

The MEL framework identified indicators to measure an increase in teachers' preparation, lesson pacing, content and pedagogical knowledge, and their ability to teach the national curriculum with fidelity. It also examines their self-efficacy, attitudes, and beliefs. The data collected to understand changes in these indicators included surveys, classroom observations, and interviews.

Outcome 1.1 Preparation for class

Time spent preparing for class

Teachers were asked how many hours a week they spent preparing for class. The results showed that Grade 1 teachers participating in the pilot reported an increase in score, meaning they reported spending much more time on lesson planning per week.

All teachers interviewed indicated they regularly access Matenek at least once a day, with one teacher accessing it twice a day, to read their lesson plans and familiarise themselves with their immediate tasks. This self-reported survey result is backed up by usage data from the Matenek platform that shows a similar increase in preparation time.

Figure 2: Lesson Preparation (source: teacher survey)





Figure 3: Application utilisation statistics (source: Google Analytics)

Table 4. Average daily minutes, per month, per user (source: Google Analytics)

Month	Days in the Month for preparing (excluding Sunday & holidays)	Daily average usage (minutes)
April	6	39.01
Мау	26	45.41
June	22	52.13
July	27	40.90
August	15	30.26
September	25	53.05
October	9	58.54
TOTAL AVG		45.61

All teachers reported that Matenek had positively influenced their lesson preparation and their classroom practice. All teachers said Matenek stimulates them to prepare for lessons:

"(Matenek) Stimulates me to prepare more in terms of preparation time when compared with printed book."

Most teachers also indicated the notifications help them to be more efficient and effective:

"Notification helps a lot because it reminds us to prepare before teaching."

Although four teachers indicated they weren't receiving notifications.²⁰

Teachers highlighted Matenek's accessibility, and were appreciative of the ease in accessing lesson plans as compared with the printed lesson plan books. Respondents stated that the printed lesson plan books are heavy and sometimes missing pages or replaced by previous users with pages (lessons) in the wrong order. One teacher expressed pleasure at the easy access by explaining:

"When I am at the farm, I can access Matenek when I rest under the tree."

Teacher readiness

Teacher readiness was measured through a question rated on a three point scale. From classroom observations, the teacher readiness measure showed treatment teachers improved their readiness at the start of a lesson over the pilot period much more than the control group.



Figure 4: Teacher readiness (source: classroom observation)

²⁰ Further investigation into notifications issues will determine if the notifications were not being received due to user error or a bug in Matenek.

Student readiness

The student readiness measure asked; "At the time the lesson must start what is happening with the students?" Results showed that while the treatment teacher group began at a lower baseline than Grade 2, Grade 1 saw an increase in score while the control group remained constant.



Figure 5: Student readiness (source: classroom observation)

Teachers didactic materials were properly prepared

The classroom observations also had observers check if didactic materials were properly prepared and in place on group tables or teachers' tables. The treatment teacher classes showed a modest increase and the control group decreased in score.

Figure 6: Didactic materials prepared (source: classroom observation)



Student learning materials were properly prepared

The next observation metric looked at whether student learning materials were properly prepared and on the students' tables. In this category there is a substantial increase in the mean score for the Grade 1 treatment group, where the Grade 2 (control) group saw a very slight increase.



Figure 7: Student materials prepared (source: classroom observation)

Utilisation of lesson plan book

In surveys, teachers were asked, "When was the last time you reviewed the lesson plan book to prepare for teaching?" As hoped, Matenek teachers experienced a decrease, however, Grade 2 control teachers also experienced a decrease.

Figure 8: Utilisation of lesson plan book & other support (source: teacher survey)



Refreshed knowledge on a subject area

Teachers were also asked, "When was the last time you refreshed your knowledge on a subject area?" This question sees a minor increase in scores for both cohorts. As both cohorts were already coming from a low score, it shows this was not an activity conducted frequently, that is, more than once a week.

Small positive differences were also seen for questions related to asking colleagues for help and asking school leaders for help, in both the pilot and cohort group.

Outcome 1.2 On-pace delivery of lessons and subjects

Within the classroom observation protocol, observers compared the teacher's pace with the indicative time in the lesson plan. Timekeeping observations showed that treatment teachers increased at all stages of the lesson except the third stage. Meanwhile the control teachers maintained a consistent score or deteriorated. As might be expected, punctuality scores for both groups declined as the lesson progressed, which may be an indication that there is too much content within the lesson and teachers cut short the third activity in order to reach the conclusion.



Figure 9: Class pace (source: classroom observation)

While observers were invited to comment on a total of six possible activities in any one lesson plan, very few classes offered this many. In order to create the most useful comparisons, the introduction, activities 2 and 3, and the conclusion were considered.

From the teacher interviews we learned that teachers considered the "Done Teaching"21 function on the Matenek application very helpful to keep track of already taught lesson plans, to report to their supervisors, and provide a sense of where they are in the curricular progression.

²¹ 'Done Teaching' allows a teacher to mark progress, and identify lessons plans that have been taught.

Outcome 1.3 Fidelity of lesson implementation

Within this outcome, the program team was observing the quality of a teacher's implementation of the lesson plan. To create the most useful comparisons between the treatment and control teachers, four components of the lesson were examined and compared - the introduction, two activities and conclusion. The treatment group saw a significant increase in scores in fidelity of lesson implementation, especially in the introduction and conclusion phase of the lesson.



Figure 10: Fidelity of lesson content delivery (source: classroom observation)

As identified previously within Outcome 1.2 'On-pace delivery of lessons and subjects', lessons start strong and lose fidelity as they approach the conclusion. In interviews, many teachers explained they did not have enough time to finish the full content of the lesson, which may explain why they may rush and are less likely to deliver content true to lesson plan indications during activity 3.

The control group fell at each stage.

Outcome 1.4 Content and pedagogy skills

Utilisation of professional development content

Through teacher interviews we learned all teachers believe Matenek is bringing them new ways of doing things, whether through learning a new practice or because they have learned new content.

