Save the Children

EDTECH FOR LEARNING IN EMERGENCIES AND DISPLACED SETTINGS

A Rigorous Review and Narrative Synthesis

Michaelle Tauson and Luke Stannard

Acknowledgements

The authors of this report and Save the Children UK would like to thank Mike Fisher and Leah Williams for their research support.

A huge thank you goes to the reviewers of the report as well: Charlotte Balfour-Poole, Mark Chapple, Mary Cox, Marco Grazia, and Mary Greer, Arlo Kitchingman. Your feedback was invaluable. A very special thank you goes to Prisca Benelli, Sebastien Hine, and Josie Scott for their support.

Published by Save the Children UK
savethechildren.org.uk

First published 2018
© Save the Children UK 2018

This publication may be used free of charge for the purposes of advocacy, campaigning, education and research, provided that the source is acknowledged in full.

Cover photo: Save the Children provided Dorothy* with books, pens and a radio to help her learn remotely from radio lessons while schools were closed. We also fund a team of community volunteers who help children with their school work, provide psychosocial support and refer vulnerable children to Save the Children for further referral as necessary.
*name has been changed for security reasons.
Credit: Save the Children

Typeset by: iCRE8design

Save the Children

Contents

1. Executive Summary **6**
Background and Objectives 6
Methodology 7
Main findings and implications 8

2. Introduction and Background **11**
2.1 Introduction 11
2.2. Purpose of the Report **12**

3. Definitions and Theories of Learning **13**
3.1 Definitions 13
3.2 Conceptual Framework 14
3.2.1 Theories of learning 14
3.2.2 Zone of Proximal Development 14
3.2.3 Scaffolding 14
3.2.4 Types of learning 15
3.2.5 Pillars of learning 15
3.2.6 Barriers to Teacher Engagement 16
3.2.7 Learning during and after crisis 17

4. Methodology **19**
4.1 Designing the Research 19
4.2 Step by Step Process 19
4.3 Limitations of the Study 21

5. Mapping of Research **22**
5.1 Classification of Studies 22
5.2 Categorisation of Findings 24
5.3 Synthesis of Current Systematic Reviews 30

6. Narrative Synthesis of Findings/Analysis of 'What works' **33**
6.1 The Child 33
6.1.1 Learning outcomes are not improved simply by the provision of hardware alone. 33
6.1.2 EdTech must take pedagogical standard of design seriously 35
6.1.3 EdTech software must be tied to curriculum for optimal results 36
6.1.4 EdTech must be responsive to the learners' level 37
6.1.5 Examples must be relevant to learners' context 39
6.1.6 EdTech can increase learner motivation 40
6.1.7 EdTech can potentially boost learner's '21st Century' learning skills. 40
6.1.8 Learners can teach themselves how to use tech quickly 41

Save the Children

Contents

6. 2 The Community 42
6.2.1 Adult/Teacher led scaffolding key to productive learner engagement with technology 42
6.2.2 EdTech must supplement and not supplant teaching if it is to be successful 44
6.2.3 Teacher perceptions of technology are important 46
6.2.4 The availability of Teacher Professional Development 47
6.2.5 Parents perception of technology is important. 50
6.2.6 Context of intervention is key to successful integration: History and Context affects usage 50
6.2.7 EdTech can, but does not necessarily, represent the best value for money/sustainability 52

6.3 The Enabling Conditions 53
6.3.1 Infrastructure a major barrier to successful utilization of EdTech 53
6.3.2 EdTech for accelerated learning: preparation to integration to formalized education 54
6.3.3 EdTech can blur lines between formal, informal and nonformal learning 55
6.3.4 Gender 56
6.3.5 Wellbeing 58

7. What are the major gaps in research in emergency and displaced settings? 59

8. Summary of Findings 61

9. How do we ethically implement EdTech in emergencies: A Framework for Engagement 64

10. References: 66

Appendices 71
Appendix I: Research Strings: 71
Appendix 2: Academic Databases and Journals Searched 72
Appendix 3: Grey Literature Search 72
Appendix 4: Technology Overview 74

Young boy using VR in conjunction with a smart phone in Bandung, Indonesia.

1. Executive Summary

USING EDTECH FOR LEARNING IN EMERGENCIES AND DISPLACED SETTINGS: A RIGOROUS REVIEW AND NARRATIVE SYNTHESIS

BACKGROUND AND OBJECTIVES

Estimates suggest that children living in countries affected by violence and disasters are roughly three times more likely to be out of school than children living in stable, but low-income countries (World Bank, 2011 as cited in Dahya, 2016). With roughly 535 million children currently living in these settings (UNICEF, 2016), many children are at risk of missing out on education. With the ever-increasing incidence of emergencies and the ever-changing face of conflicts, tackling the issue is becoming increasingly challenging and complex. At the same time, global funding for education has decreased steadily since 2009 (from 10 per cent to less than 7 per cent in 2015) and households now bear a high percentage of education costs (UNESCO, 2017).

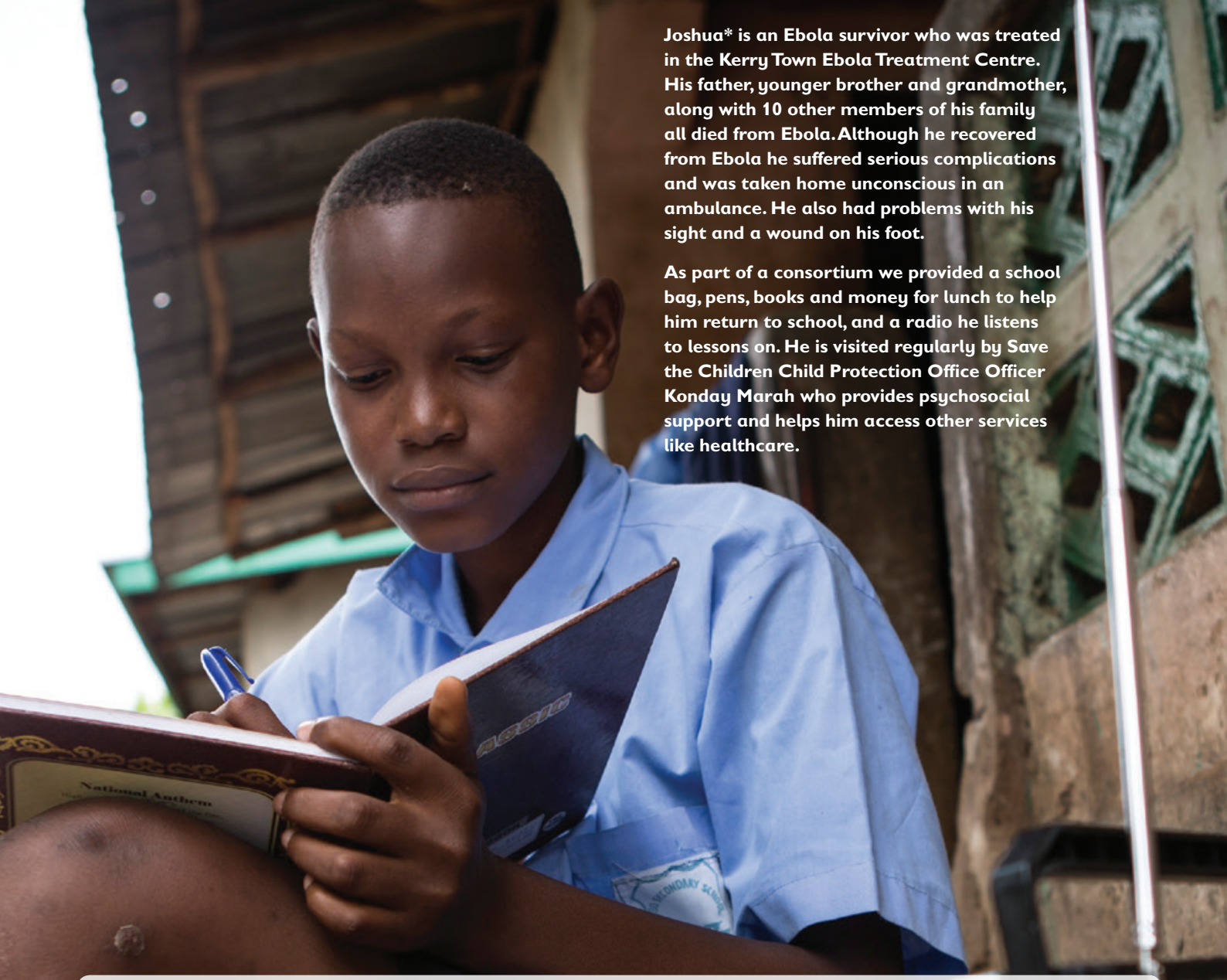
Due to ever increasing challenges, increased costs, and decreased funding, governments, international organisations, and civil society have begun to welcome, and even call for, private sector support in the delivery of education (Menshay and Zakharia, 2017). According to UNESCO's 2017 Global Monitoring Report, the private sector is now a major key player in the delivery of education. Investment is increasing steadily where 'spending on both private tutoring and education technology is expected to exceed US$200 billion in the next five years' (UNESCO, 2017: 106). Educational technology (EdTech), or the use of information communications technology (ICT) for educational purposes, had been a key area of engagement for the private sector.

For example, according to Menashay and Zakharia (2017: 8), roughly 50 per cent of the engagement of the private sector in the Syria response has included the 'development and distribution of technological education innovations'.

Taking into account the above, the purpose of this report is to build an understanding of 'what works' in EdTech to ensure that children can learn in crisis or displaced settings. The field of EdTech is vast, and has influenced almost every facet of modern educational delivery. This report will focus on 'child facing' EdTech, which refers to technology – both software and hardware – designed directly for use by the child or by a teacher, parent, or facilitator working with a child.

Overall, this report amasses evidence to develop a more nuanced understanding of what is required to implement effective and ethical EdTech programmes that lead to children learning, asking the research question:

> ***How can the utilisation of EdTech (at home or at school) for teaching and learning best facilitate the learning process of children in crisis-affected settings?***



Joshua* is an Ebola survivor who was treated in the Kerry Town Ebola Treatment Centre. His father, younger brother and grandmother, along with 10 other members of his family all died from Ebola. Although he recovered from Ebola he suffered serious complications and was taken home unconscious in an ambulance. He also had problems with his sight and a wound on his foot.

As part of a consortium we provided a school bag, pens, books and money for lunch to help him return to school, and a radio he listens to lessons on. He is visited regularly by Save the Children Child Protection Office Officer Konday Marah who provides psychosocial support and helps him access other services like healthcare.

METHODOLOGY

The purpose of this review is to build a holistic understanding of how EdTech can impact learning, trying to ascertain what conditions lead to more positive outcomes, taking into account learning theories; impact studies; and feedback from teachers, parents, and students. We wanted to take a step back from traditional systematic reviews, which often focus almost exclusively on the results of randomised control trials and quasi experimental designs in order to decide 'what works'. In this study we wanted to investigate 'the what' alongside 'the how' and 'the why' in order to understand how investments in EdTech really matter for efficient and effective learning. Ultimately, if investment in EdTech for learning has arrived and is here to stay, we want to be able to help guide investments so they are sustainable, ethical, and lead to efficient student learning. For this reason, this review has used a wide range of data sources to build up an evidence base to understand why and how EdTech works.

This review process, after establishing a clear research question and research strategy, included a search of both academic and grey literature, reviewing a large body of sources. Databases searched included: Google Scholar, Springerlink, Proquest, ERIC, Sage Journals, and JSTOR. Searches were also conducted using individual journals which included The Journal of refugee studies, Refugee Survey Quarterly, Migration Studies, International Journal of Refugee Law, and Information Technologies and International Development.

These searches turned up 1000s of hits, and in the end we collected roughly 500 documents. After a second and third review for relevance and quality, 135 documents were included in the study. A narrative synthesis was then conducted to synthesize and analyse findings.

*name has been changed for security reasons

CREDIT: SAVE THE CHILDREN

MAIN FINDINGS AND IMPLICATIONS

1. **Impact evidence exists but is not utilized appropriately:** Although there is an overwhelming consensus of how EdTech can contribute to learning and the facilitation of the learning process, many EdTech initiatives are designed without taking existing evidence into consideration.
2. **The provision of hardware alone is not sufficient to improve learning outcomes.** The mere access of ICT in schools or at home does not implicate learning outcomes. A number of factors must be in place for learning outcomes to improve.
3. **EdTech is a tool that needs to be constructed with the principles of pedagogy in mind,** such as active learning, engagement, and content that hooks onto previous learning. EdTech should support cognition and not only present content.
4. **EdTech must be implemented in line with the local curriculum.** Neglecting alignment will mean that content may not be relevant for the child, but may also increase the workload of the teacher.
5. **EdTech must be responsive/adapt to the learners' level.** Materials should be at the correct level for the child so that they are challenged, but can also progress. Content should allow children to learn through their mistakes.
6. **Scaffolded, appropriate, and adaptive software can be extremely useful in classroom settings.** EdTech can indeed support teachers and free them up to engage in greater student-teacher interaction, which is important to improving learning outcomes.
7. **Examples must be relevant to the learners' context.** If not, children will struggle to connect to the examples, and therefore will fail to learn the material. Contextually appropriate material means that children are more likely to engage.
8. **Material that is contextually appropriate can be used by families and can help increase opportunities for social engagement.** This is important in emergencies where family support is crucial for child wellbeing and can help a child to achieve improved learning outcomes.
9. **Child learners tend to be able to teach themselves how to use technology fairly quickly.** Children, do not necessarily need extensive support in learning the technical aspects of simple EdTech devices. In fact, if left to explore the devices at the outset they can collectively build an understanding in a child-centred manner.
10. **Adult/teacher led scaffolding is key to productive learner engagement with technology.** The iterative, affective support that adults can provide is necessary to ensure learning, as in-app scaffolding cannot 'differentiate a careless error from more serious misunderstanding'.
11. **EdTech must supplement and not substitute teaching if it is to be successful.** Evidence shows that EdTech used to supplement in classroom learning can lead to improved learning outcomes. However, when teaching is substituted for EdTech, learning outcomes tend to diminish.
12. **How EdTech is used matters more than *what* EdTech is used.** EdTech can be an important tool to supplement and indeed potentially improve learning outcomes for those who engage with it. For this to be successful it is important that attention is paid to how it is used, for example not simply to deliver content to learners. It can, if appropriately utilized, provide very valuable support that has the potential to facilitate teachers in being able to provide more support, and increase the chances of teacher-student interaction.
13. **We cannot change the learning environment just to utilise a tool.** We must avoid the desire to reengineer how students interface with learning environments, just to suit a new educational tool. We must use the evidence of how this tool can improve current practice.

14. **Teachers' opinions and perspectives matter when it comes to effective EdTech use.** Teachers' opinions of EdTech and its relevance to the learner's educational development are important. Teachers' attitudes play a more important role in whether technology is effectively implemented over other barriers, such as teacher training or time.

15. **Teachers must be trained and engaged with regularly for EdTech to be an effective tool in the classroom.** EdTech is a relatively new educational tool, as with all educational tools the teacher, or primary deliverer of content, needs to be comfortable using it, prior to using it with learners.

16. **Poor teacher training leads to poor results.** If resources are stretched too thin, the implementation is rushed, and/or teacher training is not engaged with readily, then the impact of the intervention on learning outcomes is diminished. Not only does the quality of this initial teacher training need to be of a high standard, it needs to be sustained. Continued teacher development positively correlates with successful EdTech take up.

17. **Parents' perception of technology is important for learning.** Parents/Primary Care-givers are the most important actors in their children's education and parents have to be supportive of EdTech if it is to be used and used effectively. Taking an active approach to parental engagement can work to alleviate fears they may hold around technology, and indeed promote a positive attitude to the education their children are receiving at school.

18. **The history and context of the country and education systems will influence the usage of EdTech for learning.** Should the wider cultural context of a country or community be engaged with in a proactive manner then it can go a long way to support the successful integration of EdTech which can lead to sustainable improvements in learning outcomes.

19. **EdTech can, but does not necessarily, represent the best value for money or sustainability.** Educational technology can be expensive. In emergency situations when resources are limited and the infrastructure to support the technology is under strain, the sustainability and feasibility of an intervention has to be established, if long-term improvements in learning outcomes are the aim of the intervention. Technology interventions can become a burden to the communities in which EdTech is integrated if the long term considerations of software updates and maintenance are not considered. The issues that need to be considered regarding value for money include considering the appropriateness of the hardware, sustained training initiatives for teachers, adaptation costs for the learning environment, and capacity building, where needed, to ensure that broken equipment can be maintained.

20. **Infrastructure is a major barrier to the successful utilization of EdTech.** Infrastructure will differ based on the region engaged, so too will equity of access within countries. There is a need to look beyond the claimed infrastructure and policy framework of specific countries, and build an understanding of the actual and current infrastructure and what it is best suited for. Otherwise, initiatives will lead to wastage and opportunity costs.

21. **EdTech can be effectively used alongside accelerated learning programmes** in order to help children to catch up and get back on track in their appropriate learning levels, but only if EdTech programmes are aligned with the curriculum and work as a supplement to accelerated learning programmes.

22. **Boys and girls perform the same when not facing barriers to access,** but barriers to access are both gendered and pervasive and are buried within economic and societal contexts. In an emergency, or any context, we have to build our own understanding of these divides by working closely with local populations before engaging in programmes that may exacerbate inequality in society.

