

# School in a Box in Low Resource Primary School in Mozambique: Practical Application of Zone of Proximal Development in Teacher Training with Mobile Technology

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## ABSTRACT

The new Sustainable Development Goals call for quality education for all. This study aims to examine the role of mobile educational technology, through the School in a Box intervention, particularly in supporting teachers skills in achieving quality education, in the context of a public primary school in Mozambique. Quality education is examined specifically in relation to participative pedagogical practices designed to contextualise learning in locally relevant meaning, and providing children with the skills of learning how to learn. Additionally it is examined in the context of teacher professional development and creating peer support structures within the teaching community enabling teachers to be at the forefront of initiatives introducing mobile educational technology in low resource learning environments in Sub Saharan Africa. This paper sets the context for the use of the School in a Box tool in the classroom and in teacher professional development against the theoretical framework of Vygotsky's zone of proximal development. The study aims to furthermore examine how teachers can be enabled to appropriate use of the technology to the local environment and curriculum needs.

## KEYWORDS

Africa, iPad, Low-Resource Primary Classroom, Mobile, Mozambique, School in a Box, Solar, Teacher Continued Professional Development, Teacher Training, Vygotsky, Zone of Proximal Development

## INTRODUCTION

The practice context for this study is a collaborative research project with Irish Aid to examine how School in a Box technology and methodology might have impact in public primary classrooms in Mozambique. The first phase of the intervention took place in 2015 and consisted of needs assessment, technology deployment, and one week of in-service teacher training in August. In 2016 a second phase will involve measuring learning outcomes in students in the intervention group, as well as collaborating with the local teacher training institute to provide ongoing support and training of the project.

This paper aims to put the study in the context of an appropriate theoretical framework; Vygotsky's zone of proximal development, emphasising how the tool can be used to transform teaching and learning. This paper is concerned only with the first phase intervention, the aim of which is to train teachers on the use of the School in a Box technology as a tool in the realistic context of the classrooms they are teaching in.

## Research Questions

The new Sustainable Development Goals (SDGs) move away from quantitative measures of education for all, to an emphasis on quality education for all. 59% of 15 - 24 year olds have not completed primary education in Mozambique, and the country ranks in the 15th percentile worldwide in learning (EPDC, 2014). While it is easy to see what the problems are, it is somewhat more difficult to define what constitutes quality education, or rather what factors contribute to quality education, as pedagogical practice in Mozambique still widely relies on repetition, rote learning and chalk and talk.

Taking a human rights based approach to education for all, Craissati et al (2007) stress that children being allowed to be active participants in their own learning is vital.

*There should be respect for the agency of children and young people, who should be recognized as active contributors to their own learning, rather than passive recipients of education ... Teaching and learning must involve a variety of interactive methodologies to create stimulating and participatory environments. Rather than simply transmitting knowledge, educators involved in creating or strengthening learning opportunities should facilitate participatory learning. (Craissati et al., 2007, p.34)*

The importance of participative learning environments has also been stressed in a DfID (Department for International Development, UK) commissioned systematic review of 489 studies (Westbrook et al., 2013), which found that classroom interaction is the key to pedagogical practice for impact on learning.

This study is concerned with the role of technology in improving quality of education, but with a specific focus on how technology can change how teachers teach, and how the introduction of technology can foster a culture of self-learning in teaching communities. The research questions are as follows: do teachers engage in more participative practices in the classroom as a result of using the School in a Box project? Do teachers engage in more peer support activities as a result of School in a Box intervention? What are the constraints and factors that contribute to its successful implementation?

## Context of Study

The study is a pilot action research project working with Grade 3 teachers in a large public primary school near Maputo. The school was chosen by Irish Aid because of its easy access from Maputo, and because of its typicality as an urban public school in Mozambique. There are 5000 students in the school and 72 teachers. Approximately half of the classrooms are exterior under the shade of some trees, and the rest are interior. Interior classrooms for the most part do not have desks, chairs, windows or doors. Electricity is available in interior classrooms but can be intermittent. Eight teachers from the school were trained in 2015 and five are continuing for full implementation of the project.

## School in a Box Technology

The technology consists of an iPad connected to a powerful projector and powered by a solar battery and solar panel. The configuration of the hardware varies for interior and exterior classrooms. Apps that allow easy content creation such as BookCreator, iMovie, Keynote, and Explain Everything (white board app) are pre-loaded on the device.