The suggested activities and learning opportunities within the application via short videos and flashcards were helpful to learn new subject content and pedagogy. One teacher stated:

"I learned a difficult concept such as units and decimals through flashcards and video, then later I was able to implement it in the classroom."

All but one teacher said they were able to take the new information they learned in the flashcards and videos and use them in the classroom.

Change in teacher practice

During classroom observations, observers were able to identify strategies a teacher used in the classroom. A clear increase was seen in the treatment group over the control group.

Figure 11: The diagram displays the difference in the number of classes using these strategies (source: classroom observation)



Helping "stuck" students

In the treatment group teachers assisting students who may have been 'stuck' on a concept, increased significantly compared to the control group. Overall, six more classes were observed supporting 'stuck students', over the number observed at baseline.

Utilisation of paired or solo work

There was a slight increase in the number of classes where the teacher utilised paired or solo work.

Checks for student understanding

At baseline, teachers checking for students comprehension was already very high, and we only observed a slight decline at endline. However, observers noted an increase in the amount of time teachers spent with different students during the lessons.

The largest difference observed was in teachers in the treatment group responding to student questions. An additional seven classes used this practice whilst two additional classes used it in the treatment group.

Student praise

The difference in number of incidents by grade and gender was also recorded. The most significant difference was in male praise, which was used in eight additional classes, whist six fewer classes used it in the treatment group. While female praise increased it did so by more in the control group than the pilot; one additional class in treatment compared to seven additional classes in the control.

Incidents of verbal and physical violence

The observers also measured the difference in number of incidents of verbal and physical violence as a percentage of students of that gender. There was a substantial reduction in violent incidents between base and endline observations. Interestingly this occurred almost equally across both the control and the pilot groups. This could be the result of the Matenek content developed in partnership with UNICEF about child-friendly schools, or more broadly, training that teachers have received on this topic and its influence on teacher behavior in the classroom.



Figure 12: The diagram displays the difference in the number incidences by gender (source: classroom observation)

Classroom layout

There was little difference between the two cohorts in regard to classroom layout. This component considered tables (clean and sufficient number), chairs (clean and sufficient number), clean floors and walls, didactic materials on walls, student work on walls, and a student corner with resources. Some features may change with time of year, day or circumstances and are not necessarily indicative of change in teacher behaviour.

The two most significant differences were the decline in the number of classes within the control group with clean floor and walls, and the large increase in the number of classes in the treatment group with student work on the wall.

Teacher confidence

Examining the changes in survey results from baseline to endline, there is a clear pattern that merits further investigation in changes to teacher confidence. At baseline treatment teachers, with one exception, tended to start from a higher level of confidence, however at endline this decreased. Control teachers meanwhile increased in confidence.

One explanation might be that because treatment teachers are older they may have had a certain confidence in their teaching abilities. By participating in the Matenek pilot, they realised some of the areas they had felt confident in now had room for improvement, and they were responding to the challenge.

Outcome 1.5 Attitudes and behaviours

Through surveys, teachers were asked to respond to seven statements relating to their teaching skills such as behaviour management, use of technology, approach to planning and progress monitoring, and access to professional development opportunities. Teachers were also asked whether they agreed with five statements relating to how teachers are valued, teacher absence and a willingness to use new materials and learn new skills.

Value of Matenek

Through interviews we learned that all teachers thought Matenek helped them tackle difficult issues, which they described as a demanding curriculum, and overcrowding in class. There was clearly a degree of pride in the Matenek teachers' cohort, who used words such as *motivation* and mentioned how other teachers look at them and aspire to become a Matenek teacher:

"I would like to recommend Matenek to all the teachers. My colleagues, teachers, also want and really like the app. They want to have access to Matenek too."

Some of them describe how this sense of pride is also reinforced by the inspectors' appreciation of their job.

Teachers were asked a set of questions to determine if they wanted to continue using Matenek next year. All responded positively, citing the ease of access, the notifications, profile and flashcards. One teacher mentioned the sense of security they feel when using Matenek,

"If I lose my books, I already have the books inside the app. If I lose my pen, everything is written inside Matenek."

Teacher motivation and respect

While interview data suggested teachers felt motivated and respected as a Matenek teacher, the survey results showed a small difference. Across the measure 'teachers are valued and rewarded' there was a small decrease in the overall score for both groups. This merits further investigation, as it is possible the participants have been given cause to reflect on the value of their work and see it as higher than previous to the pilot program.

Perspective on teacher absence

We saw a substantial fall in both groups when looking at the change in how teachers see absences — specifically when absence is acceptable. Teachers reported that various reasons for teacher absence was less acceptable at endline, such as leaving to help the community, or if the lesson was finished. This was proportionally higher fall for treatment teachers over the control teachers. This may reflect Matenek imparting a greater sense of responsibility as teachers are more aware of their lesson progress and what they need to accomplish to stay on pace.

Value of new materials

There were modest changes in teachers' attitudes towards the value of new materials, with a slight decrease for both groups on whether new materials helped teachers serve their students better — although this was coming from a high starting point.

Willingness to learn new things

There was a slight increase on willingness to learn new things for treatment teachers compared to control teachers, again coming from an initially high starting point.

Outcome 2: More school leaders are able to understand teachers' needs and provide better support

The MEL framework identified indicators that sought to measure increases in school leaders' understanding of teacher's needs. This understanding may in turn be used to support the teacher and the program more broadly. Interviews were used as the data collection method to understand changes in school leader behaviours.

Outcome 2.1 Understanding of needs and support

School leaders were unanimous in their assessment that Matenek teachers' general preparation and classroom practices have improved by using Matenek. One school leader said:

"It has changed my teacher's performance such as they actively come to school to prepare before teaching."

All school leaders, but one, seem to be well acquainted with the Matenek project. They understand the project's overall goal of supporting teachers by giving them access to curriculum lesson plans, and professional development content. They were also familiar enough with the project and the application to use it for their reporting needs. One school leader was very specific, indicating that:

"I open the 'Notification' to see what the teacher needs to do to prepare for the lesson and see their profile to check their progress."