In August 2014 Magnum photographer Michael Christopher Brown travelled to Za'atari and taught a group of Syrian refugee teenagers how to take photographs using an Apple iPhone. These photographs were taken by Omar*, a 14 year old Syrian boy living in Za'atari refugee camp in Jordan.

*name has been changed for security reasons

CREDIT: SAVE THE CHILDREN

2. Introduction and Background

2.1 INTRODUCTION

Globally, according to UNESCO (2017), 264 million children of primary and secondary school age are out school. UNESCO also estimates that worldwide roughly 100 million young people are fully illiterate. While data on attendance, enrolment, and literacy can be difficult to gather in fragile and conflict-affected settings, estimates suggest that children in these settings are roughly three times more likely to be out of school than children living in stable, but low-income countries (World Bank, 2011 as cited in Dahya, 2016). With roughly 535 million children currently living in countries affected by violence and disasters (UNICEF, 2016) many children are at risk of missing out on education.

In addition, the occurrence of natural disasters has been increasing steadily since the 1970s (Guha-Sapir and Hoyois, 2015) and in recent years the incidence of violent conflict has seen an upsurge. Conflicts have become more severe and the number of displaced persons continues to rise. Conflicts have become more complex as they become more urban over time and contexts remain fragile for longer periods even after a conflict "ends" (IISS, 2017). With the ever-increasing incidence of emergencies and the ever-changing face of conflicts, tackling the issue is becoming increasingly challenging and complex. At the same time, global funding for education has decreased steadily since 2009 (from 10 per cent to less than 7 per cent in 2015) and households now bear a high percentage of education costs (UNESCO, 2017).

In recent decades, due to these challenges, increased costs, and decreased funding, governments, international organisations, and civil society have begun to welcome, and even call for, private sector support in the delivery of education (Menshay and Zakharia, 2017). According to UNESCO's 2017 Global Monitoring Report, the private sector is now a major key player in the delivery of education. Investment is increasing steadily where 'spending on both private tutoring and education technology is expected to exceed US$200 billion in the next five years' (UNESCO, 2017: 106). Educational technology (EdTech), or the use of information communications technology (ICT) for educational purposes, had been a key area of engagement for the private sector. For example, according to Menashay and Zakharia (2017: 8), roughly 50 per cent of the engagement of the private sector in the Syria response has included the 'development and distribution of technological education innovations'.

The merits and risks of private sector engagement in the field of education in emergencies, especially regarding technology, have been intensely debated. Proponents see technology as ubiquitous, therefore capable of bringing equal access to all, efficiently and effectively. Opponents, on the other hand, voice concerns over exploitation and undermining the role of the state as the main duty bearer to provide education to all children within its borders (see Menashay and Zakharia, 2017 for a more nuanced debate). Opponents also cite the fact that evidence in conflict, disaster, and displaced settings is so sparse that we lack an understanding of how to best use technology in these circumstances.

The purpose of this report is not to engage in this debate, but start from the assumption that private sector engagement in education in emergencies has already taken hold, as evidenced in the Middle East. We assume that the trend of using EdTech to address gaps in the provision of education is increasing and will continue to do so, regardless of the advantages and disadvantages. The purpose of this paper is, however, to examine the evidence regarding EdTech, from a learner centric perspective in all settings, and to apply findings to emergency settings. The purpose is to build an understanding of 'what works' so that we can help guide tech companies, governments, international organisations, and civil society to work better together to ensure that children are learning and will not be left behind due to conflict and disasters.

While taking for granted that EdTech is "here", does not mean that the arguments of opponents should not be considered. On the contrary, greater consideration must be taken to ensure EdTech interventions are ethically and effectively implemented. Firstly, engaging with the private sector introduces an additional layer of complexity to an already over complex situation. Working to deliver education in emergencies already includes the involvement of a wide range of stakeholders with competing agendas, varying values and priorities, diverse knowledge bases and many ways of working. As a result, it can become challenging to ensure that children's needs are put first and the best innovations for the context are put forward. Simply, in some cases, the drive to introduce innovative practices can lead to the implementation of programmes or endeavours that may not be the most appropriate for children within the context.

2.2. PURPOSE OF THE REPORT

Taking into account the above, the purpose of this report is to build an understanding of 'what works' in EdTech to ensure that children can learn in crisis or displaced settings. We have focused on the aspect of learning over other areas, such as school management, teacher training, or classroom management. Not discounting the importance of these other areas, we were keen to understand how technology can be used to help children whose learning may have been temporarily or permanently disrupted, taking into consideration what is best for the child.

Overall, this report amasses evidence to develop a more nuanced understanding of what is required to implement effective and ethical EdTech programmes that lead to children learning, asking the research question:

How can the utilisation of EdTech (at home or at school) for teaching and learning best facilitate the learning process of children in crisis-affected settings?

To answer this question, we reviewed the most recent academic, peer-reviewed literature as well as a small number of grey studies to build an understanding around the following (see Methodology section for more details):

1. **What EdTech interventions or trends are considered successful/lead to the most effective learning for children**
2. **What interventions or trends are considered failures**
3. **Which factors are necessary for the success of interventions and what factors lead to failures (or no outcome)**

In general, a comprehensive review is missing from the literature that clearly links the variables that matter for better learning to EdTech initiatives. This research attempts to connect theories of learning with impact studies and systematic reviews in order to establish these links. This research also identifies the gaps in the research and prioritises a list of what we need to know to ensure the effective design of programmes to help children, making clear what we do not know.

Finally, after analysing the evidence on learning we develop theory based guidance on the best actions/interventions to address the needs of the learner through EdTech. In this sense we are building a framework for engagement that asks, how can EdTech best be used and when should we use it? The purpose of this tool is to help the third sector to engage with private and tech actors that wish to engage in humanitarian crises and offer support, allowing for a more straightforward engagement process.

3. Definitions and Theories of Learning

3.1 DEFINITIONS

To ensure that readers are on the same page as the authors of this review, we provide working definitions of relevant terms. Many of these terms have a wide usage and encompass multiple meanings, however we have provided simplified definitions to ensure that findings are clearly presented.

EdTech

The concept of EdTech generally includes a number of broad definitions across disciplines; however, for the purposes of this research, Ed Tech will be seen as 'practice' as opposed to theory[1] Simply, EdTech as practice is the use of technology for teaching and learning. In this review EdTech will be examined across the spectrum, including independent learning at home to face-to-face learning with the incorporation of technology, and all that lies between.

Technology

Technology is also a broad term, and when left open to ambiguity, can easily be replaced with terms such as innovation or advancement. However, we restrict the term to reflect the use of information and communications technology (ICT), specifically as a tool to facilitate education. ICT, for the purposed of this research, includes the use of radio to the most sophisticated and interactive digital teaching and learning tools.

Learning and Facilitating the Learning Process

Learning can be seen as 'the retention of information' and 'the acquisition of knowledge, skills, and attitudes' or generally, 'understanding' (Januszewski and Molenda ,2013: 4-5). Due to the nature of the research, as this is not an evaluation of a particular project, measuring 'learning' is not feasible. The purpose of this research is to understand how technology either enhances learning outcomes or creates an environment where learning can take place. Therefore, it would not be practical or feasible to attempt to assign an indicator for learning and measure specific learning outcomes. Instead this research seeks to build an understanding of the learning process in relation to EdTech.

In this sense, the use of the word 'facilitation,' is synonymous with terms such as promotion or assistance (Robinson et al., 2013). Overall, we are interested in understanding if EdTech programmes 'promote an environment where learning can more easily occur' (Januszewski and Molenda, 2013: 4). We are interested in finding out if EdTech can support personalised learning, for example does its use help children to achieve numeracy or literacy, improve skills, or contribute to the improvement of psychosocial outcomes? Also, can EdTech help children to catch up so they are able to achieve at appropriate schooling levels? And finally, we are interested in understanding if EdTech can help children learn to learn.

Pedagogy

Pedagogy is a concept used extensively, but defined rarely. It is important to define what is meant by pedagogy because, as Murphy (1996: 28) states 'in different cultures at different points of time in history, the meaning and status has shifted'. It is synonymous with educational research and discussions. In this review when pedagogy is referred to, it is in relation to the praxis of teaching. Praxis is used to describe the relationship between 'theory and practice in teaching' (Murphy, 1996: 34). It is the process by which a learning environment is established and coordinated. In short, pedagogy is the *'interactions between teachers, students and the learning environment and learning tasks' (Ibid)*. When EdTech is introduced to a learning environment it will be structured in a manner that influences these interactions and this is significant and worthy of consideration.

Crisis-affected

Borrowing from Burde (2015) the terms 'crisis-affected' as well as 'emergency' will be used in order to describe the context. Much debate surrounds these labels, for example, when does an emergency become protracted and cease to be a humanitarian

[1] http://edutechwiki.unige.ch/en/Educational_technology

issue and become a concern of development practitioners? We will leave these debates in this review to establish a working definition that incorporates sudden onset crises, protracted situations, and will include post-conflict settings.

The motivation behind this inclusive definition is twofold. First, data and information are limited in sudden unset and acute crises due to a number of security, logistical, and ethical reasons. We therefore must broaden our search for evidence. Second, while protracted situations may fall under another definition, depending on the audience, the medium and short term consequences are clearly linked and findings from these settings remain relevant.

3.2 CONCEPTUAL FRAMEWORK

The field of education is awash with theories that explain what learning is, how best to promote it, and in which manner it should be measured. To engage with the theoretical perspectives, and the array of evidence covered in this review it is necessary that time is taken to address what theoretical perspectives informed our framing of learning.

3.2.1 Theories of learning

As Lowyck, (2014: 6) points out 'learning theories do not constitute a monolithic, coherent system.' Indeed, there are a number of theories of learning that have developed to build our understanding of this broad topic. The purpose of this research is to consider salient arguments around learning and apply them to how children may or may not learn using EdTech. We cannot cover all of the competing theories; however, it is important that this report acknowledges this diversity.

The majority of the studies that have been analysed for this rigorous review took a sociocultural perspective to learning. This position posits that individuals learn through 'an active process and that the context has an important role in learning' (Hall, 2007: 96). These theories have been developed from the work of Lev Vygotsky (1978). From this perspective, 'active' learning is mediated through other people, and the use of tools. Tools are psychological, for example, language is a tool, and we use it to help others expand their own understanding of a topic or subject. When a learner knows how to use new language (Hall, 2007: 96) it modifies and 'transform the learners' thought processes'. From a sociocultural perspective EdTech can be a means of helping with the uptake of language (tool); it is not a tool in itself. It is part of the environment the learner experiences. The learning that takes place via the EdTech has to be accessible to the learner.

3.2.2 Zone of Proximal Development

When we introduce learners to new ideas, these ideas need to sit within the grasp of the learners' current understanding. This idea was worked on by Vygotsky (1978) who developed the notion of the Zone of Proximal Development (ZPD), which represents an important aspect of this theory of learning. Belland (2014: 506) states that this (2014: 506) involves activities a learner 'cannot yet accomplish but which they can accomplish with assistance'. To give an example, single-digit subtraction and multi-digit subtraction: 6-1 = 5 will likely be within a particular learner's ZPD, and others could be given as questions like 7-3 = 4. However, 19-11=8 is likely to be too difficult for that learner, without having the concept broken down into its constituent parts and explained to them.

3.2.3 Scaffolding

The disaggregation of concepts and ideas, as explained above, is referred to as scaffolding. Scaffolding supports buildings whilst we construct them: it affords those constructing them the safety and support to move onto the next level of the process, or the next 'zone' to use the language of Belland. The concept of scaffolding is integral to educational support for children and adults. Belland (2014: 507) states that this structuring 'refers to the role of scaffolding in simplifying tasks while still representing the whole task', put simply it is signposting where or what is next, and giving the student the support to make that step. It is not taking that step for them. This support can be presented by humans, peers, or an appropriate piece of software. To build a robust understanding of effective EdTech, this concept needs to be clear.

Importantly for those looking at EdTech, there are elements that can inhibit that step being taken, as Belland (2014: 507) describes 'two contextual factors [that] influence students' reception of scaffolding: the extent to which the cultural knowledge contained within scaffolding conflicts with students'

existing internalized cultural knowledge, and students' motivation.' Therefore, the context of the learning, whether it sits within their ZPD, and the example used to mobilize that learning are of great importance.

3.2.4 Types of learning

A considerable number of the studies that this review has assessed looked at learning outcomes as a measure of progress. A learning outcome is likely to contain a number of forms of learning within it. To define learning is not a simple task, to assist with this demarcation we will draw from Bloom's (1956) work on a taxonomy of educational outcomes. In this work Bloom discussed the three domains of learning in humans, that are still used and discussed today in the learning sciences (Hirsh-Pasek, 2015, Krathwohl, 2002).

The first of these is referred to as the cognitive domain of learning. Bloom (1956: 7) argued that this domain deals with the 'recall or recognition of knowledge and development of intellectual abilities and skills'. It is a domain of learning that Hsin et al. (2014) found to have garnered the most research in their review of EdTech, and is the one most closely associated with actions produced by the learner that are assessed in terms of learning outcomes, for example, remembering and recalling facts and statistics.

The second domain of learning is the affective domain of learning. The affective domain, according to Bloom (1956: 7) deals with 'objectives which describe changes in interest, attitude, and value'. It is the social domain of learning, that when engaged with encourages learners to improve interpersonal skills, and the development of ideas. The affective domain is important to consider with regards to EdTech, which many fear can isolate learners and stunt affective development. This fear was expressed to researchers by parents in Jordan for example (Qablan, 2009).

The final domain of learning that will be referred to in this paper goes by an array of names, Bloom (1956) called it the manipulative form of learning, Dave (1967) and Simpson (1972) referred to it as the psychomotor domain, but in this review, we shall refer to it as the *Technical* domain of learning. It is concerned with physical hands on learning, and (Kasiligam et al, 2014: 30) 'on performing sequences of motor activities' such as learning to use a tablet, for example.

These domains of learning intersect and overall development in a learner is likely to include development from all of these domains. The manner in which to evoke learning is the subject of much debate, it is also the topic of the learning sciences, which have produced evidence-based theory on how best to stimulate learning.

3.2.5 Pillars of learning

Hirsh-Pasek et al.'s (2015: 7) work on what constitutes learning is drawn from 'well agreed upon pillars of learning at the core of the learning sciences'. The learning sciences combine aspects of linguistics, neurobiology, psychology, brain imaging and other areas that are not concerned with (2015: 6) 'merely what we should teach children – that is, what content – but also how children best learn'. In this regard it is a framework that looks at learning as a verb, an active and developed process of acquiring skills, knowledge and an ability to apply such learning. It is a child-centric approach to learning that considers learning to be the action of the child, not simply the reception of information.

The first pillar is referred to as active 'minds on' learning. This pillar (Hirsh-Pasek et al., 2015: 8) draws the distinction between being 'physically active and mentally active.' Evidence demonstrates that (Hirsh-Pasek et al., 2015: 9) 'learning is not simply a passive registration of information nor is it simply a result of any type of physical activity'). Learning that is sustained requires active engagement on the part of the learner. For example, when a learner is presented with a new word, it is not simply typing that word into the software as a means of demonstrating they have learnt it. All this shows is they have learnt the spelling, not the use. It is using the new language the learner has been exposed to in a sentence, which demonstrates an active engagement with the words connotations and meaning.

The second pillar is referred to as engagement with the learning process, which states that the 'type of engagement is critical for learning' (Hirsh-Pasek et al., 2015: 11): In essence does the exercise keep the learner on task. This pillar states that distraction is a key problem in learning that must be avoided, that learning is about building resilience in the learner and (Hirsh-Pasek et al., 2015: 13) 'praising children for their efforts and hard work helps them understand that learning is not instantaneous'.

Yaarub and Sulafa* working hand in hand on executing his border scene during an animation workshop run by Save the Children in Lebanon, facilitated by photographer and filmmaker Diaa Maleab.

The third pillar of this framework is a call for meaningful learning. This relates to context and learning that (Hirsh-Pasek et al., 2015: 13) 'comes from experiences that connect to our existing knowledge' or as Ausubel (1968) referred to it, learning that 'hooks' onto what the child already knows. Hirsh-Pasek et al. (2015: 14) argue that this distinguishes 'meaningful learning from rote learning' which occurs when 'new information does not link to previously learnt content'.

The fourth and final pillar of this framework for learning stresses the importance of social interaction. Sociocultural perspectives of learning consider learning to be an inherently social activity. This framework argues that (Hirsh-Pasek et al., 2015: 18) for 'social interaction to benefit learning it must be high quality' and the benefits of social interactions influence on learning (Hirsh-Pasek et al., 2015: 17) 'have been known for decades'. This does not mean that all learning must happen in groups, but there is a strong evidence base that suggests sharing our new understanding with others helps to reinforce the learning and build connections to material previously covered. This factor is related to the learning environment, be it formal or informal, there are a multitude of actors in a given learning environment.

3.2.6 Barriers to Teacher Engagement

One of the key actors in any learning environment is the teacher/facilitator of the space. This review is interested in what promotes effective EdTech use. There are a multitude of reasons why education professionals do not engage with the EdTech that is available to them. As a means of addressing the different reasons this paper will draw on the framework built by Ertmer (1999) in their paper 'addressing First- and Second-order barriers to change: strategies for technology integration'. In this Ertmer discusses what can enable and prevent teachers using EdTech in classrooms.