The combination of technology has been chosen for its robustness, intuitiveness and ease of training, and lack of need for technical support. This technology combination has previously been deployed to School in a Box projects in Upper Humla region of Nepal, Cabo Delgado province

in Mozambique and remote rural communities in Maputo province in Mozambique (see [www.iadtschoolinabox.com](http://www.iadtschoolinabox.com)).

### **School in a Box Methodology**

Using a community engagement ethos, School in a Box works with on-the-ground educational and community partners to assess needs and co-design technology deployment, training and content requirements suitable for the environment, everyday constraints and most immediate needs of end-users.

The iPads are used both in the classroom and to create content; using the local environment for examples relevant to the learner's world in a problem-posing and language experience approach (Freire, 2013) on very easy to learn apps that facilitate high quality interactive content creation and use on the iPad. The photographic and video making capacity of the iPad allows easy integration of examples from the immediate environment or brought by children into projected lessons.

### **School in a Box Teacher Professional Development**

The teacher professional development aims to support and scaffold teacher skills in a very practical and simple way to allow the tool to be useful and relevant to the classroom and community environments teachers are working in. At the end of the week long workshop, participants are comfortable with using the iPads and setting up the projection and solar energy components. Additionally they are able to quickly and easily create lessons on the aforementioned apps, using photos from the immediate environment and text in Portuguese or first language. The focus of the workshop is to equip teachers in a very practical way to make the learning relevant to the lived experiences and local environment of their students, and to the needs of the local curriculum

## **THEORETICAL BACKGROUND: ZONE OF PROXIMAL DEVELOPMENT**

In the context of a participative and inquiry based classroom, Vygotsky's Zone of Proximal Development (ZPD) is a useful theoretical framework for explaining how knowledge and understanding is acquired firstly through social interaction, and subsequently in the learner developing the skills of learning how to learn. ZPD will be used on two levels in the context of this study; as a framework for how teachers can use the technology in the classroom, but additionally for the context of teachers own professional development.

The essence of Vygotsky's (1978) ZPD theory is, contrary to previous theories of learning, that development lags behind learning, which occurs firstly (on the interpersonal plane) through social interaction and later (on the intrapersonal plane) becomes internalised in the individual. Vygotsky (1978, p. 35) provides the example of a child learning and adhering to the rules of a group game, and only later internalizing this learning in the form of self-regulation.

In particular we will examine Warford's (2011) phases of progression through the Zone of Proximal Teacher Development and their relevance for the School in a Box training process. Additionally the ZPD can be used to define the following objectives of the teacher training period with Mozambican primary teachers; enable teachers to understand how the tool can be used to mediate meaning, set up teacher peer learning structures that will continue after the period of in-service training and embed understanding of how meaningful units of analysis can be used to structure lessons for deep learning.

### **Meditating Tool**

Key to the ZPD is the concept is the difference in what the learner is capable of alone, versus what the child is capable of with the help of another through social interaction, and the importance of mediational tools such as language in this exchange. The "expert other" is the person who aids the

learner in their development and is usually defined as a teacher, adult or more capable peer (Vygotsky, 1978).

The central tenet of School in a Box is that the technology becomes a tool for teachers to set the context for interactive, inquiry-based, deep learning, as well as modeling the process of learning how to learn. Moll's quote on mediating learning resonates with the ultimate goal of the School in a Box project:

*The focus, therefore, is not on transferring skills, as such, but on the collaborative use of mediational means to create, obtain and communicate meaning... The goal is to make children consciously aware of how they are manipulating the literacy process and applying this knowledge to re-organize future experiences or activities. (Moll, 1990, p. 164)*

Returning to Westbrook et al.'s (2013) review of research which attempts to find pedagogical practices most suited to low resource learning environments in the developing world, six specific teaching behaviours, were identified as having most impact on learning: "demonstration and explanation based on sound pedagogical content knowledge; flexible use of whole class; frequent and relevant use of visual aids and locally produced learning materials beyond the use of the textbook; open and closed questioning encouraging student response and questioning; use of local languages; and, planning and varying lesson sequences" (p.37). These practices all qualify within the definition of mediating learning within a zone of proximal development.