Many leaders have reportedly used the information available in Matenek profiles - 'done teaching' and the notifications - for their own roles. They report being very supportive of Matenek for the same reasons as teachers:

- Compliance: it helps them to do what they have to do
- Practicality: it is easy to use
- Utility: they see it making their work easier:

"I see [the teacher] is using the smartphone during the classroom observation, and it reduced the need for me to support [the teacher] on their teaching. So, as it helps [teacher], it also helps me as their Coordinator." Many school leaders report how their Matenek teachers are now following the curriculum, as opposed to previous practice. They also noted that teachers are no longer requiring as much support. Considering that school leaders are often overburdened with teaching and administrative roles, this is a very important finding.

Outcome 3: More MoEYS staff understand, value, and use Matenek and other ICTs.

The MEL framework identified indicators that sought to measure an increase in MoEYS staff and senior leaders' understanding, value, and use of Matenek and other ICTs. Data collected to understand changes in these indicators included surveys and interviews.

Outcome 3.1 MoEYS understand and value using ICTs and Matenek to achieve education outcomes

Understanding of Matenek

At the beginning of the Matenek program, MoEYS staff struggled to understand how Matenek was just for teachers. At endline nearly all participants were clear about the purpose of Matenek, with one staff clearly stating:

"Matenek uses technology to modernise teaching and learning and to motivate teachers to learn more and to help their students."

Only one staff member thought there was still a component for students on Matenek.

Engagement in the Matenek program

Interviews showed that MoEYS senior staff were clear about their role in the project through each stage — the initial pilot approval, program design, content creation, review and publishing, implementation support, and evaluation.

Some saw their role in advocacy, such as supporting dialogue with high-level staff and allocating staff time to support monitoring. Some staff reported being highly involved in content review, approval, and publishing learning materials on the content management system.

Impact on teachers

Many staff reported the impact on teachers' increase in digital literacy:

"I met with teachers who are implementing Matenek, they were excited to express they were now participating in the technological era."

Prior to the program, there was concern about older teachers' ability to effectively use the technology, their digital literacy skills and eyesight. Others were concerned about the availability of electricity and access to internet impacting teacher's ability to use Matenek.

Interviewees were clear about Matenek's impact on the MoEYS, with one stating that:

"Matenek helps the MoEYS in implementing the national curriculum and to bring up the educational quality."

Impact on MoEYS

They noted that Matenek makes the distribution of lesson plans faster, easier, and decreases costs for the MoEYS, although one respondent did express fear regarding the potential reduction of staff due to easier curriculum distribution (fewer people would be needed to physically deliver curriculum and materials).

One respondent also highlighted the importance of seeing a change in student learning outcomes to best understand the impact of the program.

Personal impact of Matenek

Interviewees struggled to talk about how the program impacted them personally. MoEYS staff talked more about broad impacts, with most feedback centered on how they might better work with INFORDEPE (Instituto Nacional de Formação de Docentes e Profissionais da Educação/ National Institute for Teacher Training and Education Professionals of Timor-Leste). They thought the current 'train-the-trainer' model implemented by INFORDEPE could be improved by Matenek because it allowed the MoEYS to train teachers more directly.

Program implementation

Respondents were very positive about the program's implementation and noted Catalpa's good communication and collaboration processes, including working with the Minister and Vice Minister. Some staff reported wanting to be more involved in monitoring and other school visits.

Recommendations for improvement centred on video production processes (using trained actors, varying locations, better video and audio equipment). It was also noted that teachers might benefit from clarity around how to request technical help — the example involved a teacher thinking their phone wasn't working but it was a problem with credit (pulsa), and the teacher hadn't reached out for help.

Many interviewees thought the decision to continue to scale Matenek should be based on the final results and opinions of the pilot teachers. MoEYS staff even suggested inviting them to the final meeting to share their experiences:

"The most important factor is the recommendation from the teachers. If they say Matenek is good, the MoEYS will also say it's good."

They vocalised a range of options for the growth of the program including expanding to more first grade classes, expanding to more grades in the same schools, or expanding to all Basic Education and Secondary Education schools in Timor-Leste. One person suggested that:

"In the future it will be part of the annual budget plan."

Understanding the role of MoEYS in creating valuable learning resources

When examining survey data²² from MoEYS staff in the treatment group, we explored their attitudes towards the role of MoEYS in creating valuable resources and supporting teachers.

²² The survey data is from a small sample, and high starting points in survey responses make it difficult to draw statistically significant conclusions.

Interestingly, in almost all cases, we saw a deterioration in the score which reflected MoEYS staff attitudes to design and developing resources to meet teacher needs.

This may be the result of overconfidence in understanding at the start of the pilot, then after participation, MoEYS staff recognised this as a gap in their skillset. Alternatively, it shows the need to improve the support provided to MoEYS staff to build capacity in these areas.

Perceptions on the value of technology

In the next group of questions, respondents were asked how useful they thought technology was to achieve improvements in a range of areas. The analysis for this set of questions showed a general positive increase for both the control and treatment group, whilst both started from an already high score.

Barriers to access

Another question asked respondents to rate their thoughts on the main barriers to teachers making use of the technology and the internet. The treatment group showed a reduction in the perceived importance of named barriers to the utilisation of technology to support education. Despite identifying smartphone ownership, lack of interest, and digital literacy, their estimation of the importance of these factors reduced. Other barriers including lack of time and absence of internet services in the rural villages remained high.

For the control group, their scores rating the importance of these challenges increased. Those working more closely with teachers using technology through Matenek saw less barriers at endline. This suggests that the treatment MoEYS staff may be more willing to try new technology projects in the future. Of interest is the drop in 'no interest in new technology' response which suggests MoEYS staff may now recognise a growing interest in teachers' use of technology and fewer perceived barriers.

MoEYS support of teachers

MoEYS staff were asked to rate their thoughts on how the MoEYS supports teachers in a range of ways. Within this outcome, both groups started from very high scores. At endline these scores remained high with noticeable difference as there was little room to move upwards on the scale.