Ertmer (1999: 50) identified first-order barriers to engagement as consisting of 'obstacles that are extrinsic to teachers', examples of which include 'equipment, time, training support' and general infrastructure to support technology use. These essentially include the issues that are out of the teaching staffs' control. Second-order barriers to engagement (Ertmer, 1999: 51) are 'typically rooted in teachers' underlying beliefs about teaching and learning'. These are often related to teachers' opinions of the value of technology integration, and an aversion to changes in practice, not dissimilar from any adult working in an environment that is changing.

*names have been changed for security reasons

The influence of structural barriers (first-order) to EdTech engagement are important considerations for all those interested in education practice. These are coupled with perception led (second-order) barriers to engagement. These understandably overlap and reinforce one another. For example, if as a teacher you are working extra shifts to accommodate an extended student body (first-order) then there is perhaps little time to learn a new piece of EdTech software. This first-order barrier is likely to compound a belief (second-order) that it is not appropriate to use EdTech with your class. What this framework gives us is a clearer means of demarcating the barriers to engagement. with the hope to employing practice that works to address one or both of these in difficult crisis based settings.

3.2.7 Learning during and after crisis

In order to build an understanding about EdTech and what aspects enable children to learn in crisis settings, we have to first understand how a child's ability to learn is affected by crisis. It is important to consider what obstacles children face in these circumstances so that we are able to develop the right technology interventions to help overcome these issues.

If we are to speak of learning in emergencies, we must take into account the potential impacts of trauma and ongoing stress on children their ability to learn in these contexts. Child and families who find themselves at the centre of an emergency are exposed to trauma on multiple levels. Many experience the loss of homes, livelihoods, and, in many cases, physical harm and/or the physical harm of others. Even after the initial shock of conflict or a disaster, individuals often continue to face innumerable stressors. Children and families, including the displaced and refugees, will often see a lack of access to basic needs such as housing, health care, education, and dignified livelihoods opportunities. In addition, the displaced may be confronted with discrimination, violence, extortion, and many other stress inducing situations.

Research shows that exposure to trauma is a major impediment to learning in adults as trauma impairs both cognitive and executive functions (Tauson, 2017). For example, those who suffer from Post-Traumatic Stress Disorder (PTSD) will often demonstrate an inability to control or regulate emotions, maintain attention, switch attention between tasks, and even have extreme behavioural reactions, lower IQ test scores, short term memory loss, paranoia, and hallucinations (Aupperle et al., 2012; Emdad, 2005; Freeman, et al., 2013; Gracie et al., 2007; LaGarde, 2010; Starcke and Brand, 2012).

Even for those who do not suffer from PTSD, there is evidence to suggest that poverty, stress, and trauma can interfere with cognitive function. According to Mani et al. (2013) poverty and scarcity can lead to temporary or prolonged cognitive impairment and a reduction in cognitive functioning. These findings are bolstered by research done on intrusive thinking. Those who undergo trauma or extreme stress are more likely to experience intrusive thoughts, such as rumination about the past or worry about the future (Aikins et al., 2009; Bomyea and Lang, 2016; Michael et al., 2007; Munoz et al., 2013). These are particularly constraining in that individuals only have limited attentional resources in which to process concerns and think critically, therefore excessive rumination and worry can cause cognitive impairment (Munoz et al., 2013). Essentially when we find ourselves facing extreme levels of stress and trauma we will become preoccupied with thoughts that will impede our ability to 1) focus on whatever current task in which we are engaged, 2) weigh consequences and make the best decisions, and 3) achieve wellbeing (Tauson, 2017).

For children suffering with PTSD, the research on mental health outcomes and the impact on memory and learning is less abundant but seems to show similar findings (Beers and De Bellis, 2002; Samuelson et al., 2010; Yasik et al., 2007). Beers and De Bellis (2002) have shown that children with PTSD showed lower results in measures of attention and abstract reasoning/executive function. Studies by Yasik et al. (2007) and Samuelson et al. (2010), looking at children in the United States found that children with PTSD suffer from memory and learning deficits. Findings from these studies also showed that children who had experienced trauma, but did not suffer PTSD, did not suffer the same deficits. However, these Western studies may not be applicable to emergency and crisis settings as they do not take into account on-going and reoccurring exposure to stress, trauma, and chaos.

Delaney-Black et al. (2002: 283) on the other hand, show that children regardless of PTSD, if having faced trauma, 'may actually inhibit intellectual and academic functioning'. Findings from the study, again conducted in the US, showed that 'self-reported violence exposure in children was negatively correlated with IQ scores and standardized reading achievement test performance' (Delaney-Black et al., 2002: 283). Enlow et al. (2012) similarly find that children exposed to trauma in the first 5 years of age, even after adjusting for a number of factors – including gender, socioeconomic status, maternal IQ, and others, suffer long term consequences. Children demonstrated decreased cognitive scores at least until the age of eight, and children who experienced violence in the first 24 months showed even worse outcomes.

Evidence of the impact of trauma and crisis on cognitive ability is less abundant in countries affected by such atrocities. However, evidence does exist which shows that lasting impact on mental health, which, as we have established above, has strong links to memory, clear thinking, and attention. Attanyake et al. (2009) conducted a meta-analysis, examining evidence from 17 countries where children were exposed to war. Their findings showed that children exposed to conflict were more likely to suffer from depression and anxiety disorders. A study conducted in Sri Lanka with 420 school children (Elbert et al., 2009: 238) showed similar findings and that those children who had been traumatised experienced 'lasting interference' in their daily lives. Children had lower school performance and did not perform as well on memory tests.

We need to take into account how children learn, but at the same time we also have to consider the fact that those facing ongoing trauma and stressors may face additional impediments to learning. This study investigates the evidence surrounding EdTech in order to show what helps children to learn and what helps to facilitate the learning process. However, we must take note that these initiatives may have different outcomes when implemented with crisis affected populations. Throughout this study we will call these practical and contextual barriers to learning and education into question and report our results with clear caveats.

Further, we need to consider, especially in emergency settings, that learning outcomes may not be the most important objective. Childhood is a critical time for cognitive, emotional and physical development (Attanyake, et al., 2009). Therefore, we must consider the most appropriate interventions to long term wellbeing when we consider using EdTech in emergencies.

Ali* attends a Save the Children drop in centre for child labourers where centre staff encouraged him to return to school. He is several grades behind, and receives support from the centre to help him keep on top of his schoolwork. Ali is friends with Tarek who encourages him to stay in school. He is not sure if he will stay in school, but he hopes to become a mechanic some day. He wakes up every morning at 4am to go to work.

*name has been changed for security reasons

4. Methodology

4.1 DESIGNING THE RESEARCH

The purpose of this section is to describe and justify the methodology, research methods, and analysis used in this review. The process of designing the methodology for this review began by recognising some of the challenges and drawbacks of traditional systematic reviews, which were first to designed to be used in medical sciences in the 1970s with the purpose of identifying "what works" (Mallet et al. 2012). This approach is extremely useful in the field of medicine as studies are conducted using similar, if not nearly identical methods. In the end, findings can be easily compared across studies, building a clear picture of what works. However, in social sciences, such as international development and humanitarian fields, these studies can be extremely biased and present mixed findings.

The methodology of this study was developed taking into consideration many of the critiques and recommendations that have resulted from work done at the Overseas Development Institute (Mallet et al. 2012; Hagen-Zanker and Mallet, 2013). Mallet et al. (2012) present several critiques and challenges of conducting systematic reviews in development and crisis settings, while Hagen-Zanker and Mallet (2013) provide a number of recommendations of steps to take in order to combat these challenges.

Of the many considerations provided by Hagen-Zanker and Mallet (2013: 19) to ensure reviews in development are flexible and fit for purpose, their method allows for reviewers to:

- Only keep track of and collect information on studies that are included and disregard studies that are discarded
- Use an analysis that appropriately answers the research question in a sensible and appropriate way (in that a meta-analysis is not required)
- Flexibly adapt the process if challenges are encountered – although alterations must be highlighted and addressed.

The purpose of this review is to build a holistic understanding of how EdTech can impact learning, trying to ascertain what conditions lead to more positive outcomes, taking into account learning theories; impact studies; and feedback from teachers, parents, and students. We wanted to take a step back from traditional systematic reviews, which often focus almost exclusively on the results of randomised control trials and quasi experimental designs in order to decide 'what works'. In this study we wanted to investigate 'the what' alongside 'the how' and 'the why' in order to understand how investments in EdTech really matter for efficient and effective learning. Ultimately, if investment in EdTech for learning has arrived and is here to stay, we want to be able to help guide investments so they are sustainable, ethical, and lead to efficient student learning. For this reason, this review has used a wide range of data sources to build up an evidence base to understand why and how EdTech works.

4.2 STEP BY STEP PROCESS

Step 1 in this process involved the defining of the research question. The question of 'what works in educational technology' has broadly been asked many times in recent decades and investigated in a large number of recent systematic reviews (see section 5.3). However, upon an initial investigation into the research, we identified major gaps in this area, most notably in emergency settings. More specifically, we noticed what was missing from the research was an analysis which builds an understanding of how EdTech can effectively lead to or facilitate learning in emergencies. Even more so, a major gap surrounds how EdTech can be most effectively and ethically used, especially in crisis settings.

Step 2 led us to the development of a research strategy, defining of research strings, setting of exclusion and inclusion criteria, and establishing a retrieval process. Research strings were initially established by making use of the comprehensive list provided by Burde et al (2015: 84). This list made for an extremely useful starting point as it is comprehensive. Some words were removed from the

list and a column of terms related to EdTech were added for the purpose of this study (the full list can be seen in Appendix 1).

At first, these strings were applied using complex Boolean searches. However, we found these searches were overly complex and did not result in useful findings. We then started the process over, using much more simplified searches which incorporated fewer terms at a time.

We chose to search both academic and grey literature, reviewing a large body of sources. Databases used included Google Scholar, Springerlink, Proquest, ERIC, Sage Journals, and JSTOR. Searches were also conducted using individual journals which included The Journal of refugee studies, Refugee Survey Quarterly, Migration Studies, International Journal of Refugee Law, and Information Technologies and International Development (See Appendices 2 and 3).

These searches turned up 1000s of hits, which were quickly scanned by title and abstract. When a large number of hits were retrieved while searching databases, research officers would stop reviewing documents when no relevant article was seen for 2 to 3 pages, and all relevant titles and abstracts where exhausted. When using google scholar, the first 10 pages were scanned before attempting a different set of search terms. Those documents that were deemed relevant were saved in Mendeley for review in the next step. In the end we collected roughly 500 documents.

Step 3 included a second review of documents for relevance. Reviewers examined all 500 documents, closely reading abstracts and skimming documents for a basic quality and relevance assessment. Examples of documents that were excluded at this stage may have included articles that did not adequately address learning. At the end of this process 257 documents remained.

Step 4 included the final quality assessment of documents. In this stage reviewers examined documents using two tools. Qualitative documents and systematic reviews were checked for quality using Critical Appraisal Skills Programme Checklists[2] (CASP). CASP checklists include 10 questions to assess rigour, credibility, and relevance to the topic. For quantitative and mixed method studies the Quality Assessment Tool for Quantitative Studies created by the Effective Public Health Practice Project[3] was used. While many tools are available for quality assessment, all have strengths and weaknesses. These tools were chosen due to simplicity and straightforward guidance.

If any disagreements in the team took place regarding the level of quality, we re-reviewed and discussed, and decided as a team if the document should be included. Quantitative studies were only included if they were deemed medium to high quality. The authors took care not to place too much emphasis on findings from research that was deemed medium quality. At the end of this process 135 documents were included in the study.

Step 5 incorporated the classification of studies. Each retrieved study, which was deemed as quality research, was classified by the following (see Appendix # for classification sheet): Author/s, year, methodology, type of publication, outcome indicator, general findings, type of technology studied, country category, country, education level addressed, and type of education. We sought to record if learning outcomes were captured and in what subjects. Additional information such as gender issues, disability, marginalized groups, refugees, and emergency contexts was captured (see section 5.1). This categorization allowed us to do a final assessment for quality and also helped to identify blaring gaps in research.

Our final step in the process was to conduct the analysis. As stated above, as the purpose of this study is not only give a list of types of technology that work, but to understand what about tech works, we needed to understand what about each study was successful and what about the design and the delivery of the programme led to its success or failure. We not only wanted to uncover statistical significance, but to understand that if a study had positive and significant findings, what elements of the programme were successful and what patterns emerged. In order to do so we conducted a narrative synthesis.

Snilstveit et al. (2012) point out a number of weaknesses in conducting a narrative synthesis, most notably the lack of transparency and clarity. This is

2 http://www.casp-uk.net/casp-tools-checklists

3 http://www.ephpp.ca/PDF/Quality%20Assessment%20Tool_2010_2.pdf

due to the fact that methods of conducting such an analysis are not necessarily objective and formal guidance does not exist in this process. In order to combat these shortcomings, we have worked to identify and group findings by theme and present findings in tables (see section 5.2). While analysing each study, we coded findings, grouped studies by findings, and presented these groupings in tables as a sort of descriptive vote counting. The narrative synthesis developed around these findings in the following sections are then linked back to the tables. In this sense readers can visually identify the saliency of each finding. This also allow for readers to quickly identify gaps and where more research is needed.

4.3 LIMITATIONS OF THE STUDY

The research team encountered two major limitations over the course of the study. First, the research team was comprised of only English speakers, which meant that studies in other languages were not reviewed, resulting in a strong bias toward Western perceptions of progress and outcomes.

Second, impact studies, specifically randomized control trials and quasi experimental studies, from conflict and displaced settings are generally missing from the literature (Carlson, 2013; Dahya, 2017). Therefore, to address the research question and overcome this clear limitation we begin by forming a theory of learning, taking into considerations the impact of stress and trauma on children's ability to learn and retain information. We then investigate the research question by analyzing and synthesizing the findings from a large body of literature across multiple disciplines and multiple country settings where information is available. We break down the findings from studies to understand what about each initiative led to its success or failure, analysing patterns that can be applied to all settings. We then analyse and apply findings to emergency and displaced settings. Seven practitioners with extensive experience in these settings have reviewed the document in order ensure the application of findings was sound.

A Save the Children Temporary Learning Center at A Primary School in a village in Sindhupalchok District, Nepal. The school building was badly damaged and is not usable for teaching. Save the Children has worked with the community to build a Temporary Learning Centre which was completed, and used to teach students, a week before the official Back to School Date.

5. Mapping of Research

5.1 CLASSIFICATION OF STUDIES

The purpose of this section is to visually map the research retrieved and used in this review. This section allows the reader to not only see the types of studies used to generate evidence, but where findings are concentrated in regard to geography, type of technology, school level, and gender. The biases in research are rather notable in most regards.

For example, Table 5.1 demonstrates the methodological split and the broad backgrounds from which EdTech research emanates. Different types of reviews make up a large share of evidence available. For instance, nineteen systematic reviews or rigorous meta- analysis have been conducted in order to answer questions relating to 'what works' in EdTech. Twenty-one narrative and landscape reviews, which tend to include a stock taking of initiatives, have been conducted. Quantitative and mixed methods studies together provide the largest body of evidence for this report. The twenty-five theory based documents, represent a common theme in the literature, which is the attempt to bring a common form of analysis and application to the diverse market of Edtech.

Table 5.1: Methodology of reviewed studies

Methodology	No.
Quantitative	**23**
Mixed Methods	**19**
Qualitative	**28**
Systematic Reviews	**19**
Theoretical Framework	**25**
Landscape/Literature Reviews	**21**

The categories of countries (see Table 5.2) where research takes place shows a definite bias towards OECD and OECD defined middle income countries.[4] Only 35 per cent of studies took place in mainly lower income countries or what might be considered fragile[5] states. This bias is not surprising considering the high cost factor associated with EdTech. What is perhaps interesting to note is the lack of studies from a middle-income background. These economies spend more money per head on their education systems than low incomes. The large group of studies from low-income states may indicate the diverse of non-state actors involved in education in these countries.

Table 5.2: Country category of studies

Country Category	No.
OECD	**51**
Mainly OECD	**3**
Middle Income	**29**
Low Middle Income	**6**
Low Income with OECD Examples	**9**
Low Income	**30**
Fragile/Post Conflict	**5**

The breakdown of the regional coverage of this review can be seen in Table 5.3. As can be seen in the table, there is a high concentration of studies conducted in North America and Europe as well as Sub Saharan and North Africa. However, as mentioned in the methodology, the research team was limited by language and only studies that were written in or translated into English were used.

4 http://www.oecd.org/dac/stats/daclist.htm

5 Studies were catagorised as conducted in a fragile state if stated by the author of the respective report

Table 5.3: Regional Coverage

Study Location	No.
North America	14
Europe	10
Sub-Saharan Africa	22
North Africa	14
Latin America	8
South East Asia	5
South Asia	5
Middle East	8
Oceania	5
Multiple	44

As Table 5.4 demonstrates, this review found a considerable amount of literature on 1-to-1 device use. This is not overly surprising considering that tablet computers (which we examine separately) and smart phones are relatively new in comparison. When we discuss 1-to-1, we speak of other devices that children can use independently, i.e. computers and laptops. Studies which examine laptop use mostly come from the world's biggest EdTech project, the One Laptop Per Child Programme (OLPC). Desktop computer based educational programming is perhaps the most common form of EdTech that is evidenced in this review. In reports written in five years from now, or perhaps less, it would be safe to expect the amount of studies that concentrate on tablet use would increase substantially. We also separate studies that look at particular apps or a small number of apps, rather than the whole device.