In the case of School in a Box, the technology also becomes a mediating tool and a way of working with language and meaning relevant to grade 3 children in Mozambique. This mediating becomes even more important and useful when Portuguese (the language of instruction in Mozambique) is not the home language of the child, which is the case in over half of the children in the participating classrooms. Photos and text in Portuguese, or first language, or both, can easily be integrated into the Explain Everything whiteboard app. Each element of this can be moved and manipulated very easily on the screen by the teacher or student. A simple sentence supported by a photo taken from the local environment can be used to explore vocabulary, grammar, sentence structure and life sciences. A word can be pulled out of the sentence, placed on the relevant part of the picture, and other theme words added by the children. Colours, vocabulary themes or other elements can be explored visually and through vocabulary. Individual words in the sentence can be moved around to explore grammar and sentence structure. All this content can be created directly in the class by the teacher and the children working collaboratively in a progressive sequence of deepening learning.

Haßler, Major and Hennessy (2015) from Cambridge University have carried out a critical review studies from 2009 to 2015, examining of the use of tablets in primary and secondary education with a particular emphasis on learning outcomes. They found that the technology was most effective when it "acted as a catalyst for more creative pursuits and exploration of new pedagogical approaches" (Haßler et al., 2015, p.16).

In an environment where dropout rates are very high, providing children with the tools to make learning meaningful may not only help children find the motivation to stay in school longer, but may help children to continue their own learning in the case that drop-out is necessary for economic or social reasons.

## **Internalisation and Appropriation**

The internalisation phase of the ZPD is commonly interpreted when the child learns to do something unaided that he/she could only previously do with help. Moll (1990) argues that this is a reductionist interpretation of the concept, and that Vygotsky was interested in the "relationship between thinking and the social organization of instruction". He suggests that this needs to be extended to "collaborative uses of mediational means to create, obtain and communicate meaning" (Moll, 1990, p. 164) Thus the teachers role involves creating "zones of learning" and "mediating meaning" and in this case

internalisation takes the form of children consciously applying what they are learning to new situations, and “taking control of their own learning”. (Moll, 1990, p.164)

Rogoff (2008) takes internalisation a step further again to the concept of appropriation. Appropriation is distinguished from internalisation in that it involves the transformation of the person rather than internalisation of knowledge or skills. This is exemplified through the girl scouts who through simply participating in the process of cookie selling become transformed into planners, organisers and leaders in how they approach the activity. It is a process of becoming rather than a process of acquiring (Rogoff, 2008). In the context of the School in a Box in the classroom, the teacher provides an opportunity for the child to participate in games involving visual images of vocabulary and information, creating the context for internalising learning. Eventually the teacher is encouraged to allow children to provide examples of content for lessons, opening the way for children to move towards the appropriation phase and becoming active and self-aware learners.

But these phases don't just apply to how the tool is used in the classroom. They also apply to the teacher training and how teachers become active agents of their own learning and professional development.

### **Zone of Proximal Development in Relation to Teacher Development**

Warford's (2011) work on his Zone of Proximal Teacher Development (ZPTD) (2011) relates to the integration of Vygotskian concepts into pre-service teacher education. Warford (2011) breaks the ZPTD down into four stages; self-assistance, expert-other assistance, internalisation and recursion (Warford, 2011, p. 254). The objective of the process is to integrate educational theory into classroom practice which happens in the fourth stage, using a number of interventionist tools such as surveys, reports, journaling, micro-teaching and interactionist tools such as group discussions, teacher student interactions and role plays.

These phases closely correlate with the process of teacher professional development carried out by the School in a Box team over an initial one week period. In a first phase Warford (2011) emphasizes past experiences with education and situating this in the present with learning autobiographies. The School in a Box workshop starts by situating itself in the teachers past experiences and their current needs. In the expert other phase, a teacher tutor with expertise in using iPads in an educational context introduces the devices, and over a couple of days of hands on exercises and practice, teachers move through this phase relatively easily and fluidly. In this phase group discussion and peer learning structures are encouraged and facilitated by the School in a Box team. Towards the middle of the week, the third phase of internalization is introduced where teachers integrate use of the technology with their teaching through creating lesson plans, designing content and micro-teaching. The fourth phase is recursion, creating opportunities for peer input and review and reverting back to earlier stages of the process if necessary. This phase involves creating follow up structures to continue after the workshop such as weekly meetings and sharing of content that allow ongoing reflection, discussion and learning.

Appropriating Warford's (2011) four phases of ZPTD we can devise a progression of activities, taking it a step further by integrating corresponding units of analysis as presented in Table 1.