Outcome 3.2 MoEYS use of ICTs and Matenek to achieve education outcomes

General use of technology

Through a series of survey questions, the MoEYS staff were asked about their use of technology, including a regular phone, smartphone, laptop, desktop, television and radio. Results showed that from the period of pre to post-intervention, in many cases the control group saw increases higher than the treatment group. This is partly explained by the high values of many in the treatment group at baseline. Aside from Television watching, all groups saw increases in their scores.

Use of technology to share content

With regard to improved understanding of educator needs and sharing content, there was a positive change for treatment staff compared with control staff. This suggests the staff who worked closely on Matenek (treatment group) were more frequently using technology to support a range of activities with educators and NGOs.

Use of technology at work

MoEYS staff were asked how often they used different types of technology at work. Of interest, results showed an increase in smartphone usage within the control group, whereas for the treatment group smartphone usage was already high at baseline.

The survey showed that there was a marked increase in the use of Excel software from the treatment group, but a small drop in the use of a digital calendar. The control group, however, saw a large increase in the use of a digital calendar, from baseline to endline.

Use of technology to share content with schools

The next question seeks to understand how MoEYS employees make use of different technologies to share content with schools. While all groups started from a relatively low score, the scores for treatment staff either remained the same or decreased slightly. For the control group, while starting from a lower baseline, scores also increased. This represents a general increase in the use of technology, even outside the program.

In regard to the frequency of sharing content, treatment staff showed that they had recently used technology to share content with teachers, with scores rising from 0.5 to around 1.8. While the control staff had started from a higher baseline, treatment staff experienced a much higher shift in scores.

Outcome 3.3 MoEYS feel confident using ICTs and Matenek to achieve education outcomes

In surveys, MoEYS staff were asked about their confidence in a range of technologies and their feelings about technology. Since a very high proportion of respondents expressed confidence in using these technologies, there is limited room for improvement and the difference-in-difference analysis is of limited value.

From interviews, finally, we know all senior staff reported that Matenek made it easier to access and prepare for lesson plans, and that teachers were better able to access learning content and improve their teaching knowledge. One interviewee explained:

"Before teachers used to use the big printed book and they didn't have enough time to prepare. But now with Matenek on the smartphone, it's smaller and lighter and teachers are excited to read and prepare for class."

5. Cost effectiveness

Based on our estimates, Matenek affords the MoEYS a cost effective, efficient, and impactful delivery mechanism for teacher training. These benefits are also seen across distribution and updates to curricular materials and teacher support, when compared to more traditional models. By using Matenek, the MoEYS can also save time by making it easier for school leaders to support teachers and track their teaching progress.

The below estimates are based on data from the MoEYS for actual printing costs for the lesson plan books as well as Catalpa's assumptions about training and delivery costs. More complete estimates can be found in the appendix.

Printed lessons plan books versus smartphone Cost comparison for one-time purchase per teacher (not including delivery) USD 140 USD 133 USD 128 USD 124 USD 116 USD 108 **USD 99** USD 97 Grade 4 Grade 3 Books Grade 2 USD 92 Books Books Grade 1 **BOOKS** USD 76 **USD 60** Grade 1 Grade 2 Grade 3 Grade 4 Smartphone

Figure 13: Printed lessons plan books versus smartphone (source: MoEYS & Fone Haus)

Figure 13 includes the cost for printing the lesson plan books for a single teacher compared to the cost of a high-quality smartphone. Across grades 1-4 (Cycle 1), teachers require three lesson books that are 600-700 pages each. The printing costs for these sets of books were provided to Catalpa by the MoEYS and are included in the figure above. The MoEYS does not currently have enough budget to provide every teacher with the printed lesson plan books. The reduced costs of the smartphone, in comparison, could provide an immediate — if short-term — solution for giving more teachers access to the lesson plans.

In the long-term we would expect the MoEYS would not have to buy smartphones for teachers, but instead, could rely on teachers owning their own phones.



Figure 14 includes the cost comparison for delivering content through printed books versus digitally. The printed lesson plan books for all teachers in Cycle 1 are compared to the cost of buying all teachers high-quality smartphones, and finally to the cost for uploading content to Matenek only. This costing includes delivery of books or phones at a standard rate. This does not include the maintenance for either phones or books as both may need to be replaced due to wear and tear. Further, this does not include other program costs such as staff or content creation because we believe the costs for both printed books and Matenek would be comparable. While we do not recommend the MoEYS buy every teacher a phone nor print every teacher a book, this comparison allows us to visualise the difference in costs if scaled to all Cycle 1 teachers.



Figure 15: In-person traditional teacher training versus online (source: Catalpa costing)

Figure 15 includes the cost comparison for delivering teacher training through traditional, inperson models versus digitally. In-person teacher training for all teachers in Cycle 1 is compared to the cost of providing pulsa for Cycle 1 teachers to access online teacher training, and finally the cost for Matenek alone in a scenario where pulsa is not required because free access has been negotiated with a telecom provider. This cost comparison does not include the cost for creating training content because it is assumed teacher training content would need to be created for all models, both online and in-person.

Our estimates for in-person training includes five days of training for 20 people per school cluster (total estimated for 4040 teachers compared to 5251 in the system). The training is assumed to be run by two staff in each district. Teachers are meant to receive training three times a year and thus the costs essentially triple in this model. In the online model, teacher training is delivered via the Matenek platform and the number of trainings does not affect the costs. Costs primarily centre on the price of data, a server, maintenance, and IT staff to upload and manage the teacher training content. We have provided three different models for the cost of data including \$10, \$7, and free. The free option would require negotiation with a telecom provider.

The costs developed for this comparison can be further analysed against the MoEYS proposed budget for 2020 - the Ministry has allocated \$331,081 for the training of 182 teachers in subject content matter, which comes out to \$1,819 per teacher. In our model using \$7 for pulsa, the per teacher cost of delivering training is \$87. While this \$87 figure does not include the costs for creating content and thus would be a higher total cost, the costs of this model do not increase based on the number of teachers engaged. While we don't seek to completely replace face-to face training, we can increase exposure and learning, as well as offer opportunities to save money.