Table 5.4: Type of Technology Studied

Type of Technology	No.
1-to-1 Computer	43
Smartphone	7
2G Mobile	7
Tablets	20
Radio	2
Apps	16
Other/Multiple	40

In regard to the level of education, this review found primary was the predominant level of investigation, secondary or pre-primary. All of the pre-primary studies emanated from OECD countries. It must be noted that tertiary studies were not sought in this review and many tertiary studies were discarded, due to relevance. Even still, 24 tertiary studies were still included, likely indicating that the tertiary level is the most investigated learning level.

Table 5.5: Educational Level of Intervention

Educational Level	No.
Pre-Primary	13
Primary	61
Secondary	31
Tertiary	24
Other	7

Of the studies that measured learning outcomes (see Table 5.6), an overview of subjects shows that literacy and reading outcomes were readily examined more often than maths, numeracy, and science.

Table 5.6 Educational Subjects addressed in studies

Subject	No.
Science	13
Math	20
Numeracy	10
Literacy	31
Reading	34

Table 5.7 shows that most studies did not focus on the use of EdTech among specific groups nor generally mention these groups in the studies. Most studies looked at mainstream student outcomes and did not differentiate by gender, children with disabilities, marginalized groups, or refugees. This demonstrates a major gap in the literature.

Table 5.7: Specific Groups Investigated

Category	Focus	General	Total
Gender	15	23	38
Disability	2	2	4
Marginalized Groups	9	11	20
Refugee/ Displaced Persons	9	11	20

5.2 CATEGORISATION OF FINDINGS

During the analysis stage findings from documents were coded and grouped by theme. All 135 documents were coded and the themes are reflected in Table 5.8. The table shows 20 common and reoccurring themes within the literature. The findings are disaggregated by 1) children, 2) community, and 3) the enabling conditions. What can be seen from this visual display is that the amount of evidence unequally supports findings. For example, some findings are supported by a substantial amount of evidence, while others demonstrate much more evidence is needed. Section 6 provides a narrative

Table 5.8: 20 common and reoccurring themes within the literature

Section	Theme/Finding	Source
6.1.1	Learning outcomes are not improved simply by the provision of hardware	Ale (2017) Bando (2016) Berrera-Osorio (2009) Bulman and Fairle (2016) Islam and Grönlund (2016) Genlott and Grönlund (2016) Mouza and Cavalier (2012) Passey (2016) Piper et al. (2015) Power (2014) Petko (2017) Steffens (2014) Valk et al. (2010) Wainer (2015)
6.1.2	EdTech must take pedagogical standard of design seriously	Chang and Tilanhun (2014) Chiong and Shuler (2010) Flewitt (2015) Islam and Grönlund (2016) Koutromanos (2016) Mouza (2012) Neumann (2016) Neumann (2013) Northropp (2013 Verenikin (2016) Wolf et al. (2014)

Section	Theme/Finding	Source
6.1.3	EdTech software must be tied to curriculum for optimal results	Ale et al. (2017) Dahya (2016) Hubber (2016) Hirsk-Pasek et al. (2015) Gomez et al. (2013) Genlott and Grönlund (2016) Islam and Grönlund (2016) Jabbar (2015) Kim et al. (2011) Koutromanos (2016) McManis and Gunnewig (2012) Northrop et al. (2013) Passet et al. (2016) Piper et al. (2015) Valk et al. (2010)
6.1.4	EdTech must be responsive to the learner's level	Arguel (2016) Cayton-Hodges (2015) Hirsh-Paseket al. (2015) Genlott and Grönlund (2016) Hirsh-Pasek et al. (2015) Hirsheleifer (2016) Hsin et al. (2014) Hirsheleifer (2016) Islam and Grönlund (2016) McManis (2012) Neumann (2013) Northropp et al. (2013) Kumar (2012) Koutromanos (2016) Mouza et al. (2012) Piper et al. (2015) Wolf and Wolf (2010) Zualkernan (2016)
6.1.5	Examples must be relevant to learner's context	Bulman and Fairle (2016) Carlson (2013) Dahya (2016) Hirsh-Pasek et al. (2015) Higgins et al. (2012) Hsin et al. (2014) Islam et al. (2016) Keengwee and Bhargava (2014) Kim et al. (2008) Spitzer (2014) Sultana (2006) Zualkernan and Karim (2016)

Section	Theme/Finding	Source
6.1.6	EdTech can potentially increase learner motivation (mixed evidence)	Higgins (2012) Islam and Grönlund (2016) Jabbar (2015) Jantjes (2015) Koutromano (2016) Mouza and Cavalier (2012) Tamim (2015) Zelezny-Green (2014)
6.1.7	EdTech may contribute to the acquisition of '21st Century' skills (mixed evidence)	Ananiadou and Claro (2009) Airasian and Miranda (2002) Carlson (2013) Cayton-Hodges (2015) Genlott and Grönlund (2016) Zheng et al. (2016)
6.1.8	Learners can teach themselves how to use technology relatively quickly	Kim (2012) Wolf et al. (2013)
6.2.1	Adult/teacher led scaffolding is key to productive learner engagement with technology	Ale et al (2007) Cayton-Hodges et al. (2015) Hsin et al. (2014) Islam and Grönlund (2016) Lowyck (2014) Koutromanos (2016) Northropp et al. (2013) Neumann and Neumann (2013) Piper et al. (2015) Yelland and Masters (2007)
6.2.2	EdTech must supplement and not substitute teaching if it is to be successful	Ale et al. (2017) Arguel et al. (2017) Genlott and Grönlund (2016) Hasehmi (2011) Hosman (2010) Islam and Grönlund (2016) Morpeth (2009) Restyandito (2013) Tamim (2011) Zualkernan (2016)

Section	Theme/Finding	Source
6.2.3	Teacher perceptions of technology are important for the success of programmes	Agarkar (2016) Berrera-Osorio (2009) Blackwell (2016) Blikstaf-Balas (2017) Conje (2008) Flewitt (2015) Gomez et al. (2013) Hosman (2010) Hennessy (2010) Islam and Grönlund (2016) McManis (2012) Passey (2016) Piper (2015) Qablan (2016) Kahn (2016) UNESCO (2013) Tay (2016) Vadachalam (2017) Valiente (2010) Warschauer et al. (2014) Webb et al. (2004) Zheng et al. (2016)
6.2.4	The availability of Teaching Professional Development is relevant for the successful integration of EdTech	Agarkar (2016) Berrera-Osorio (2009) Blackwell (2016) Blikstaf-Balas (2017) Conje (2008) Flewitt (2015) Gomez et al (2013) Hosman (2010) Hennessy (2010) Islam and Grönlund (2016) McManis (2012) Passey (2016) Piper (2015) Qablan (2016) Kahn (2016) UNESCO (2013) Tay (2016) Vadachalam (2017) Valiente (2010) Warschauer et al. (2014) Webb et al. (2004) Zheng et al. (2016)

Behind the Scenes of Save the Children's first VR shoot in Bandung, Indonesia.

CREDIT: SAVE THE CHILDREN

Section	Theme/Finding	Source
6.2.5	Parents Perceptions of technology are important if EdTech is to be used at home or at school	Chiong and Shuler (2010) Dahya (2016) Hsin et al. (2014) Passey et al. (2016) Qablan and Abuloums (2009) Steffens (2014) Sultana (2006)
6.2.6	Cultural dispositions towards technology and education must be considered as part of EdTech interventions	Agarkar (2016) Ames (2013) Chukwuere (2015) Dahya (2016) Forgasz (2010) Hubber (2016) Hosman (2010) Hsin et al. (2014) Islam and Grönlund (2016) Kolodziejcy (2015) Passet et al (2016) Qablan (2009) Steffens (2014) Valiente (2010) Valk et al. (2010) Warschauer et al. (2014)
6.2.7	EdTech does not necessarily represent the best value for money/sustainability	Bando et al (2016) Carlson (2013) Dahya (2016) Hennessy (2010) Passey (2016) Paterson (2007) Valk et al. (2010) Warschauer et al. (2010)
6.3.1	Infrastructure is a major barrier to successful utilization of EdTech	Bando (2016) Berrera-Osorio (2009) Carlson (2016) Conje (2008) Dahya (2016) Gulati (2008) Hosman (2010) Hennessey (2010) Islam and Grönlund (2016) Khan (2012) Paterson (2007) Qablan (2009) Steeves (2017) Vadachalam (2017) Warschauer et al. (2014)

Section	Theme/Finding	Source
6.3.2	EdTech for accelerated learning can aid in the preparation to integration to formalized education	Banerjee et al. (2007) Hirsh-Pasek et al. (2015) Lewis et al. (2016) Linden (2008) Mauralidharan et al. (2017) Mouza (2012) Nedungadi et al. (2014) Neumann (2016) Wolf et al. (2014)
6.3.3	EdTech has the potential to blur lines between formal, informal and nonformal learning	Garcia (2015) Khaddage et al. (2016) Zelezny-Green (2014)
6.3.4	Gender is not a factor that determines the success of EdTech, if socio-economic barriers are addressed in implementation.	Aesaert (2015) Chew et al. (2014) Cummings (2015) Forgasz (2010) Hilbert (2011) Kahn (2012) Kim (2012) Kolodziejcszy (2015) Power (2014) Punter (2013) Power (2014) Steeves (2017) Yang (2012)
6.3.5	Wellbeing must be considered with regards to EdTech use, however the implications for technology use and the wellbeing of children is under-researched.	Cardak (2013) Dunn et al. (2012) Emert (2013) Spitzer (2014)

5.3 SYNTHESIS OF CURRENT SYSTEMATIC REVIEWS

As can be seen in Table 5.9 a large number of systematic reviews have been conducted in regard to EdTech examining a wide variety of settings and types of technology. While very limited rigorous research is available in regard to EdTech in emergency and displaced settings, during our search for literature we uncovered a large number of reviews which examine the impact of educational technology on learning. Through our quality and relevance review process we identified 8 reviews (see Table 5.9 below) that fell within our specified criteria (in addition to 11 others that were excluded due to quality, year of publication, or direct relevance). The wide availability of systematic reviews shows that evidence that links EdTech and learning is plentiful,

The below table presents findings from the eight reviews. These reviews include the combined evidence from several hundred peer-reviewed articles, evaluations, and grey literature. Overall, examining multiple types of technology, across all regions of the world, mostly within the last decade, the research findings have a great many consistencies and none of the documents present greatly divergent results. Findings from these studies have been analysed and results are presented throughout the documents. However, the table below demonstrates that the research is not limited, and reviews are thoroughly examining a diverse range of EdTech initiatives across the world. As will be discussed throughout this report, EdTech initiatives do not necessarily take this over-whelming consensus of evidence into consideration when designing programmes to be used in emergency and displaced settings.

Table 5.9: Literature/Systematic Reviews regarding EdTech and Learning

Reference	Technology investigated	Countries/ Context	Years	Number of studies included	General Findings
Bulman and Fairle (2016)	ICT and CAI at home and school	Global (No studies from Africa)	1999-2014	31	Findings are mixed: ICT investments should not be expected to largely impact learning outcomes, including: grades, test scores and other measures of academic outcomes
Carlson (2013)	Mobile phones, internet enabled computer labs, interactive radio instruction	Global/Conflict Affected	2008-2013	12 case studies	This review, looking solely into emergency settings shows evidence is sparse; more systematic approaches to gather evidence are needed. However, when appropriately applied in contextually relevant ways, EdTech initiatives can enable positive learning experiences and improve learning outcomes. Findings showed that programmes can be cost effective once scaled up, if implemented properly
Haßler et al., 2015	Tablet use in Schools	Global	2009-2015	23	Reviews are mixed: 16 show positive learning outcomes, 5 no difference and 2 negative. The generalisability of evidence is limited and detailed explanations as to how or why using tablets within certain activities can improve learning remain elusive.
Higgins, 2012		Global (mostly OECD)	2000-2012	33	Research findings from experimental and quasi-experimental designs indicate that overall technology-based interventions tend to produce just slightly lower levels of improvement when compared with other researched interventions. The range of impact identified in these studies suggests that it is not whether technology is used (or not) which

Reference	Technology investigated	Countries/ Context	Years	Number of studies included	General Findings
					makes the difference, but how well the technology is used to support teaching and learning.
Hsin et al. (2014)	Technology supported learning (undefined) children ages 0-8		2003-2013	87 (peer-reviewed)	As for learning results, 61 studies reported positive findings, 24 reported no differences, and only 2 reported negative outcomes. Fifty-one studies of the 87 reported that effects on learning are conditional on a number of factors.
Islam and Grönlund (2016)	1:1 devices in the classroom	Global	2000-2013	145 (including 59 peer-reviewed)	This review shows mixed results and that using ICT in the classroom can lead to improved, negative, and no results. They find that only 'good pedagogy guarantees improvements.'
Power, 2014	Wide range (including radio, laptops, tablets and e-readers, CAL)	Middle and low income countries	2005-2014	83 studies (45 research documents, 20 literature reviews and 18 grey literature reports)	Access to ICT alone does not lead to positive outcomes. ICT interventions should: • be designed to enable educational change, emphasizing curriculum, pedagogy, teaching and learning, not the technology. • develop systematic MEAL, capturing changes in teaching and learning practices and learning outcomes, as well as participants' experiences and perspectives.
Tamim et al. (2015)	Tablet and mobiles	Global (Mostly USA and East Asia)	2010-2015	68 (27 quant and 41 qual)	Findings indicate a moderate effect size for the impact of tablets and smart mobile devices on student learning outcomes overall. Findings showed a significant favouring of student-centred pedagogical use of technology.

6. Narrative Synthesis of Findings/ Analysis of 'what works'

In order to understand "what works" we synthesized and analyzed the findings from 135 documents relating to EdTech. We have attempted to investigate any 'truths' or consistent findings that are reported to have an impact on learning outcomes.

Therefore, this document unpacks these findings and builds an understanding of how these can be related to education in emergency settings. There are 20 major themes and subsequent findings in this report. This is a considerable number to tackle and from which to build a framework of engagement. In order to conceptualise and make sense of the findings, we have grouped these themes and findings into three interrelated areas: The Child, The Community, and The Enabling Conditions. Save the Children believes in the rights of the child to thrive, be protected, and to learn. The right of a child to a quality education that enables them to grow and positively participate in the society is a fundamental value of the organization. This focus on the child is where our findings begin.

6.1 THE CHILD

The majority of the findings relate directly to the child and the immediate educational environment they encounter. It is important that we focus on the learner as we are working to ascertain what conditions lead to improvements in learning outcomes for those displaced by emergencies. What follows are 11 themes and subsequent findings relating directly the child including the pedagogical design of EdTech, the child's interaction with the EdTech, and other supporting factors.

As discussed in the conceptual framework (page 13) this review considers that learning: should be child centered, an 'active' process that requires children to manipulate stimuli in order to better understand; necessitates that the child be engaged and focused on the task in question; must be meaningful to the child's context and their previous learning so that it hooks onto this knowledge; and finally, promotes social interaction as a means of corroborating and building an understanding of a topic or subject.

6.1.1 Learning outcomes are not improved simply by the provision of hardware alone.

Learning outcomes are often used as an indicator to determine whether or not an EdTech intervention can be classified as a success. When EdTech is introduced to a learning environment we often imagine that it is the provision of hardware that improves the learning that takes place, thus impacting outcomes. Therefore, if the mere access to technology is linked to learning and improved learning outcomes, then we would assume to see a positive relationship among ICT in schools and ICT and learning outcomes. However, this link is not clear.

Overall, the findings of studies evaluated throughout this narrative analysis consistently show that the provision of hardware alone is not enough to improve learning outcomes (Piper et al., 2015: Genlot and Grönlund, 2016; Mouza and Cavalier, 2012; Petko, 2017; Steffens, 2014., Berrera-Osorio et al., 2009). Bulman and Fairle (2016: 46) in their systematic review of ICTs influence in schools and at home, they concluded that the influence on learning outcomes of ICT use in schools is 'ambiguous'. Steffens (2014: 561) goes further stating that 'there is no linear relationship between ICT use and achievement in PISA'.

Determining a causal relationship between ICT access and learning outcomes can be difficult to establish. For example, whether at home or at school, ICT access is often correlated to a wide variety of factors. These can include variables such as wealth and geographic location, but can also include variables that are difficult to measure, such as attitudes toward ICT usage and the beliefs in its benefits. At the same time, learning outcomes can also be linked to a large number of social and demographic factors. Schools in wealthier areas may have more access to ICT and less wealthy schools might be included in targeted

Chandika Bhattrei* has been a teacher at a Primary School in a village in Sindhupalchok District, Nepal. She has taught at the school since 1998. The school was completely damaged and is not usable for teaching. Save the Children has worked with the community to build a Temporary Learning Centre which was completed, and used to teach students, ahead of the official Back to School Date.

programmes so that they are more likely to have ICT (Bulman and Fairle, 2016). However, even when adjusting for income and other factors, Bulman and Fairle (2016) present evidence that shows that this link may not exist.