Units of analysis are inspired by Moll's (1990) discussion of Vygotsky's emphasis on meaningful wholes or “events” rather than separated skills or activities: “these «events» consists of a series of interrelated but diverse learning activities, usually organized around a specific theme or topic.” (p. 164) In the School in a Box context, a teacher starts a numeracy lesson by introducing a new concept, such as symmetry, using the book or a game based learning exercise projected from the School in a Box kit. The teacher then shows an example from the local environment and asks children to find examples of symmetrical objects in the immediate environment. Taking photos of these, the teacher then integrates the student's findings into a projected lesson that other students interact with by drawing lines of symmetry onto the photographed examples. The end result is a digital lesson that can be used and shared by the community of learners. The unit of learning is a complete progression of learning

**Table 1. Warford's (2011) four phases of ZPTD applied to School in a Box and expanded to include Moll's (1990) Units of Analysis**

ZPTD Phase:	Activities:	Units of Analysis:
<b>I. Self-Assistance</b>	Hands-on practice with setting up and operating School in a Box kits. Completion of content creation exercises on variety of apps.	Competent setting up and use of School in a Box kit.
<b>II. Expert other assistance</b>	Facilitated group discussion on use of School in a Box kit in primary classroom. Facilitated group exercises and feedback on content creation related to education.	Demonstration of understanding of use of School in a Box kit in local primary educational context.
<b>III. Internalisation</b>	Creation of lesson plans integrating School in a Box technology. Micro-teaching with device.	Integration of use of device in teaching practice.
<b>IV. Recursion</b>	Peer group structures organized by group. Peer group collaborate to design and implement new teaching activities using School in a Box kits.	Design of new activities integrating technology into teaching with meaning

of a mathematical concept, such as symmetry, from introduction, to meaningful internalization, to recursion and on to the further stage of Rogoff's (2008) appropriation.

Micro teaching provides opportunity for internalization of skills using the technology to deliver a lesson, but furthermore skills have to be transferred into the local context of teaching for the appropriate grade, and integrated into a designed lesson plan. This crosses into knowledge areas unfamiliar to the trainers, and takes learning into Rogoff's (2008) concept of appropriation of the learning. Likewise the community of teachers continues to appropriate the project through ongoing peer to peer support and sharing of content, beyond the formal teacher professional development period, designing the application of the technology in accordance with their needs and environment, with the ultimate aim of participants taking ownership and leadership of the project.

Applying the ZPTD to the School in a Box teacher training carried out in August 2015, teachers moved through the ZPTD phases from simple functional use of the technology to new skills being applied to create participatory learning games and exercises in curriculum areas not covered by the tutor, thus appropriated by the teachers for their own requirements.

### Peers as Expert Others

Kuusisaari's (2014) work with in-service teachers in Norway found that teachers at similar levels of qualification and experience can be effective as expert others for each other, particularly when they challenge each other through their discourse (p. 55). The importance of peer support in introduction of new practices is supported by Westbrook et al.'s (2013) review of almost 500 studies, which emphasises that successful reform need to be driven by the teachers themselves using collaboration and peer learning, rather than being imposed top down from outside the school community. Haßler et al.'s (2015) review of use of tablet devices in education also highlights the importance of fostering collegiality and teacher empowerment at the level of school culture for successful implementation.

This is particularly relevant to the School in a Box approach of creating a community of practice (Wenger & Lave, 1991) as part of the implementation and potential scaling phase of the study. The last day of the workshop focused on setting up peer support structures, such as a regular weekly peer meeting, and opportunities to share lesson plans and digital content. This work to build peer support between teachers will be further supported throughout the implementation phase of the project, led by the Director of Pedagogy at the school.

## Critiques of Zone of Proximal Development

Chaiklin (2003) presents critiques of the common conception of ZPD as inspiring “a vision of educational perfection” (p. 42). Chaiklin draws attention to the fact that the ZPD is a zone of proximal development and not learning, and that the ZPD is intricately linked with Vygotsky’s theory of child development, which contests that development happens in response to a need in the environment (Chaiklin, 2003, p. 47). This critique reinforces the need for mediating activities brokered by teachers using the School in a Box technology to be related to the environments in which children live, and daily literacy, knowledge and thinking skills needed by children. Murphy et al. (2015) outline an often used simplistic interpretation of the ZPD as a “gap” between what the child can accomplish aided by an “expert-other”, commonly perceived to be the teacher, and what the child can accomplish unaided. This limits the interpretation of the ZPD to being an explanatory tool, rather than a descriptive tool outlining the nature of interaction in the zone of mediation using tools and artefacts.