Value for Money

A critical component of DFAT's strategy is achieving value for money across their programs, which they define along eight principles under the Public Governance, Performance and Accountability Act (2013);

- 1. Cost consciousness
- 2. Encouraging competition
- 3. Evidence based decision-making
- 4. Proportionality
- 5. Performance and risk management
- 6. Results focus
- 7. Experimentation and innovation
- 8. Accountability and transparent

The above VFM principles align with the Australian Government's support for early stage innovations across the development sector through their innovationXchange (iXc) program. As defined through its Australian Development Accelerator grant, iXc funded two stages of innovations;

- 1. 'pilot stage' reaching 10-50 beneficiaries and/or 1-3 communities or locations; and
- 2. 'testing stage' reaching 100+ beneficiaries and/or 3+ communities or locations.

The Matenek pilot was submitted as a 'pilot stage' intervention, based on its new and innovative concept. The program approach of leveraging JEPD and micro-learning to improve teacher effectiveness and strengthen the implementation of the national curriculum had never been trialled before globally.

The Matenek initiative is in-line with the ADA framework, and covered 14 schools including teachers and school leaders, over 500 students, and the MoEYS national staff. An additional 20 teachers were engaged during the research and development phase.

Additionally, iXc's recommended IDIA scaling pathway defines innovation across a wider spectrum and measures its effectiveness by its ability to move through phases of innovation. These phases are defined as 1) Ideation, 2) Research & Development, 3) Proof of Concept, 4) Transition to Scale, 5) Scaling, 6) Sustainable Scale.

With the initial investment in Matenek has moved from 'Ideation', 'R&D' to 'Proof of Concept' and is working towards a plan for 'Transition to Scale'. This is evidence of both the amount of work undertaken and the program's progression to date. Below we outline how the Matenek program provides value for money across these strategic priorities and principles.

Cost conscious

Throughout the project, the operations and program teams sought to reduce costs while ensuring quality. Cost was considered in hiring consultants, selecting pilot devices, as well as other activity costs. The program also brought non-traditional skills and rare skills to the international development context below international market rates.

While the initial budget for creating Matenek covers the year and a half of development and implementation of the pilot, there are significant cost savings as the program scales. Matenek allows the delivery of multiple training opportunities for a fixed cost, compared to traditional training where costs quickly escalate because mobilising people is far more expensive at scale. This is especially important given the expectation in Timor-Leste that training is delivered multiple times each year. Much of the Matenek costs refer to its development. Its running costs are expected to be significantly lower as it moves into its next phase of innovation. To better understand the program cost comparisons see section 'Cost Effectiveness'.

Encouraging competition

Catalpa has agreed to provide an irrevocable lifetime license for the MoEYS to use Matenek. This means the MoEYS will not experience vendor lock-in should they want to work with another organisation as they move to scale-up, encouraging competition.

Evidence based decision making

The Matenek platform was built through a human-centred design process that facilitated feedback and a co-design activities with teachers and MoEYS staff. This design process encourages continuous feedback loops to inform design direction. It ensured we were building the technology based on evidence of its ease of use (user experience) and direct feedback from teachers. During the research process we also reviewed literature and evidence from past projects that were not successful, to avoid making the same mistakes.

The Matenek program employed a DBIR methodology which enabled continuous improvement and increased the overall effectiveness of the pilot. By learning which teachers were struggling, we were able to provide targeted support, leading to greater fidelity of implementation. Further, our ongoing conversations with MoEYS officials were guided by this data and aligned with the decision making timelines of the MoEYS, especially around budgeting. Given the usage data and early feedback, the MoEYS decided to budget USD\$29,000 to support the scale-up of Matenek in 2020. The final outcomes data was also scheduled to be delivered well before the end of the school year, giving the MoEYS senior leadership time to plan for scale-up.

Performance and risk management

Catalpa applies strict risk management, fraud and anti-corruption measures and conducts context-specific awareness training for all staff and subcontractors, in accordance with Catalpa's related corporate policies. We hold regular refresher training, systems reviews and

finance spot audits. Using the risk matrix submitted to DFAT, we were able to identify areas for potential risk and create strategies that mitigate against them.

Results Focus

Given the pilot outcomes, we believe Matenek meets the iXc's criteria of showing – "potential to improve the lives of people in poor and vulnerable communities in developing countries by achieving measurably better impact or more cost-efficiently than conventional approaches" – as evidenced in the 'Findings' section of this report.

Further, based on the IDIA framework, we believe the program aligned with progress made by better performing iXc initiatives which showed only - "26% of programs had advanced at least one stage on the pathway to scale".

Experimentation and innovation

The Matenek pilot was a first for Timor-Leste, an edtech intervention aimed directly at improving teaching quality, and to our knowledge, one of the first projects globally to combine JEPD and micro-learning to improve teacher effectiveness in the delivery of curricula. As described above, we used human-centred design process combined with an iterative and adaptive implementation methodology to ensure we were solving real challenges and co-creating solutions with potential for impact at scale.

Given the innovative nature of the Matenek program, and the application of a quasiexperimental evaluation process which demonstrated significant results, the Matenek pilot strongly aligns to the principle of 'Experimentation and innovation'.

Accountability and transparency

Catalpa maintained clear and accurate financial records for the implementation of the program, and was fully accountable and transparent in the use of these funds. Catalpa's accounts are also independently audited each year.

6. Pathways to scale

Given the usage of Matenek and the impacts observed in the survey, classroom observations, and interviews, Catalpa is recommending three potential models for scaling Matenek in 2020. Parts of each model can be mixed with other models to create an option that works best for the MoEYS.

All models will require a negotiated contract with a telecom provider to allow discounted access to data from the current rate of \$10 down to \$7 per teacher. Given the addition of more users, we believe this is feasible. In Model 1, for first grade teachers who sign up beyond the 100 direct-support teachers, we would seek to 'whitelist' Matenek so they could access the content for free (without using any of their own data plan).

In all models, we recommend that smartphones be purchased for teachers at a cost of approximately USD \$89 per teacher. In the following school year, we'd expect sufficient market penetration such that the program would not need to buy smartphones, drastically reducing the ongoing costs for the MoEYS.