A study by Petko (2017) using large scale assessment data, provides evidence that the link between ICT access and test scores is indeed less straight forward than one might assume. According to this study no correlations were found among ICT usage in schools and test scores. However, when linked to quality of technology available and attitudes associated with technology, outcomes may be positive. For example, the use of digital entertainment at home is negatively correlated with learning outcomes, but the use of other types of technology, coupled with positive attitudes towards technology are related to positive outcomes. While Petko submits that the results are rather limited – and no causal link has been established-, results might lend evidence to the argument that the pedagogical design of the EdTech, considered application, and use are more important than its mere presence.

A study from Wainer (2015) looking at 5th and 9th grade students in Brazil, showed that computer ownership at home once adjusted for social and economic status had positive correlations with learning outcomes. However, when examining internet connectivity and test scores, Wainer finds a negative correlation for 5th grade students and positive for 9th grade students, though not statistically significant. This poses questions regarding distraction and the most useful types of ICT and how they are used. More evidence is needed to understand this link.

According to Steffens (2014: 554) there is a much more nuanced relationship between ICT use at home and learning outcomes, if just having access to ICT results in better learning, PISA scores should have increased incrementally alongside the increase in tech usage. However, no "linear relationship between ICT use and PISA results" exists. According to Steffens, to a certain point, as ICT usage goes up so do PISA scores. However, beyond this set point, as ICT use goes up, PISA scores go down. This includes ICT use for both entertainment, and school related activities. This study provides evidence that the type, amount,

*name has been changed for security reasons

and engagement with technology matters and that families' attitudes and engagement practices with ICT matter for learning outcomes.

According to Islam and Grönlund's (2016: 208) systematic review of 1-to-1 computer interventions, the influence EdTech has on teaching and learning 'critically depends on the implementation method which is generally sensitive to existing teaching methods'. This concentration on how and not what was reinforced by Glenlot and Gronlund (2016: 78) who stated that 'only when ICT is used to support other pedagogic factors that have been shown to have positive impact more efficient and effective' (Genlott and Gronlund, 2016: 78).

From this macro level perspective, we can conclude that the mere access of ICT in schools or at home does not implicate learning outcomes on its own. A number of other variables will matter for the successful integration of EdTech. Research seems to show there might be a right amount of technology and a right way to use technology for it to be beneficial for learning outcomes. This is an important finding for those implementing EdTech programmes, especially in displaced and emergency settings where children encounter a number of distractions on a daily basis, which can impede cognitive function. Overall, we need to determine the right amount and right type of technology so that families and schools are optimizing the learning opportunities of children. Making the assumption that any technology is good technology could lead to negative outcomes for children who are already at a disadvantage.

6.1.2 EdTech must take pedagogical standard of design seriously

As demonstrated in the previous section (6.1.1), the provision of hardware is not in and of itself enough to improve learning outcomes. In this sense, technology can be used as an educational tool, and like any tool it can be used in a range of ways. There is a great deal of literature which discusses how tools can best be used to assist in the learning process. These were alluded to in the conceptual framework (Section 3.2), which situated learning as: 1) active learning, 2) with content that promotes engagement and avoids distraction, 3) and is relevant to the learners' lived context so that it 'hooks' onto what they have previously learnt and provides an element of social interaction with other learners. EdTech is no different; it needs to be constructed with these principles that have been developed through practice and theory for a very long time.

Hsin et al. (2004) in a systematic review of literature relating to young children's use of technology, claim that the teaching and learning approaches applied to the design of the EdTech do indeed matter. Children learn better when we design programmes that utilize evidence from the learning sciences and apply these findings to practice (Kempler and Keakick, 2006; Passey et al., 2016; Sonder, 2006 cited in Mouza and Cavalier, 2012: 155). Hirsh-Pasek et al. (2015: 7) state that the 'pedagogical structure of the environment determines what kind of learning' occurs. As such, focus needs to be on what form of activity is being promoted within the EdTech in question, and not just the technology itself.

These principles are not always readily engaged with by commercial providers of Edtech. Work by Lunch and Redpath (2014 cited in Flewitt et al., 2014: 297), argued that 'whilst commercially produced apps may use state-of-the-art imagery, they are mostly based on outmoded behaviourist and/or transmission theories of learning'. This issue was reinforced by Wolf et al. (2014: 14) where they argued 'the need for far more, theoretically grounded apps' was evident. Verenikina et al. (2016: 389) maintain that when it comes to early years apps, they are designed by adults 'using pre-determined and predictable coding scripts, within content areas that they anticipate the children will be interested in.' There is, it appears, a dearth of engagement with the evidence of how we learn utilized in the development of EdTech. That said there are examples that have been developed with this evidence in mind, such as the UK based NGO: OneBillion

The focus must, according to Passey et al. (2016: 123), be around 'support for cognition' rather than on 'presentation of content'. The presentation of content is indicative of rote learning, which does not require active engagement and manipulation on the part of the student. Cognition implies active manipulation of the learning object by the learner. For example, take the building of a Lego house, rote learning approaches would show the learner the house, give them the

instructions, then ask them to write down how to build the house. Active child centered learning would involve giving the child the bricks, and asking them, with a model or a guide (scaffolding), to build the house. They would therefore be actively constructing the model as they learnt.

Chi (2009) provided a clear taxonomy of learning that drew from findings in the learning sciences, in which they argued learning must be active, constructive, and interactive. These more collaborative approaches to childrens' interaction with EdTech were referred to by Flewitt et al. (2014: 15) in a qualitative study that addressed early literacy interventions with iPads, as "open content' apps, where users could personalize activities, engaged children more deeply and creatively in learning tasks' and they report that children developed a more rounded learning experience than the 'closed' more behaviourist apps.

Mouza and Cavaliar (2012: 146) conducted a longitudinal study looking at one-to-one computing in the education of high-risk students in the USA. The authors state that there are few 'studies that have looked at changes in the learning environment or identified instructional practices' that make the most of EdTech, or in this case laptop computers. This is not to say that teaching approaches must replicate the exact processes enacted with previous educational tools, but that the form of learning encouraged via EdTech interventions is significant. As stated by Islam and Grönlund (2016: 206), in their systematic review of international literature associated with one-to-one laptop initiatives 'only good pedagogy guarantees improvements' in learning.

What the findings from a number of these studies show is that it is not simply the EdTech itself, but the wider educational activities that promote collaboration between learner and learners, as well as learners and teachers, that promote better learning outcomes. More consideration needs to be given to those engaging in the provision of EdTech to look at what makes successful learning activities if EdTech is to be utilized to its full potential.

The implications of these findings for education in emergency settings are clear. If improving learning outcomes is the goal of an intervention, there must be an active attempt to produce software that encourages active, engaged learning, which connects to the child's previous learning and promotes social interaction with the subject at hand. Fortunately, there are positive examples of this to work from, and it does not have to restrict commercial providers of Edtech. Indeed, it can free developers to be creative within a framework that has been proven to work, and can assist teachers with the integration of the Edtech into the teaching of the curriculum.

6.1.3 EdTech software must be tied to curriculum for optimal results

Curricula are in a fundamental sense, an attempt to coordinate and develop a child's exploration of a particular subject in a logical and progressive manner, which builds on their previous learning and progresses towards more complex material that follows. EdTech software has the potential to assist with this progression. In emergency settings this progression is almost always disrupted, and, as such, our goal should be to get children back on track to attain the educational goals.

McManis and Gunnewig (2012: 22) in their framework for early years teachers' engagement with Edtech argue that there 'is growing recognition of the importance of incorporating technology in meaningful and authentic ways to the curriculum'. A key and consistent finding during this review is that for the greatest influence on learning outcomes to occur, EdTech must be integrated within a model of curriculum (Hirsk-Pasek et al., 2015; Passey et al., 2016; Islam and Grönlund. 2016; Valk et al., 2010; Genlott and Grönlund, 2016; Northopp et al., 2013; Gomez et al., 2013; Piper et al., 2015; Dahya, 2016; Jabbar, 2015; McManis, 2012). The need for education projects to engage with curricula to build sustainable change, according to Dahya, (2016: 30) 'is no different when working with ICT'.

A study conducted by Piper et al., (2015: 12) compared three separate EdTech interventions in the Kenyan education system. The authors found all three to promote positive learning outcomes in English and Kiswahili when compared to the control (which received the same intervention but without any use of technology). The study did not find a statistically significant difference between the tablet use among teachers, instructional supervisors, and

an e-reading initiative. What was consistent amongst the interventions was that these were aligned to the national curriculum. It did conclude that, as well as the need for teacher training to optimize integration of EdTech, the government must 'address ICT as an instrument of teaching'.

Ale et al. (2017) conducted a longitudinal, quasi-experimental study that assessed the impact of in-depth contextualization prior to the implementation of One Laptop Per Child (OLPC) projects in nine rural Indian primary schools. This study focused on changing the manner in which the OLPC programme contextualized its intervention and included a 'specific OLPC-subject syllabus [that] was created collaboratively with teachers to integrate with the pre-existing curriculum' (Ale et al., 2017: 779). In this study they worked with the teachers already in place to 'provide structure and guidance' on how to use the OLPC programmes with their classes. In addition to this, device maintenance was provided, this contributed to a positive influence on learning outcomes, over the control group. The results (Ale et al., 2017: 784) 'demonstrated the role of contextualized technology in rural Indian classrooms' as being beneficial to learning outcomes. Without this support teachers were less likely to feel comfortable delivering the curriculum via the EdTech device, this support was relevant to the context and the need of the teaching staff.

Neglecting alignment with the curriculum can also increase pressure for teachers. Kim et al.'s 2011 mixed methods study based in two Mexican primary schools near the USA border, addressed differences in technology engagement between a rural and an urban group of students. The authors (Kim et al., 2011: 477) reported that teachers expressed that 'the learning contents of the mobile devices did not align with the curriculum and lesson they were teaching'. The study demonstrates a secondary issue associated with a lack of integration of EdTech into the curriculum, when an intervention is not well aligned to curriculum, teachers must work to incorporate such an intervention into the learning of the students. This could exacerbate the second-order barriers associated with teachers' attitude to EdTech (see section 3.2.6 for more information on second-order barriers).

These findings demonstrate that EdTech needs to be incorporated into a plan for learning. Ideally this will align with a national curriculum that the child can track in the years ahead and will pull from the skills and knowledge that the child has previously attained. While in an emergency or crisis setting this can be particularly challenging, it is an important consideration. If implemented properly, EdTech programmes can help to fill-in the gaps during disruption and increase the speed with which learners can return to full time education. This will require working with ministries, civil society, and teachers to understand the missing elements. To enable a transition through education it is important that the EdTech software is responsive to the learners' level and needs as they progress through the curriculum. Overall, we cannot just decide what a child should know, but should build on their pre-existing skills and experience.

6.1.4 EdTech must be responsive to the learners' level

Making mistakes is a critical part of learning. When a child encounters a task that is too difficult for them, a positive response is for them to seek assistance. This is often referred to as 'help seeking behaviour'; if the learner receives the right support they can renegotiate their previous attempt and move onto the next issue. If the tasks that follow continue to be too difficult, the learner's motivation to continue is likely to reduce. The work needs to be suitable for their developmental level and adaptive to their mistakes for engaged practice on the part of the learner to continue.

The literature reviewed for this report has consistently shown that for EdTech to result in positive learning outcomes, it must adapt to the level of the learner (Zualkernan, 2016; Cayton-Hodges, 2013; Arguel, 2016; Hirsh-Pasek et al., 2015; Neumann, 2013; Hsin et al., 2014; Hirsheleifer, 2016; Mouza et al., 2012; Islam and Grönlund, 2016; Piper et al., 2015; and Glenlott and Grönlund, 2016; Valk et al., 2010). This is often referred to as personalized learning which Wolf and Wolf (2010: 15) refer to as a 'student-driven learning path'. The authors claim that 'each student's path may vary not only in terms of when and where learning takes place, but also in terms of the modalities and instructional strategies used'.

Northropp et al. (2013: 523) also maintain that the content 'needs to be accessible to the student and matched to his or her appropriate developmental learning level' for it to be effective. This extends beyond the realm of learning alone and moves into motivational issues. As Hirsh Pasek et al. (2015: 12) argue, if the 'content is too easy or too familiar, children may stop' and as highlighted by Lewis (2016: 12) 'learners need content that meets their academic, linguistic, and skill needs'.

EdTech software can, if appropriately designed, offer a range of hints, tutorials and guidance in the software. As Cayton-Hodges et al. (2015: 16) stress software can 'guide the user along the path through challenges,' and Genlot and Grönlund, (2016) found this formative assistance to be beneficial to learning outcomes in literacy. Cayton-Hodges et al., (2015: 16), in their survey of maths apps available on the Apple App Store identify that it is important to reward 'help-seeking behaviors'. They allow teachers to assess what the learner understands, and are a sign that the child is comfortable in the situation and seeks help to improve their own understanding.

Hirshleifer (2016: 6) argues that appropriate software 'allows students to learn from mistakes as they complete the exercise' which in a busy classroom is a tool of real value, to the learner and the teacher. In an emergency or crisis situation, where class sizes are often bigger and capacity is stretched (Burde, 2015) EdTech software with the ability to provide scaffolding support for a teacher/facilitator could be a real asset. It could (Cayton-Hodges et al., 2015: 16) 'keep the user engaged, on task, and moving forward which is positive to the learning experience'. This is particularly important in non-formal education settings where there are learners across a range of age ranges working in the same class. EdTech that responds to the learners input can provide the teacher/facilitator with more time to go between learners, and not constantly have to field questions from students at different stages in their understanding. Findings by Islam and Grönlund (2016: 205) comprehensive systematic review indicate that if EdTech is adaptive to the learners level, this increased 'focus on the learning tools may help reduce students' behaviour problems' and subsequently allow teachers to spend more time teaching, as opposed to dealing with behavioural issues that arise through a lack of understanding or completion of a task.

Nour*, 14, lives with her grandmother siblings and extended family. She has returned and dropped out of school several times and says that classes are rushed and hard to keep up with and that teachers are impatient with students. She struggles to see the value in education as she does not believe she will do well at school in its current format.

*name has been changed for security reasons

Though there are clear benefits to adaptive and personalized learning there are still areas for improvement (Cayton-Hodges et al., 2005). Cayton-Hodges et al. (2005) state that there are three main forms of feedback provided by educational apps found on tablets; these were: *status feedback, corrective feedback,* and *conceptual feedback*. They found that 'conceptual feedback is less common' than other forms of feedback and it is this form of feedback that engages higher order thinking, such as evaluation (Cayton-Hodges et al., 2005: 8). This raises questions about what form of learning is being encouraged and the depth and quality of the feedback that is currently being most readily provided by EdTech software. EdTech that provides conceptual feedback could be even more important for those in displaced or emergency settings, where teachers are not as likely to be formally trained (Burde, 2015).

These findings indicate that if the EdTech is adaptive to the learner's developmental level, is linguistically appropriate, and scaffolds learning for students, then it can help to foster a more proactive educational environment that has the potential to make school more attractive for those in emergency settings. Other considerations include using EdTech that is age appropriate and not just appropriate to the learning level, particularly in education in emergencies or situations of displacement. Due to the fact that children are likely to have had their learning disrupted, children fall behind in school. If EdTech is designed exclusively for these earlier grades and does not adjust for the older learner, it can lead to the demotivation of the learner.

Indeed, if these aims are achieved then EdTech can be used to promote sustained engagement by the student and will promote 'minds on' active engagement. This is an extremely important consideration in emergency settings where children are often pushed out of education and pulled in to more harmful coping strategies, such as child labour and early marriage. Children and families in these situations need to feel that a child's time at school is time well spent.

6.1.5 Examples must be relevant to learners' context

As we have seen it is possible for EdTech if it is responsive to the learner's developmental level and tied to the appropriate curriculum, can be an educational tool of real value. Part of reason that EdTech, or learning in general, must be tied to the curricula in order to lead to positive learning outcome is due to context. Curricula generally reflect the context in which they are devised, and it is important that the examples used are compatible with the learners understanding of the world. The literature reviewed shows a clear need for learners' context to be considered (Hirsh-Pasek et al., 2015; Keengwee and Bhargava, 2014; Kim et al., 2008; Dahya, 2016; Carlson, 2013; Sultana, 2006; Islam and Grönlund, 2016; Hsin et al., 2014). All new learning needs to (Ausubel, 1968) hook onto the old learning the child has done before if it is to be sustained.

Keengwee and Bhargava (2014: 745) in their study built out of three case studies in mobile learning recognize the need for technology to be implemented and designed in a manner that is 'relevant to the social and cultural context of learning'. Hsin et al. (2014: 93) in their systematic review argue that the 'content of the technologies also plays a role in the children's development'. If for example, visual tools, avatars, or examples are appropriate to the child's culture then they are more likely to engage with the software readily. This extends beyond interactions in a formal classroom set up. As Hirsh-Pasek et al. (2015: 93) argue when content is contextually appropriate, the chances for 'interpersonal meaning as a shared parent-child experience, potentially connected to previous and subsequent family activities' are greater. EdTech has the potential to increase the opportunities for social interaction in family settings, which we know to be essential to learning.

Dahya's landscape review of education in emergencies (2016: 19) argues that the projects that produce the best learning outcomes in emergency settings take a 'learner and community-centered approach to ICT for education [that] is culturally relevant'. This finding was echoed by Burde's review of EIE (2016) and reinforced by Sultana (2006) in a study based in Hebron, in the West Bank, Palestine, during the Israeli military's second *Intifada* in 2001. The conclusions of this qualitative study found that community engagement and contextual understanding led to better designed learning interventions. This was not simply down to contextualized examples, there was a hugely committed educational community and strong parental engagement, but the learning was relevant. Indeed Sultana (2006: 75) stressed that many

distance-learning initiatives struggle because they 'fail to connect to the realities of the context in which they are applied'. In a war zone, post-conflict setting, or crisis there are ample incentives to keep children at home. If the learning does not speak to the context of the child, or indeed the parent, then it has less of a draw.