Moll (1990) also points to common reductionist views in the interpretation of what the ZPD is.

*For example, a problem in applying the concept of the zone to the analysis of classroom instruction is that the basic definition of the zone, emphasizing the transfer of knowledge, and especially of skills, by those knowing more to those knowing less, may characterize virtually any instructional practice. (Moll, 1990, p. 160)*

Moll suggests moving from an interpretation of the ZPD as transfer of skills to development of meaning. He also identifies three aspects of ZPD that have in his view led to reductionist interpretations of the concept. In the first instance units of analysis have been interpreted as dislocated skills, while he prefers units related to a meaningful whole. He gives the example of whole language approach to reading, where the classroom becomes a reading environment, rather than focusing on the mechanics of reading. The second aspect is mediation which is often reduced to mere instruction, which he believes should move to creating social contexts for mastery of these means of communication necessary for higher order thinking skills. The third element of ZPD discussed by Moll is change, commonly believed to be change in knowledge, but Moll suggests that this needs to be extended to “collaborative uses of mediational means to create, obtain and communicate meaning” (p. 164).

This point returns to the purpose of education and whether it is merely a box ticking exercise in increasing literacy rates, or equipping children with the means to read for meaning, and to use that ability to think and communicate creatively and critically. The whole approach has to be enabling and participative, building children’s confidence in their ability to take charge of their own learning, problem solving ability and capacity to participate fully in society.

## DISCUSSION

There hasn’t been room in this paper to review other theoretical frameworks such as Cultural Historical Activity Theory (Vygotsky 1934/1986; Leont’ev, 1978; Engeström, 2014) and Communities of Practice (Wenger & Lave, 1991) with important relevance for the School in a Box pilot project. Further work has been done on this and reflected in the pilot design.

The intention of the School in a Box intervention is to provide a tool for transforming teaching into a more participative practice in environments where there may not be many physical resources to work with otherwise. The Zone of Proximal Development is a useful framework for placing the technology as a mediating tool for teaching, rather than as being about the introduction of ICT into education. When extended to the Zone of Proximal Teacher Development, it provides a basis for the technology to act as a resource to allow teachers to take charge of their own learning. Furthermore it provides a basis for teachers to provide to expert peer support for each other.

Haßler et al. (2015) conclude their review of the use of tablets in education with a call for more research of high quality in the context of international development on this topic. They specifically mention the promising results of the One Billion and iSchools projects, both of whom are based on one to one tablet interventions using apps developed for specific learning content related to numeracy in the former case, and the full Zambian primary curriculum in the latter (in both cases with whom the School in a Box team have met to discuss future areas of possible collaboration using the one device per teacher model). Importantly for the School in a Box initiative, Haßler et al. (2015) found the many-to-one use of the devices was more effective in terms of learning outcomes than one-to-one use of tablet devices.

Much of the research stresses that new technology takes time to embed and gains might not be immediate (Carr, 2012), and that effective professional development for teachers determined eventual benefits to students (Hennessy et al., 2010). They additionally call for further studies that examine the role of solar energy as part of the overall solution, again of specific relevance to the School in a Box intervention at implementation stage.

It is hoped that this study can set the context for further work in looking at how technology can be used to support teachers in their very challenging work in low resource classrooms in Sub-Saharan Africa, as well as examining the very important role teachers and head teachers themselves have to play in taking leadership of how these technologies can embed in the local curriculum and learning environment.

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*N. Miguel Seabra (1972-2015), PhD, MSc/MArch., is a passionate and innovative educator and lecturer, a collaborative and creative consultant for the 21st century education challenges, as recognized by his peers. After he completed his University degree in Architecture (1996), he was invited to lecture in Education, Design Thinking/ Architecture Studio at the same University, engaging in a fulfilling academic career at Faculty of Architecture and Arts of Lisbon Lusíada University. He is an experienced advocate, advisor and author about the impact of digital technologies in education, who gathered experience in organizing and speaking both locally and internationally in seminars and workshops. Since 2005 he has been recognized as an Apple Distinguished Educator (ADE) and recently as an Apple Professional Development (APD) Certified Trainer. His Architecture background led him to develop a Design Thinking methodology in Education - a creative approach in the use of digital technology as a teaching/learning tool - grounded in local cultural realities merged with current global educational possibilities. Dr. Seabra contributed to the design of the School in a Box training design and trained participant teachers on the programme.*