Model 1: Grade One expansion plus 'over-the-top'

This model focuses on expanding Matenek to a new cohort of 100 Grade 1 teachers (reaching approximately 3500 students) with direct support from Catalpa and MoEYS. It also adds a 'bring your own device' option where any first grade teacher across Timor-Leste can sign up on their own smartphone. This will allow us to test if the program can grow organically, outside of schools where Catalpa or MoEYS provides direct support.

Additional work in this model will centre around creating supplemental, micro-learning content (flashcards and videos) for Grade 1 in new subject areas. This process will focus on working closely with one MoEYS staff member, chosen as the proposed 'e-learning Content Focal Point,' building their capacity to manage and develop the content creation process in the future. We recommend this new e-learning content focal point be placed in the proposed e-Learning Directorate where they can play a coordinating role across other MoEYS departments who should be involved in transforming content for use online.

Content creation will follow a similar process used in the pilot year, however, in this phase the content will be co-designed with the MoEYS 'e-learning content focal point' and two staff from Catalpa. All created content will continue to be presented to the Curriculum department for feedback, with final approval by Basic Education but will also include input from INFORDEPE. The MoEYS 'e-learning content focal point' and Catalpa staff will also work closely to develop content creation standards and guidelines, replicable for other grades and subjects in the future.

The 100 Grade 1 teachers receiving direct support will attend a full day, in-person training session and receive a smartphone with data. Following training, they will have access to a hotline for program support. All teachers will receive at least one monitoring visit. It is proposed that this training and support will be led by two Catalpa staff members, working in close collaboration with MoEYS staff across the Basic Education, Curriculum, INFORDEPE, e-Learning, and IT departments.

ALMA has scaled to over 500 schools across Timor-Leste and regularly provides training and support to schools in the program. Utilising this existing program channel, Grade 1 teachers in the 'over-the-top' model will learn about Matenek through ALMA training as well as through local advertisements. Sign-up and support for 'over-the-top' teachers will be managed by one MoEYS staff member who we recommend embedding in the IT Department. This staff member can create new user names and troubleshoot basic issues with the app.

Model 2: Grade 1 & 2 and content expansion

Model 2 expands Matenek to include Grade 2 teachers while continuing growing Matenek to more Grade 1 teachers. The 50 Grade 1 teachers and 50 Grade 2 teachers will receive direct support including full day, in-person training and a smartphone with data. Following training, they will have access to a hotline through which they can seek support.

All teachers will receive at least one monitoring visit from Catalpa with additional monitoring being handed over to MoEYS staff. It is proposed that this work be led by two Catalpa staff, working in close collaboration with MoEYS staff across the Basic Education, Curriculum, INFORDEPE, e-learning, and IT departments.

Additional work in this model will centre on creating supplemental, micro-learning content (flashcards and videos) for Grade 2 and additional content in new subject areas for Grade 1. The process is the same as detailed in Model 1, working closely with a proposed 'e-learning content focal point' and making guidelines for future content creation.

Model 3: Eskola integration & Grade 1 Expansion

The goal of this model is to integrate Eskola and Matenek by creating a mechanism to import Matenek data into Eskola, and present data in an easy-to-understand dashboard. The dashboard should give school leaders and regional directors better insight into teachers' lesson plan progress and take action to support teachers who might be falling behind.

While the focus of the pilot was on teachers, there may be more that can be done to improve school leaders' understanding about the project. A possible way forward is defining a more structured way to coordinate Matenek activities with ALMA, given school leaders are regularly engaged by ALMA. There are a few possible ways to configure this coordination, one of which is to design and develop a feature that integrates both platforms. School leaders and teachers seem to agree that knowing where how teachers are progressing in the curriculum is a shared benefit. It helps teachers keep track of what has been taught and helps them with their reporting requirements to school leaders.

Additional features in Matenek will be designed based on the needs of the MoEYS. This may include a chat feature, bulk selection of 'done teaching,' additional notifications, access to supplemental resources and more. The software development work for these additional features would require engineering and program staff from Catalpa.

Further, Model 3 continues expanding Matenek to more Grade 1 teachers. As per Models 1 and 2, teachers would receive direct support including training, device, hotline, and monitoring visits. This work is proposed to be led by two Catalpa staff, working in close collaboration with MoEYS across Basic Education, Curriculum, INFORDEPE, e-Learning, and IT departments.

Potential barriers to scaling

While the results from the evaluation suggest great potential for Matenek to impact teachers and their students, possible barriers to scaling must be considered. First, a negotiated contract with a telecom provider would enable discounted access to data, reducing the costs of the program and making it easier to scale. Further, in the 'bring your own device' model, if Matenek is 'whitelisted' it would make the app free to access, removing a huge barrier for those 'bring your own device' teachers who otherwise would need to pay for data to access the app content. However, there is a risk that negotiations are not successful, increasing costs in the short-term for the program, and in the long-term creating a barrier to access for teachers who use Matenek on their own devices.

High-quality smartphones can be purchased at approximately USD \$89 per teacher. This is a big cost and requires maintenance. In school year 2021, we expect sufficient market penetration of smartphones such that the program would not need to buy smartphones, drastically reducing the MoEYS' ongoing costs. However, there is a risk that trends in

smartphone purchases do not continue at the same pace as in 2018, meaning the MoEYS would need to continue buying phones to ensure access to Matenek.

Catalpa has worked with the IT Department on managing the help desk for ALMA/Eskola. IT would need to grow their capacity to also support Matenek. While this additional capacity does not yet exist, we believe current staff could be leveraged to support this scale-up by training new hires or other existing staff. There is a risk, however, that it would not be possible to train additional staff to meet the needs of the program.

Beyond 2020 & Exit Strategy

The Beyond 2020 strategy for the Matenek initiative is focused on two key areas:

- 1. Scale up and further expansion of Matenek by the MoEYS in Timor-Leste
- 2. Modification of the learning platform and the evidence of JEPD via micro-learning, and applying it to other development challenges/contexts.