These studies show the need for EdTech to be accessible to the lived experience of the child using the software. Most importantly, designers of EdTech need to ensure that the learning is relevant to the child's cultural context, and in emergencies with diverse populations working with potentially limited resources, this poses a real but achievable challenge for those engaged in education in emergency settings. EdTech providers need to take this challenge seriously if learning engagement is to be sustainable and at an optimal level.

6.1.6 EdTech can potentially increase learner motivation

The use of EdTech is often cited as a contributing factor in increasing students' motivation (Mouza and Cavalier, 2012; Islam and Grönlund, 2016; Jabbar, 2015; Koutromano, 2016; Zelezny-Green 2014; Higgins, 2012; Tamim, 2015; Jantjes, 2015). This is an important, but perhaps unsurprising finding. It shows that EdTech has an allure that is worth considering for those working in education in emergency settings where education is but one option for many children in displaced settings.

Islam and Grönlund (2016: 200) in their systematic review of one-to-one computing initiatives stated that increased engagement and motivation are one of 'three most frequently cited findings on positive impacts' of EdTech. Mouza and Cavalier (2012: 149) in their review of One-To-One computing in education for at risk high school students in the USA stated that the use of laptops can increase 'student motivation and persistence in doing school work'. This noted increase in persistence is positive, as EdTech can increase children's self-efficacy in tasks, which is known to be an important aspect of learning.

However, some studies have found that motivation may wane over time (Tamim et al., 2015) and that students who are accustomed to using technology may be less motivated than those who are unfamiliar (Gulati, 2008). Therefore, we must build an understanding around what it is about EdTech that has the potential to motivate students rather than acting on the assumption that tech motivates learners in and of itself. It is important that any motivation that comes with EdTech is maintained through engaging with students and considered software that promotes learning in a sustainable fashion. At the same time, we have to weigh the costs and benefits of using EdTech in order to increase motivation. In other words, given the overall shortfall in education in emergencies funding, should we implement EdTech only as means to increase motivation and attendance, when lower cost interventions are readily available?

6.1.7 EdTech can potentially boost learner's '21st Century' learning skills

The question of how to obtain the skills necessary to thrive in the 21st Century is the subject of much debate in education circles. These skills are often associated with EdTech, and they include skills such as: problem solving, collaboration, analysis, evaluation, and synthesis. According to Genlott and Grönlund (2016: 68) in the near future learners will be expected to 'find, select, interpret, analyze, and produce information that is relevant to them'. 21st Century skills are widely considered to be 'higher order skills' and are more difficult to engender in a learner than mere comprehension (Airasian and Miranda, 2002: 249). These skills require the learner to not only understand what has been covered, but to be able to engage with who has written it, and potentially why they have done so.

Why these skills are so important is complex. One argument is related to the changing demands of industry in modern economies. Ananiadou and Claro (2009: 6) in a paper on the subject for the OECD stated that 'the current century will demand a very different set of skills and competencies from people in order for them to function effectively'. The forms of work will likely render the current definitions of literacy insufficient. Another argument relates to the need for learners in conflict settings to interrogate the validity of information they encounter, especially considering the politics at the time of writing.

A systematic review of one-to-one laptop environments by Zheng et al. (2016: 1074) concludes that there was 'a wide consensus in the studies we

reviewed that the use of laptops promotes 21st-century learning skills'. At the same time, Zheng adds that 'studies rarely attempted to operationalize and systematically measure the growth of 21st-century skills'. Therefore, what these skills are and if they are adequately achieved is still up for debate.

This finding is corroborated by Islam and Grönlund (2016: 214). Islam and Grönlund (2016: 214) go further to state that these skills 'must be developed not in competition with, but alongside and integrated with 'traditional' skills'. This leads back to the previous finding (section 6.1.2) that 'EdTech must take pedagogical standard of design seriously'. If EdTech software is designed in a manner that promotes collaboration, critical thinking and active problem solving there is no reason why such skills cannot be developed through EdTech use.

What we do know is that these 21st Century skills are important in emergency settings and in post-conflict and peace building scenarios. The ability for young people to not only read, but analyze multiple sources of information, and have the skills and self-efficacy to critique their origin or intention is vital for young people who might find themselves living in a hostile environment. Not only this, but for learners who have had their education disrupted it is important that they are equipped with skills that are relevant to their potential work places in the future. To do so they must be furnished with strong foundations in which to build these 21st Century skills. The foundation is of fundamental importance.

6.1.8 Learners can often teach themselves how to use technology quickly

It is often stated that young people pick up technology very quickly, that they can teach themselves how to use phones, or how to use tablets at a rate that often astonishes their parents and teachers. There are implications for the programming of EdTech interventions, such as whether time should be spent teaching children how to use technology, or if more time should be dedicated to explaining and engaging with the content of the curriculum.

Kim (2012) conducted a comparative analysis of a game-based learning model in low socioeconomic communities in rural India. The study drew from six marginalized communities from across India, working with 210 children aged 6-14 years old. Students were given EdTech hardware that they had never encountered before, and very quickly taught themselves how to use it. In the study, Kim (2012: 7) reported that all the children 'could adopt and teach themselves new technology without specific interventions by adults'. The author further proposed that learners transitioned through four stages when learning how to use the device, which they labeled 'Exploration, Recognition, Interaction, and Iteration'. They worked in groups to affectively support and teach one another how to use the devices.

Work by Wolf et al. (2013: 12), with children in two villages in rural Ethiopia also supports this finding. The study showed that children are able to teach themselves the technical, or practical aspects of EdTech hardware, in this case with Android tablets. In this study tablets were given to a group of children in a rural community that had no recognized school or literacy amongst its adults or children. By the end of the study 'all the children [were] completely "computer-literate" with the tablets'. These two studies represent a level of self-efficacy in children that is positive for those wishing to engage with EdTech to reach socially excluded learners.

This finding has implications for EdTech use in general and for emergency settings. Children, at least in these cohorts, did not need extensive support in learning the technical aspects of simple EdTech devices. In fact, if left to explore the devices at the outset they can collectively build an understanding in a child-centered manner. However, a word of caution. Technical competence is one aspect of learning. It does not mean that they could teach themselves the curriculum devised and delivered through the apps or the hardware. Indeed Wolf (2013: 13) stated that no 'child in either village was able to decode the words in the decoding task'. This is unsurprising, learning the connotations associated with a language for example are not a simple task. It appears that to get to the more productive, or higher levels of learning requires adult intervention. What this finding can mean for those engaging in EdTech is that the evidence shows that providing 'technical training' for young people may not be the most productive use of resources, and that a focus should be on supporting cognitive and affective learning.

6.2 THE COMMUNITY

When we refer to 'the community' in this review we refer to all actors that are directly and indirectly engaged with a child's education. This can include: teachers, school officials, parents, community organisers, local NGOs, policy makers, religious leaders, education department officials, and governments. The research demonstrates that a large range of actors need considering, if the intention is to promote sustained improvements in learning outcomes for those affected by emergencies or disasters.

6.2.1 Adult/Teacher led scaffolding key to productive learner engagement with technology

As we have seen in the analysis so far, there is great potential for EdTech to provide personalized, contextualized, and engaging activities to support learners in their education. These represent three of the four pillars of learning identified in the conceptual framework (page 12). The final pillar of learning is the need for social interaction to reinforce the positive learning experience. The literature has shown that adult or teacher led support is an important means for this social interaction.

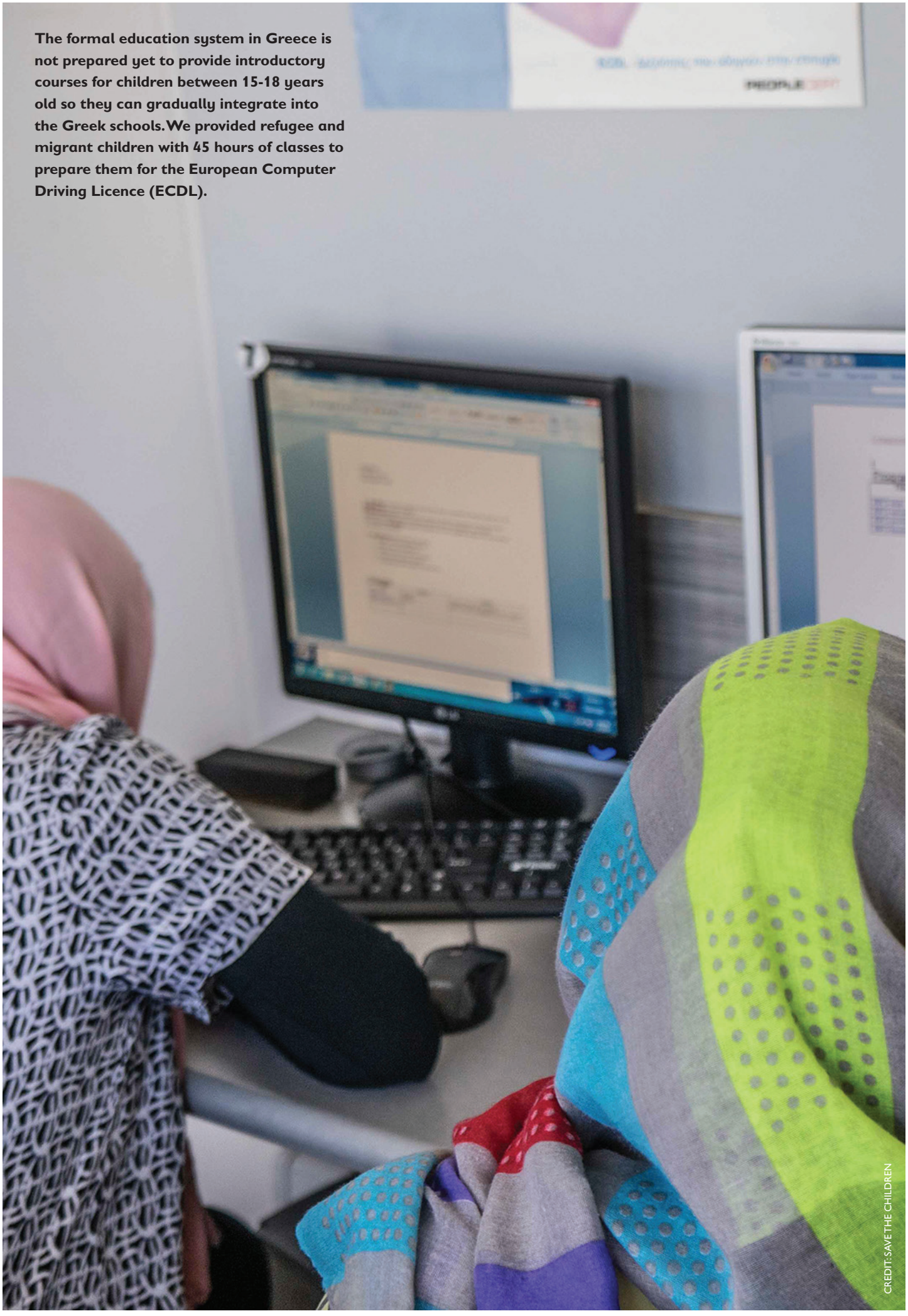
As children encounter new theories, ideas and examples, they look for support. The literature demonstrates that children benefit from having their engagement with EdTech mediated by an adult or teacher (Islam and Grönlund, 2016; Piper et al., 2015; Koutromanao, 2016; Northop et al., 2013; Neumann and Neumann, 2013). These studies reinforce that when looking to engage children in high quality, sustainable learning, the examples, and iterative affective support that adults can provide is valuable to ensuring such engagement is productive. This is not to say that EdTech software does not attempt to scaffold information for users, however Cayton-Hodges et al (2015: 15) highlight that in-app scaffolding cannot 'differentiate a careless error from more serious misunderstanding'. At present, only an adult can provide this comprehension for learners.

In the review conducted by Hsin et al., (2014: 92) which investigated young children's use of technology and its influence on their learning reported that adults make up a 'critical component in the typology for conceptualizing the interplay between children's learning and their technology'. EdTech is a means of engaging in learning in a new and exciting manner, therefore it follows that children will need support engaging appropriately with this learning tool so as to keep the focus on learning.

This engagement, whether in formal or informal settings, is referred to as scaffolding (Vygotsky, 1978). This temporary staggering of learning tasks enables the child to interpret new learning in a logical and progressive manner. There are three forms of scaffolding relevant to our understanding of EdTech use. Yelland and Masters (2007) draw attention to *cognitive scaffolding* which takes the form of teacher/ adult questioning of an activity to further engage the child in the learning process, for example "If this the right shape, what do we need to do next to make it fit this position?". The second form is referred to as *affective scaffolding,* which is best understood as 'the emotional dimension of human behaviour' and learning (Lowyck, 2014: 59). This form often entails positive or negative reinforcement of behaviour related to a learning topic. Finally, there is *technical scaffolding*, which relates to the child's interaction with the hardware itself, for example "Can you show me how to play that video again?".

Northropp et al. (2013: 536) in their evidence informed framework for using iPads to build early literacy skills recommend that 'use of technology be coupled with effective instruction' to promote learning and that adults 'explicitly teach the content before introducing the app'. This call for *cognitive scaffolding* helps to avoid misconceptions by the child and reinforces that (Northropp et al. 2013: 535) 'guidance and feedback provided by the teacher are crucial' to positive engagement. This *cognitive scaffolding* situates the activity as learning, and not just play, reinforcing that the engagement with technology is purposeful and not an end in itself.

The need for *technical scaffolding*, which involves providing support on how to use a device, was reflected in work by Ale et al. (2007: 784) and states 'the active participation of teachers in guiding, assisting and monitoring laptop use was crucial in direction how children learnt'. This reinforces the need for adults/facilitators/ teachers to be present to assist children through their work. What is particularly pertinent about this work is that it is not



The formal education system in Greece is not prepared yet to provide introductory courses for children between 15-18 years old so they can gradually integrate into the Greek schools. We provided refugee and migrant children with 45 hours of classes to prepare them for the European Computer Driving Licence (ECDL).

CREDIT: SAVE THE CHILDREN

simply teachers who influence and shape children's interaction with technology, but a wider group of actors in children's lives. A study by Neumann and Neumann (2013: 235) that looked at tablets as a tool for stimulating emergent literacy in young children argued that *technical scaffolding* is often carried out 'through parent-child interactions children learn how to use the tablet'.

The review by Hsin et al. (2014: 92) goes further by drawing focus to the fact that to optimize engagement 'adults provided them with a safe climate, encouraged them to participate in conversation, involved them in establishing the goals of the activity' which demonstrates that for effective learning the tool and the pedagogy are crucial, but so too is the wider wellbeing of the child. This has important implications for education in emergency settings.

Neumann and Neumann (2013) found that all three areas of scaffolding are important for children's engagement with tablets, as a means of reinforcing positive behaviour, developing learning, and promoting technical competence. According to Neumann and Neumann (2013: 235) 'scaffolding can also help children master tablet operation skills' and indeed stimulate child-parent interaction. This represents an area of EdTech in need of greater investigation.

What these studies go some way to demonstrate is that effective support and adult-led scaffolding are of real benefit to the students' engagement with their studies. Children need guidance and indeed seek reassurance from adults just as they do in other learning environments, formal or informal. If this support, that spans a range of areas of learning is not provided, then it will affect the learning outcomes of the children using the technology, and even risk the development of poor habits and potentially lead to frustration and disengagement on the part of the learner.

Further, these interactions can help to foster stronger emotional bonds and engage parents in children's learning. Although aspects of cognitive and technical scaffolding can be provided by EdTech software, EdTech is not yet in a position to actively comprehend what exactly a learner misunderstands when an error occurs. What the implications are for education in emergency settings are clear. We need to ensure that all adults in the children's immediate environment, and their teachers, are comfortable and have the necessary literacy levels to use the technology themselves. If they are not, then they will struggle to scaffold and help the child learn. However, if they are, then they are much more likely to engage and promote learning on the part of the children which ultimately is to the benefit of children's learning outcomes. The next finding of this review reinforces this need for EdTech to play a supporting role in learning, not a primary role.

6.2.2 EdTech must supplement and not supplant teaching if it is to be successful

> **ICT can replace teachers and organized learning only in rare instances; but it can provide *effective* support to education, especially when supplemented with teacher training (Lewis et al. 2016: iv).**

As previous findings have demonstrated, EdTech can play an important supporting role in enabling learners to engage with their education. It is a useful teaching tool. Tools are best used for the task they are appropriate for and should not be expected to perform all of the complex tasks in a classroom. The literature covered, consistently demonstrates that for optimal results EdTech should support teachers in the classroom and not attempt to substitute them (Tamim, 2011; Islam and Grönlund 2016, Hosman; 2010; Morpeth 2009; Restyandito, 2013; Hashemi 2011; Genlott and Grönlund, 2016).

A comprehensive meta-analysis by Tamim et al. (2011: 16) concluded that technology use in the classroom had 'significant positive, small to moderate effect sizes' favouring its utilization in the classroom. Crucially this work demonstrated that interventions which support instruction 'compared to technology applications that provide direct instruction' had a 'significantly higher average effect sizes'. The difference between these in real world terms could be a piece of software that students use to guide their whole path through an algebra module, and a piece of software used in conjunction with the teacher to, for example, demonstrate the practical application of Pythagoras' theory.

Islam and Grönlund (2016: 204) in their detailed systematic review of 1-to-1 computing in schools found that EdTech could, if appropriately used

Children participate in an Arabic language class in one of the 10 temporary learning spaces managed by Save the Children in Jed'ah IDP camp.

increase the opportunity for 'teacher-student communication and student-student communication'. These interactions are fundamental to building 'improved relationships that in turn help learning productivity'. If for example, a class is being led by a computer-generated avatar, then all the learners will likely have headphones on, and therefore the chance for interaction is diminished. If the EdTech is used to supplement the teacher's actions in the classroom, it provides them time to engage on a one-to-one level, more often. Islam and Grönlund (2016: 212) also reported evidence in the literature of a reduction in 'disciplinary problems' in classes the integrated laptop use. With the extra time teachers have to interact with learners, it is not difficult to see how overall student behaviour could improve.

The work of Ale et al. (2017: 784), which focused on the contextualization of One Laptop Per Child (OLPC) projects in rural India 'supported claims on the centrality of teachers in educational contexts' where EdTech was integrated. This does not have to imply that teachers lead every activity but that they are key to influencing 'the development of efficacious beliefs and successful action' (Sivandani et al., 2014 cited in Ale et al., 2017: 284). Teacher's ability to encourage self-efficacy in students is key to understanding the importance of EdTech supplementing teacher's actions and not replacing them. Self-efficacy is defined by the psychologist Bandura (1994: 2) as 'people's beliefs about their capabilities to produce designated levels of performance'. This belief is reinforced, or indeed improved, through teacher's *affective scaffolding* of tasks, and promoting a sense in students that perseverance will bring rewards. Izmesti (2012 cited in Zualkernan 2016: 244) states that 'ICT can help in personalization by presenting content in an engaging and attractive form, helping teachers record, and constantly monitor the progress of each student'. Students need to be supported in their affective learning, as much as other areas of learning. Zualkernan (2016) in a review of personalized learning for developing countries stresses that it is still beyond the reach of most EdTech programmes to engage with a learner on this affective, or emotional level. This was supported by Arguel et al.'s (2017) study that assessed EdTech software's ability to recognize student confusion levels. If the software supports the teacher, then they can provide this engagement more readily.

Hosman (2010: 60) assessed a case study of St Julie Model Primary School in rural Buseesa, Uganda. The in-depth analysis of the integration of ICT into this school is used to build a model of best practice, one aspect of which 'is an understanding of technology as an enabling tool and a compliment to existing teaching and infrastructure'. What all of these examples show is that it is imperative that we work with the resources that are currently in place. EdTech can indeed support teachers and free them up to engage in greater student-teacher interaction, which is important to improving learning outcomes. We must, as the literature shows, avoid the desire to reengineer how students interface with learning environments, just to suit a new educational tool. We must use the evidence of how this tool can improve current practice.

Morpeth et al.'s, 2009 review of open and distance learning opportunities for UNICEF in South Asia, highlighted some of the uses of EdTech in reaching and enabling learning in emergency situations. In this study it is argued that 'ready-made educational resources can be deployed in emergency areas or to untrained or under-trained teachers/mentors/carers working in severely under-resourced circumstances' they can provide crucial support for those engaged in educating children who perhaps do not have the requisite training (Morpeth et al., 2009: 28). What all of these resources do, is support instruction and not replace the instructor. It is clear that the teacher/tutor/carer needs to be present, in whatever manner, to support, encourage and guide children through their learning.

Analysis from this review provides evidence that Edtech is an important tool to supplement and indeed potentially improve learning outcomes for those who engage with it. For this to be successful it is important attention is paid to how it is used, for example not simply to deliver content to learners. It can, if appropriately utilized, especially in emergency situations where class sizes are often increased, provide valuable support that has the potential to facilitate teachers in being able to provide more support, and increase the chances of teacher-student interaction. To do this those who provide, or implement Edtech projects must focus on how it can help, and not replace the need for teaching staff. Teachers are fundamental to positive learning environments, they also hold opinions and beliefs that can positively influence and negatively influence the integration of Edtech into the classroom.

6.2.3 Teacher perceptions of technology are important

Teachers' opinions of EdTech and its relevance to the learner's educational development is important. The influence these attitudes play was discussed in the conceptual framework *(See section 3.2.5)* and reflected in a number of studies (Blikstaf-Balas, 2017; Piper et al., 2015; Valiente, 2010; Zheng et al., 2016; Berrera-Osorio, 2009; Gomez et al., 2013; Blackwell, 2016; Henessy, 2010; Webb et al., 2004; Flewitt, 2015; Warschauer et al., 2014).

Value judgments about technology are a second-order barrier to their use. According to a study completed by Blackwell et al. (2016: 311) in which they surveyed 1329 early-years educators across the United States, value judgments 'play a more important role in changing whether and how much teachers integrate technology' in the classroom than the first-order barriers, such as teacher training, or time. This finding was reinforced by Vadachalam and Chumbo's (2017) study looking at maths teaching in tertiary education in South Africa. These findings imply that those engaging in EdTech delivery need to consider the opinions of teachers seriously.

Blackwell et al. (2016: 317) also found that 'teacher's highest educational attainment [level] was also predictive of access' to technology. Access is important because it builds familiarity, and leads to the development of positive perceptions of EdTech. This was reinforced by findings by Flewitt et al. (2014) and is relevant to the application of EdTech in emergency situations, where the teaching stock may not be stable and qualification levels lower (Burde, 2016), resulting in decreased access and negative attitudes toward EdTech. The implications of this for emergencies are considerable, with large class numbers and often-poor physical resources teachers are likely to encounter both first-order barriers such as lack of internet, and second-order barriers to engagement.

Findings presented Valiente's (2010: 11) review of 1-to-1 initiatives in education affirms the importance of attitudes and beliefs of teachers and added that 'when teachers do not perceive that expected uses of technology closely aligned with the curriculum' they

are less likely to use it. This reinforces previous findings (section 6.22) related to the importance of EdTech designers integrating EdTech nto the curriculum they plan on engaging with.

Valiente's (2010) review goes on to state that there is evidence of an 'adaptation' stage with regards to EdTech and teaching practice (Valiente, 2010: 11). This phase of adaptation is substantiated by findings of Passey et al. (2016: 125) and states that the 'initial implementation of ICT into teaching practice leads to a downturn in performance'. Overall, teachers need time to adjust, and this period of adjustment can then affect learning outcomes of children. This is an important finding for education in conflict and displaced settings; having to change your teaching practice whilst dealing with the stresses of working in an emergency situation are not conducive to positive engagement, especially if this leads to a perceived drop in overall performance. In addition to this staff turnover of teachers in emergency or displaced settings can be high, leading to additional issues related to integration of EdTech. This leads on to the next finding in this narrative review. This relates to the importance of training for teachers, to the successful integration of EdTech in an educational space.

What these studies identify are a number of the reasons why teachers may have negative opinions of EdTech. What has to be considered is that first-order issues such as a lack of time, or poor infrastructure, are likely to compound second-order issues that are related to perception. A means of negotiating this is to involve teachers more readily in the change process that the introduction of EdTech represents. We know from the literature that teachers in emergency settings are likely to be subject to a number of first-order barriers and we have seen how these interact with second-order barriers. What these findings show is the need for teachers and key stakeholders to be active agents in processes of EdTech introduction, if our aim is to have a positive influence on learning outcomes.

6.2.4 The availability of Teacher Professional Development

Teachers are key stakeholders when it comes to the successful integration of EdTech into a learning environment. The introduction of EdTech results in a material change for many teachers' practice, indeed it is learning a new skill. This change needs to be introduced in a manner that is sensitive to the scale of this change in practice. The material covered provides insights into some of the positive actions that can be taken to promote successful integration of EdTech into a new learning environment.

The literature covered for the review consistently reiterated that teacher training is an essential aspect of successful EdTech integration (Piper et al., 2015; Valiente, 2010; Zheng et al., 2016; Berrer-Osorio, 2009; Blikstaf-Balas, 2017; Gomez et al., 2013; Blackwell, 2016; Hennessy, 2010; Webb et al., 2004; Flewitt et al., 2015; McManis, 2012; Warschauer et al., 2014; Passey et al., 2016; Kahn, 2016; Agarkar, 2016; Hosman, 2010; Qablan, 2016; Islam and Grönlund, 2016). EdTech is a new educational tool, as with all educational tools the teacher, or primary deliverer of content, needs to be comfortable using it, prior to using it with learners. Learning, we have seen needs to be supported, collaborative, and linked to previous practice for it to be successful, there is no reason why the implementation of EdTech should be any different.

Warshchauer et al. (2014: 57), in their assessment of OPLC implementation in three different schools in the USA found that the level of the training and support provided was related to the quality of the EdTech's utilization in the classroom. In the poorer area of Birmingham, Alabama, for example, 'little time was provided for training in XO-supported instruction'. As a result, the effects on learning outcomes were less when compared to schools in Littleton and Saugus where (2014: 58) 'teachers participated in extensive collaboration within and between schools' This study concludes that (Warshchauer et al. 2014: 59) 'teacher support was often tied to the ways in which laptops were used in the classroom' (2014: 59). This is a significant issue to draw attention to. If the quality of training is better and sustained, then teachers are furnished with more options of how to adapt their practice with the EdTech. As previous findings suggest, it is not so much the provision of hardware that influences learning outcomes, it is how the teachers use that hardware that impacts on the learners.

Indeed, Piper et al. (2015: 11) found that the Kenyan government following a review of their EdTech initiatives, 'is now focusing on improving teacher skills and pedagogy as the key to effectively' utilizing new

Behind the Scenes of Save the Children's first VR shoot in Bandung, Indonesia.

CREDIT: SAVE THE CHILDREN

EdTech interventions. As Piper et al. (2015: 12) state, the training provided to teachers needs to be of 'high-quality'. In relation to emergency settings, there is important learning in this finding. If resources are stretched too thin, or the implementation is rushed, and teacher training is not engaged with readily, then the impact of the intervention on learning outcomes is diminished.

What high-quality training looks like depends on the cohort of teachers. For training to be successful, according to Forgasz et al.'s (2009) systematic review of technology in maths teaching, found that teachers' qualification levels are correlated with the likelihood that they will successfully utilize EdTech opportunities. This is significant because, if you wish to engage teachers with training that reflects their skill level then their current level must be known. In an emergency situation, where it is potentially more difficult to get reliable data on the teaching cohort's qualification levels, then the training provided needs to be adaptive to their level. It cannot be a one size fits all approach.

Further, active engagement on the part of those teaching, must be encouraged for successful programmes, and teachers cannot be bystanders to the process. Northropp et al. (2013: 532) for example, argue 'teachers need to consider whether the technology is providing instruction at a student's appropriate level'. This not only requires a specific skill set on the side of the teacher, but also requires dialogue between the institution and the EdTech provider, or in an emergency setting between an NGO and the teaching staff. In emergency situations where teachers' time is a precious resource, learning can be taken from Mouza and Cavaliar (2012: 156) who stated that 'identifying digital resources closely aligned with their curricular and their students' needs' was better received than generic instruction on how to use EdTech. It needs to be relevant to the teachers'/ instructors' situation.

Not only does the quality of this initial teacher training need to be of a high standard, it needs to be sustained. Continued teacher development positively correlates with successful EdTech take up (Blackwell, 2016; Warschauer et al., 2014; Piper et al, 2015). Dahya (2016: 22) stressed that 'teacher training and ongoing program support is invaluable to the long-term effectiveness of mobile initiatives'. This was corroborated by findings by Islam and Grönlund (2016: 210) which stated that 'a sustained commitment from the supply side' is required for EdTech to have the biggest influence of students learning outcomes. This does not come without a cost implication for the provider of the EdTech. As was the case with Piper et al. 2015 in Kenya, if the training is not engaged with appropriately at the start, then the EdTech will not likely be used appropriately. In line with the INEE guidelines for EIE interventions to 'Do No Harm', it would be inappropriate to provide hardware that the recipients then have to retrospectively provide training for, at their own cost, so as to allow for its successful utilization.

Caution must be taken when addressing training and EdTech, as it is not a silver bullet. There is evidence from a robust six yearlong study in Maharashtra, India, that even with continued support and the continued provision of new teaching material that usage of EdTech is not guaranteed (Agarkar, 2016). What this study argues is that changes in practice (Agarkar, 2016: 421) 'depends on the teacher's awareness of new developments in school education' and if time is not available for this engagement it is unrealistic to expect such change. The previous pedagogical structure of a particular culture and space is important when it comes to changing practice. These findings were corroborated by Berrer-Osorio and Linden (2009: 25) in their work for the World Bank assessing the evidence from an RCT looking at the effects of ICT integration into a language arts programme which concluded that 'mere training and equipment does not seem to be sufficient' at improving learning outcomes'.

The introduction of EdTech represents a change in teacher's working habits, training; active teacher development can go some way to improve the perceptions of teachers towards EdTech. What the studies covered demonstrate is that teacher training is a key facet of successful EdTech uptake in a learning environment. The form that this training takes is significant – it must be relevant to the teacher's context, and promote integration of EdTech with the curriculum. In emergency situations where teachers are less likely to be formally qualified, training represents an essential capacity building opportunity. If the EdTech interventions aim is to foster long-

term improvements in children's learning outcomes then the evidence shows the training needs to be sustainably funded and part of a pallet of adopted measures. This need to work with actors beyond the children themselves is shared by the next finding. EdTech interventions offer the opportunity to build a cooperative attitude between teachers, parents and the learners themselves.

6.2.5 Parents perception of technology is important.

Parents/Primary Care-givers are the most important actors in their children's education (Clarke-Stewart, 1983; Caddell et al., 2000; Vincent, 1996). The introduction of EdTech offers opportunities to increase education related conversations in a household, and promote intergenerational learning. These are just a sample of the reasons why taking an active approach to parental engagement can work to alleviate fears they may hold around technology, and indeed promote a positive attitude to the education their children are receiving at school.

Parents/Primary Care-givers are key stakeholders in their children's education. As work by Sultana (2006: 77) in the West Bank states 'genuine parental involvement can have a most positive impact on the levels of learning achievement of young children'. Their understanding and attitudes towards technology influence their children's uptake of EdTech and use of technology (Qablan, 2009, Hsin et al., 2014; Passey et al., 2016; Steffens, 2014; Dahya, 2016). Hsin et al. (2014: 93) stated in their systematic review that 'adults' perceptions of children's technology use influence how they support or do not support their children's learning through technology'.

Qablan and Abuloum's (2009) qualitative study that addressed barriers to integration of EdTech in Science classes in a girl's school in Jordan, found that parents worry that technology is too much of a distraction for learners. As one of the interviewees in the study stated, (2009: 297) "When my parents see me using the computer at home, they think I am playing not studying". At this stage, EdTech was not likely part of many adults' educational experience. In this study a parent raised fears for their child's safety with regards to Internet use, which is important to consider when developing EdTech interventions for difficult to reach, or socially excluded learners in an emergency situation. If parents do not welcome technology into their home or allow usage, then it is a wasted investment in the humanitarian response.

Passey et al. (2016: 15) in their conceptual paper that drew evidence from developing countries engagement in EdTech, stated that parents 'values and concerns need to be known if change is to be managed successfully'. This points to the need to be proactive and seek out and engage with the key stakeholders in a target population, prior to intervention. This finding was reiterated by Dahya (2016: 6), in her landscape review of EdTech in education in emergency settings, and asserts the importance of working 'with community members to determine appropriate ICT application whenever possible'. What these findings show is that not only are parents perceptions important to uptake of EdTech, or technology use in general, but that also this can be an avenue to broaden community engagement and project development in general, which should be to the benefit of the children involved.

As these studies demonstrate parents/primary care-givers attitudes to technology are important. This finding if engaged with, offer opportunities to build a stronger network of actors around the learner. In an emergency or crisis situation this capacity building can prove an asset. This process can assist with the development of EdTech that is contextually and culturally appropriate to the learner and their learning environment.

6.2.6 Context of intervention is key to successful integration: History and Context affects usage

Education systems in every country are unique and often cater to the social, political, and economic needs of a country. Everything from policies, school management, teacher training, and curriculum development will vary by country. Many of these factors, and decisions around these factors, are deeply rooted in the wider culture and history of the country. These factors have to be taken into consideration in the development of EdTech. The notion that the culture of a country is important to the interaction with EdTech within it was reflected upon by a number of studies (Kolodziejcy, 2015; Keengwee and Bharagava, 2014; Hubber et al., 2016; Valiente, 2010; Valk et al., 2010; Ames, 2013; Forgasz et al., 2010; Warschauer et al., 2014; Agarker, 2016; Hosman, 2010; Islam

and Grönlund, 2016; Qablan, 2009). For example, Chukwuere et al. (2016: 264) conclude, following an evaluation of technology use in a South African tertiary education programme, 'culture impacts on how people use and value communication media'.

Hubber at al. (2016: 3) in their assessment of the suitability of tablet use in Malawi, argue crucial factors affecting implementation include 'attitudes towards tablet technology and the embedding of tablet technology within a country's education system'. If time is taken to consider the attitudes towards new technology, then it 'enables generic features of implementation to be differentiated from country-specific factors'. The authors' argue that this will increase the likelihood of successful programming, improving uptake, and increasing learning outcomes, the benchmark of the majority of education interventions this rigorous review has addressed.