Scale up and further expansion of Matenek by the MoEYS in Timor-Leste

Within MoEYS we have seen a positive shift in how they see and value e-learning and digital technologies in education. Support for e-learning, and specifically Matenek, has been evidenced by support of the Vice Minister, Directors, and Advisors. The above will go a long way in helping the MoEYS launch a new e-Learning Directorate. Catalpa is excited to partner with this new team as they will have both the programmatic and technical remit to expand ICT enabled learning. This support is also evidenced by the MoEYS commitment to budget USD\$29,000 to support the scale-up of Matenek in 2020.

The Matenek program outcomes align with the strategic direction of Timor-Leste's application to the Global Partnership for Education (GPE). The draft GPE plan includes both budget and strategy for the use of ICTs to support teacher training and dissemination of learning resources. We have early indications that the MoEYS would like to allocate GPE funds to support the scale-up of Matenek, which we expect to be disbursed around April 2020. Other potential pathways for scale-up funding come from opportunities to collaborate directly with UNDP, UNICEF and the World Bank.

Modification of the learning platform and the evidence of JEPD via micro-learning, and applying it to other development challenges/contexts

Outside of our direct programmatic work on supporting and scaling Matenek, we have also taken a product-focused route to ensuring the sustainability and value for money of the technology. Two projects are thus far building on the lessons learned and code from Matenek and we expect more to follow;

- 1. **Olgeta** seeks to improve education outcomes for young women in Rural Training Centres, teaching them future-ready skills that ultimately, improve their chances of engaging in meaningful work. Accessed via smartphone, Olgeta offers micro-courses that augment student's face-to-face learning. Olgeta uses many core functions designed in Matenek but puts them in a new and improved platform. Olgeta will be trialed in Solomon Islands beginning in January 2020.
- 2. The **ASTEROID** program focuses on advancing surveillance and training to enhance recognition of infectious diseases in Timor-Leste. The program, which will be implemented by Maluk Timor and the Ministry of Health of Timor-Leste has two overarching goals (1) increased capacity in infection prevention & control (IPC) in primary health centers to mitigate infectious disease threats; and (2) improved national disease surveillance. Maluk Timor and Catalpa will collaborate to increase capacity for health care providers, by focusing on JEPD and micro-learning for medical personnel. ASTERIOD will use many core functions tested in Matenek work will begin in January 2020.

7. Conclusion

This report provided an overview of the Matenek program, outlining the processes and key findings from the program pilot. We offered analysis of Matenek's impacts from the perspective of teachers, school leaders and the broader MoEYS.

The key findings are highly encouraging for all stakeholders. Matenek teachers were shown to be teaching much more effectively. This is based on their readiness to teach, student readiness, and preparation of didactic materials, and the amount of time spent reviewing lessons and learning content before class.

Matenek teachers also taught their lessons more on pace and with more fidelity. They also implemented more classroom practices and strategies compared to control teachers, especially the area of responding to student questions, praising both male and female students, and putting student work up on the wall. There was also a reduction in their use of verbal and physical violence.

The research also showed the success of the pilot in impacting school leaders and MoEYS staff. School leaders reported Matenek teachers were more prepared for class, and school leaders were better able to see their teaching progress as it was clearly and visually tracked in Matenek.

The positive outcomes continued for MoEYS staff who reported they better understood educator needs, saw fewer barriers to using technology, and they can share new content with educators more easily. As per the following quote from a senior MoEYS leader:

"Matenek helps the MoEYS in implementing the national curriculum and to bring up the educational quality."

Based on these impacts, Catalpa recommends scaling Matenek to more grades or more teachers. This expansion will support the government's larger, long-term goal of improving outcomes for students across Timor-Leste.

The evidence presented in this report clearly enumerates the promise and potential of using technology to support teaching and learning in Timor-Leste. Moving from 14 schools with limited exposure to technology to schools where teachers use Matenek to prepare for class 45 minutes each day is remarkable progress.

In addition to usage, initial research suggests that this converted into tangible and observable changes in their classroom behaviour, improving teacher effectiveness and enabling them to implement the national curriculum with greater fidelity. With Matenek, we can change the paradigm for teacher training, making it more near-time, flexible, relevant, and ongoing.

The program's emphasis should still remain in ensuring MoEYS staff and school leaders are empowered to lead education and technology projects like Matenek. This will ensure they understand the design process and can grow the project sustainably with more local leadership.

As previously described, the Ministry's NESP is currently being updated through the Global Partnership for Education (GPE), led by the MoEYS, UNICEF, and the World Bank. The GPE concept note recently released includes priorities that directly align with the Matenek program. MoEYS can accomplish NESP goals through additional investment in the Matenek program. Through a longer-term strategy and investment through GPE, the MoEYS could be supported to take strategic ownership of the program.

8. Appendices

- 1. Cost effectiveness, teacher training
- 2. Cost effectiveness, delivery of content
- 3. List of Schools
- 4. Teacher Survey
- 5. MoEYS Survey
- 6. Observation Protocol
- 7. Interview Protocol (teachers)
- 8. Interview Protocol (school leaders)
- 9. Interview Protocol (MoEYS)

Appendix 1A: Online delivery of teacher training data scenario 1 (\$10) costs

Cost item	Per month	Months	Count	Costs
IT Staff	USD 350	13	1	USD 4,550
Data scenario 1	USD 10	12	5251	USD 630,120
Server	USD 60	12	1	USD 720
Maintenance (MoEYS Staff)	USD 1,000	12	1	USD 12,000
Annual Total				USD 647,39(

Appendix 1B: Online delivery of teacher training data scenario 2 (\$7) costs

Cost item	Per month	Months	Count	Costs
IT Staff	USD 350	13	1	USD 4,550
Data scenario 2	USD 7	12	5251	USD 441,084
Server	USD 60	12	1	USD 720
Maintenance (MoEYS Staff)	USD 1,000	12	1	USD 12,000
Annual Total				USD 458,354

Appendix 1C: Online delivery of teacher training data scenario 3 (\$0) costs

Cost item	Per month	Months	Count	Costs
IT Staff	USD 350	13	1	USD 4,550
Data scenario 3	0	12	5251	0
Server	USD 60	12	1	USD 720
Maintenance (MoEYS Staff)	USD 1,000	12	1	USD 12,000
Annual Total				USD 17270

Appendix 1D: In-person delivery of traditional teacher training costs per school cluster

Description	Price per person	Days	People	Total
Desloka per day 40\$/ Nao Desloka: \$11	USD 11	5	20	USD 1,100
Snack and lunch will be estimated 9\$ per person.	USD 5	5	20	USD 500
Printer cost for material (varieties of material)	USD 5	1	20	USD 100
Staff (trainers) per diem (2)	USD 40	6	2	USD 480
One Trimester Total				USD 2,180
One Year Total*				USD 6,540
*Assumes training occures 3x per year				

Appendix 1E: In-person delivery of traditional teacher training costs by district

District Name	Total Clusters	Cost for one year of training	Total costs
Aileu	11	USD 6,540	USD 71,940
Ainaro	17	USD 6,540	USD 111,180
Baucau	17	USD 6,540	USD 111,180
Bobonaro	23	USD 6,540	USD 150,420
Cova Lima	20	USD 6,540	USD 130,80
Dili	14	USD 6,540	USD 91,560
Ermera	22	USD 6,540	USD 143,880
Lautem	15	USD 6,540	USD 98,100
Liquica	7	USD 6,540	USD 45,780
Manatuto	16	USD 6,540	USD 104,64
Manufahi	13	USD 6,540	USD 85,020
Oecusse	9	USD 6,540	USD 58,860
Viqueque	18	USD 6,540	USD 117,720
Total	202		USD 1,321,0

Appendix 1F: In-person delivery of traditional teacher training personnel costs

Description	Total staff	Monthly salary	Months	Total
Trainers*	26	USD 350	13	USD 118,30
**Assumes two trainers per district are employed in a given calendar year				
Total				USD 118,3

Appendix 1G: In-person delivery of traditional teacher training combined costs

Description		Total
Costs for delivery training		USD 1,321,080
Staff costs for trainers		USD 118,300
Total		USD 1,439,380

Appendix 2A: Printed book costs by grade

Grades	# Teachers	Price for 3 printed books	Cost
Grade 1	1271	USD 98.70	USD 125,447.70
Grade 2	1249	USD 116.00	USD 144,884.00
Grade 3	1332	USD 127.55	USD 169,896.60
Grade 4	1399	USD 132.60	USD 185,507.40
Total	5251		USD 625,735.70

Appendix 2B: Costs for reliable smartphones in Timor-Leste

Phone	Phone price
Samsung Galaxy J2 Core	USD 89.00
Samsung Galaxy J2 Prime	USD 97.00
Mintt Ultramintt S1	USD 129.00
Samsung Galaxy A10	USD 139.00

Appendix 2C: Delivery costs for books or smartphones by district

District Name	Total Clusters	Delivery cost	Cost
Aileu	11	USD 70	USD 770
Ainaro	17	USD 70	USD 1,190
Baucau	17	USD 70	USD 1,190
Bobonaro	23	USD 70	USD 1,610
Cova Lima	20	USD 70	USD 1,400
Dili	14	USD 70	USD 980
Ermera	22	USD 70	USD 1,540
Lautem	15	USD 70	USD 1,050
Liquica	7	USD 70	USD 490

Manatuto	16	USD 70	USD 1,120
Manufahi	13	USD 70	USD 910
Oecusse	9	USD 70	USD 630
Viqueque	18	USD 70	USD 1,260
Total	202		USD 14,140
Delivery assumes MoEYS uses existing vehicles (\$70 is for fuel and driver)			

Appendix 2D: Smartphone costs for grades 1-4 (Galaxy J2 Prime)

Phone	Phone price	Teachers	Cost
Samsung Galaxy J2 Prime	USD 89.00	1,271	USD 113,119.00
Samsung Galaxy J2 Prime	USD 89.00	1,249	USD 111,161.00
Samsung Galaxy J2 Prime	USD 89.00	1,332	USD 118,548.00
Samsung Galaxy J2 Prime	USD 89.00	1,399	USD 124,511.00
Total phone cost			USD 467,339.00
Uploading content to server (IT staff)	USD 350	13	USD 4,550
Delivery			USD 14,140
Grand Total			USD 486,029.00

Appendix 2E: Smartphone costs for grades 1-4 (Galaxy J2 Core)

Phone	Phone price	Teachers	Cost
Samsung Galaxy J2 Core	USD 97.00	1,271	USD 123,287.00
Samsung Galaxy J2 Core	USD 97.00	1,249	USD 121,153.00
Samsung Galaxy J2 Core	USD 97.00	1,332	USD 129,204.00
Samsung Galaxy J2 Core	USD 97.00	1,399	USD 135,703.00
Total phone cost			USD 509,347.00
Uploading content to server (IT staff)	USD 350	13	USD 4,550
Delivery			USD 14,140
Total costs			USD 528,037.00

Municipality	Group	School
Dili	EBC 1.2.3 Manleuana	EBF 1.2 Beduku
Dili	EBC 1.2.3 Manleuana	EBF 1.2 Casnafar
Dili	EBC 1.2.3 Manleuana	EBC 1.2.3 Manleuana
Dili	EBC 1.3 Hera	EBF 1.2 Hera
Dili	EBC 1.3 Hera	EBF 1.2 Mota Kiik
Dili	EBC 1.3 Hera	EBF 1.2 Aidak Bihare
Liquiça	EBC 1.2.3 Cassait	EBF 1.2 Tibar
Liquiça	EBC 1.2.3 Cassait	EBC 1.2.3 Casait
Liquiça	EBC 1.2.3 Cassait	EBF 1.2 Turleu
Liquiça	EBC 1.2.3 Liquiça	EBF 1.2 Lauhata
Liquiça	EBC 1.2.3 Liquiça	EBF 1.2 Maumeta
Liquiça	EBC 1.2.3 Liquiça	EBF 1.2 Mauboque
Liquiça	EBC 1.2.3 Liquiça	EBC 1.2.3 Liquiça
Liquiça	EBC 1.2.3 Liquiça	EBF 1.2 Vatunau