Keengwee and Bharagava (2014: 740) in their case study driven theoretical framework for mobile learning integration argue that 'the context in different countries can be different and so understanding the cultural backgrounds is important when designing the technology'. The paper offers the MILLEE project, a mobile-based English language learning course taken by 800 children in 40 villages in Andhra Pradesh, India as an example of best practice. This initiative worked with local stakeholders prior to deploying mobile-based technology so as to better understand the context and used a multidisciplinary approach. The study recommends that time is spent with key actors in the communities prior to implementation to build a greater understanding of the culture around technology, so as to maximize the opportunity for it to improve learning outcomes, when implemented. The study states that this understanding played (Keengwee and Bharagava, 2014: 743). 'a big role in making projects like MILLEE successful and feasible'

The need to evaluate cultural dispositions is not limited to the country, or culture in which an Edtech programme is being implemented. It extends to the culture of the country in which this programme has originated. This is an aspect of the findings of Ames and Rosner's (2014) investigation into an OLPC project, which provided a case study in Easy Bay Fixit Clinic in the USA, identifying some of the issues that can arise if this scrutiny is not applied. The authors (2014: 362) submit that the OLPC project had a 'specific conception of 'childhood' which was largely built around the foundations of a 'Western, individualist, middle-class and often male' culture. The attributes of this programme were not a good fit for the diverse population of the study. The implications for education in emergencies are considerable, actors must consider the assumptions they bring to a project surrounding what constitutes 'good education' and learning in general. These factors must be considered prior to the implementation of an often high-cost EdTech intervention that may well be incompatible with cultural expectations of a target population.

Another consideration when looking at the overall education system, is that of timing. Qablan (2009) found that teachers working with students in their final year, in Jordanian schools, were less likely to use EdTech available to them, due to the demands of summative assessment. This builds a broader point about which years of education are best served by new interventions relating to Edtech. The final year of education in the UK for example is heavily focused towards summative assessments, and therefore the likelihood of teachers changing their practice with these year groups is reduced due to these pressures.

What is evident is that there is a real need to consider the wider culture and education systems of a country, or community, before implementing EdTech interventions. There is a wealth of development literature that can be drawn upon to inform programming of these interventions. Should the wider cultural context of a country or community be engaged with in a proactive manner then it can go a long way to supporting the successful integration of EdTech which can lead to sustainable improvements in learning outcomes. The implications for emergencies are considerable. Emergencies are often situations were a population has been displaced into a different cultural setting, which is likely to have its own distinct approaches to education. This preliminary work to open discussions with a target population, regarding attitudes to technology can provide a useful opportunity for dialogue surrounding wider issues of integration. Education is a universal discourse that offers the chance for greater interparty communication. EdTech is an exciting educational tool, and can be a catalyst for wider discussions related to community integration.

6.2.7 EdTech can, but does not necessarily, represent the best value for money/sustainability

Educational technology can be expensive. In emergency situations when resources are limited and the infrastructure to support the technology is under strain, the sustainability and feasibility of an intervention has to be established, if long-term improvements in learning outcomes are the aim of the intervention.

EdTech or ICT does not always represent the best value for money in terms of learning outcomes, according to a number of studies covered by the rigorous review (Bando, 2016; Hennessey et al., 2010; Dahya, 2016; Carlson, 2013; Passey et al., 2016; Warschauer et al., 2010). There are a number of issues that contribute to this. Work by Hosman (2010: 61) that investigated several Edtech interventions in rural Uganda, argued that 'project sustainability is of great consequence' when considering the long-term effect of introducing Edtech into an education system. For example, in a large scale randomized control trial across 271 schools in Honduras, Bando et al. (2016: 19) 'found textbook replacement with laptops did not affect student learning after one year'. This important finding leads to questions about implementation time frames and sustainability of investment.

Paterson (2007: 98) made the case that across Botswana, Namibia and the Seychelles, despite having different issues related to implementation, 'financial allocations to ICT must properly take into account the full costs of sustainable ICT systems'. Otherwise technology can quickly become a burden on the communities in which it is integrated. To provide a sense of perspective, Passey et al. (2016) make the case that the integration of EdTech takes roughly ten years, and countries such as the UK, USA, and Australia have been integrating EdTech into their curriculums for nearly two and a half decades.

Another issue related to sustainable EdTech engagement relates to teacher training (as discussed in section 6.2.4). Evidence shows that training needs to extend beyond an initial introductory session for teachers to utilize EdTech effectively. In fact, the integration of EdTech programmes offers an opportunity to develop a collaborative community of practice amongst teaching staff, should the infrastructure and the funding be sustained.

Shadi * is 16 years old and lives in an area for people displaced by the conflict in Syria. He lives in a temporary shelter in an area where many families are living in makeshift tents made of plastic sheets, with only the most basis items available to them, like mattresses and blankets. He has been living in the camp for a year and a half, together with his mother and father and his younger brother and married sister.

*name has been changed for security reasons

A major concern is that of sustainability and long-term funding once a pilot has run its course. As Hennessey et al. (2010: 95) warn 'sustainability of schemes and potential for further rollout are also highly uncertain once funding runs out and deserves more attention'. The implications for education in emergencies are considerable, questions must be asked about the long-term suitability of the hardware that is being provided: Will it be compatible with software in two or three years' time? Work by Warschauer et al. (2014: 57) state that in the case studies and the literature they assessed, 'laptops tended to go unrepaired'. Work by Ames and Warschauer (2010: 41) went on to claim that '27.4 percent of machines were out of commission' in Uruguay within two years of the scheme's introduction. In an emergency of crisis setting, where resources are limited and supporting infrastructure is under strain, we have to consider, for example, how broken equipment can be repaired. These are just two simple examples that are intended to provide a window into the considerations required, relating to sustainable EdTech engagement for those working in education in emergencies.

What the evidence covered in this study shows is that there are a number of factors that must be considered when addressing the sustainability of EdTech programmes. The issues that need to be considered regarding value for money include consideration of the appropriateness of the hardware, sustained training initiatives for teachers, adaptation costs for the learning environment, and capacity building, where needed, to ensure that broken equipment can be maintained. As such, funding needs to be sustained to allow for the change in practice to take hold and for positive learning outcomes to take place. This is an important consideration in education in emergencies where the crisis that precipitated the intervention may have damaged the infrastructure crucial to EdTech utilization.

6.3 THE ENABLING CONDITIONS

The evidence covered by this review so far has related to actors, namely the child directly engaging with the EdTech and the actors that surround the child's engagement. The following findings relate more directly to those engaged in the implementation of EdTech initiatives and the most likely audience for this piece of research.

6.3.1 Infrastructure is a major barrier to successful utilization of EdTech

A common theme across the literature has been the barrier of existing infrastructure in preventing the successful integration of EdTech (Bando, 2016; Gulati, 2008; Paterson, 2007; Hennessey et al., 2010; Vadachalam, 2017; Zualkernen and Conje, 2008; Dahya, 2016 Carlson, 2016; Qablan, 2009; Warschauer et al., 2014; Hennessey et al., 2010; Hosman, 2010; Islam and Grönlund, 2016; Berrera-Osorio, 2009). When we discuss infrastructure, we mean resources as basic as electricity and school buildings to more advanced resources, such as internet and data availablity.

In reference to the One Laptop Per Child (OLPC) programme Warschauer et al. (2014) found that the countries that had the relevant infrastructure prior to the programme's introduction saw this biggest increase in learning outcomes. A study in Uganda by Hosman (2010: 60) found that the best way to frame EdTech integration was to view 'technology as an enabling tool and a compliment to existing teaching and infrastructure, not as a silver bullet or end in itself'. The study (Hosman, 2010: 60) argues there must be a 'realistic assessment of the existing situation. If there are insufficient schools, classrooms, and teachers, the provision of these must precede technology initiatives'. This reiterates the need for greater assessment of infrastructure on the part of the providers of the hardware.

Infrastructure differs based on the region engaged, so too does equity of access within countries, which was discussed by a number of studies (UNESCO, 2013; Qablan, 2009; Gulati, 2008). Gulati (2008: 12) in their review of technology-enhanced learning in developing countries, conclude that although equitable provision was a key driver in the implementation of open and distance learning, 'the lack of educational and technology infrastructures' stood in the way of these intended goals. Indeed, the study went further to claim (2008: 12) than when equity of access was considered, for the poorest in society, 'traditional technologies such as printed material, radio, and television remain more effective and accessible for rural and disadvantaged groups' claiming that in the developing countries addressed in the review, the improvements to infrastructure disproportionately benefited the urban dwelling rich and wealthy.

A report by UNESCO (2013) that assessed the E-readiness in five Arab states found that there is a need to look beyond the claimed infrastructure and policy framework of specific countries, and analyse what the current infrastructure is best suited for. Ascertaining what form of EdTech would work best with the infrastructure available is an attainable goal and one education in emergency professionals should work towards. This was corroborated by Carlson's (2013) final report on a USAID project in South Sudan, which utilized interactive radio. The infrastructure for radio was, for the most part, already in place. As Burde (2016) draws attention to, the crisis that precipitate the intervention are likely to have affected the relevant infrastructure. This issue cannot be overlooked when considering the applicability of EdTech options available in emergency settings.

As these studies have shown, there is a need when faced with a poor standard of infrastructure, to think honestly and creatively about what technology is best suited for the region. What may be deemed 'old' technology from the position of technology providers in OECD countries, may well, as the case in Sudan demonstrates, be the ideal avenue for engagement. If long-term impacts on learning outcomes and child wellbeing are the aim of the intervention, then a proactive engagement with the infrastructure available is an essential component of building successful EdTech interventions. Simply stated, we have to consider what is necessary for children to learn, and we must prioritise safe space, teachers, and appropriate learning materials before we consider the integration of technology.

6.3.2 EdTech for accelerated learning: preparation to integration to formalized education

In emergency and displaced settings children often fall behind in learning. Even when children are able to resume education relatively quickly, they often find themselves in different settings where language, curriculum, and/or teaching styles may vary dramatically. However, evidence supports that EdTech can be used alongside accelerated learning programmes, providing opportunities for children to catch up and get back in to public schools, or for out of school overage children to complete a primary education in half the time (Banerjee et al., 2007; Linden, 2008; Muralidharan et al., 2017; Nedungadi et al., 2014). Some evidence suggests that poorly performing children can benefit more from EdTech than their high achieving counterparts (Linden, 2008; Muralidharan et al. 2017). Of course, effective programmes seem to have all of the same characteristics as discussed in early sections such as teacher's engagement and training, a supplement to regular learning as opposed to a substitute, and are closely tied to the curriculum.

Nedungadi et al. (2014) implemented a small study in Kerala, India with 38 students from marginalized groups, in order to assess the effectiveness of using low cost tablets to improve learning outcomes in maths, reading (both the local language and English), and writing. Findings were qualitative, so the effect is not measured precisely, however, findings seemed to indicate that children learned faster, specifically in reading. The apps on the tablets used pedagogy that was integrated with the curriculum, used songs and stories from the area, and used the local language. Teachers were trained and felt comfortable utilizing the technology, and integrated the technology into their daily teaching. Children worked in groups and were able to play lessons over and over until they felt they understood. Teachers and students reported increased motivation, engagement, and accelerated learning. In emergency settings these types of activities can bring the learner closer to their appropriate learning level, if implemented correctly.

Muralidharan et al. (2017) evaluated a technology aided learning after school programme in urban India. Children who were the furthest behind saw the greatest improvement. In this randomized control trial, those who took part, relative to the control group, 'experienced twice the test score value-added in math and 2.5 times that in Hindi' (Muralidharan et al. 2017: 2). The authors identified that the most useful aspect of the programme was that the software used in this study was adaptive to the learner's level, rather than the grade level, in which the child is enrolled.

A 2007 study conducted by Banerjee et al. evaluate two remedial programmes in India. In the first programme children were provided a tutor. The tutor in the study was a woman from the local community who received two weeks of training. Students who worked with the tutor for two hours a day during the school day for an entire school year saw gains

in numeracy and literacy. The second programme was a computer aided learning (CAL) programme where students were provided 'two hours of shared computer time per week (two children shared one computer) – one hour during class time and one hour either immediately before or after school' (Banjeree et al., 2007: 1241). Facilitators (who had received 5 hours of training total) were present to help children, explaining games and helping children when they were stuck. 'The instructors encouraged each child to play games that challenged the student's level of comprehension, and, when necessary, they helped individual children understand the tasks required of them by the game' (Banjeree et al., 2007: 1241). Both programmes were extremely effective, with the CAL programming producing slightly larger effect sizes. The CAL programme was even more effective in the second year as opposed to the first. In the first-year, standard software was used, and in the second year the programme teamed up with a local developer to develop games that were more in line with the curriculum.

Linden (2008) evaluates a CAI programme used by two groups of children, using the programme both in school (as a substitute) and out of school (as a supplement). The programme was designed to 'reinforce students understanding of material presented in class '(Linden, 2008: 1). This study is important because Linden is examining the results of the same programme on two different groups of students, shedding light on the importance of regular school instruction. The material is designed to complement the school curriculum by presenting the same information they have received during the day in a different way. When used in this way learning outcomes increased. However, when used as a substitute, learning outcomes decreased. Poorly performing and over aged students tended to experience the most significant gains, showing that CAL, as a supplement to instruction time can be used as a way to bring children up to an age appropriate learning level. This study shows that EdTech by itself is not effective in bringing the learner's outcomes up to the appropriate level.

Accelerated learning programmes are often an important facet of education in emergencies programming. These studies show that, when implemented properly, EdTech programmes can help children to catch up. However, we must reinforce the notion that EdTech must be supplement learning programmes and not attempt to substitute them.

6.3.3 EdTech has the potential to blur lines between formal, informal and nonformal learning

There has been much enthusiasm and speculation surrounding EdTech and its ability to make education accessible for those who are currently denied regular access[7]. In emergency settings education is often interrupted, both as a direct result of violence and disasters, and as an indirect result children may be forced to engage in labour inside and outside the household. While many programmes have been piloted, limited evidence is available demonstrating the best ways in which to ensure that mobile learning can reinforce or strengthen appropriate learning outcomes which are linked with the formal curriculum.

According to Khaddage et al. (2016: 16) the 'potential of mobile technologies for learning lies in the ability to provide timely access to learning in authentic working contexts'. However, as noted throughout this document, access to ICT and EdTech software is not enough to ensure learning takes place. What is necessary is to ensure that technology links the informal learning process to the formal (or non-formal) so that 'seamless learning can occur anytime' (Khaddage et al. 2016: 16).

Garcia (2015) through social network analysis, investigates how secondary school children, in a creative arts college in the UK use social network and social media technology to build networks outside of the classroom and how they may use these types of technology to encourage informal learning. The study was unable to determine if established networks led to informal learning. However, the author of the study noticed that students who were active users of Facebook and were central to their networks were more likely to stay on the course and attend regularly. The study did not establish causation, but may shed light on how outside of classroom uses of social media can encourage participation. More research is needed to explore how learning can be maximized through the use of social media.

Zelezny-Green (2014) presents another example of how technology use outside of school can help to support formal learning. The study conducted in Kenya, showed that secondary school age girls

[7] See Dayha, 2016 for a comprehensive review of projects and programmes

mediate intermittent access to education through the use of mobile phones. The study showed that girls regularly used their mobile phones to call classmates to see what was missed, to make plans to revise, and to use Google to help find information about what was missed. While the access of Google does not equate learning as defined by our framework, Zelezny-Green (2014) does submit that the mobile phone is a natural tool to supplement learning in Kenya, especially for secondary school aged girls.

6.3.4 Gender

An ongoing debate has been in existence regarding gender and technology use, as women and girls are, in many cases, less likely to use technology for learning and other purposes (Aesaert and van Braak, 2015; Cummings and O'Neil, 2015; Forgasz, 2009; Hilbert, 2011; Kolodziejcszy, 2015; Punter et al., 2016; Steeves and Kwami, 2017; Yang, et al., 2012;). The understanding around diminished usage is limited. Questions surround whether or not causes are merely cultural and structural, or if men and boys are more likely to benefit from using technology for educational and other purposes, thus resulting in a lack of enthusiasm or technophobia amongst women (Hilbert, 2011). It is well cited that cultural and structural inequalities can exacerbate this digital divide, including both social and material barriers (Cumming and O'Neil, 2015; Hilbert, 2011; Kahn et al., 2012; Steeves and Kwami, 2017). However, some have posited a simple explanation: that boys are more predisposed to use technology, due to access issues, and therefore will benefit more (as cited in Hilbert, 2011; Forgasz, 2009). However, others suggest that the learning styles of boys may make learning through technology more amenable, leaving girls behind (as cited in Forgasz, 2009; Kim et al, 2012). Developing an understanding about barriers, usage, and benefits is extremely important in the context of emergencies and displaced settings as gender disparities are easily intensified, and we must ensure that we mitigate these factors and not exacerbate them.

Considering Access

Kolodziejczyk's 2015, study in Papua New Guinea, that addressed attitudes to ICT use in Higher Education Institutions showed that the debate is actually more nuanced and less straight forward than presented above. Through a mixed methods study, findings from this study showed that male and female university students were just as likely to access computers and use them for the same amount of time during the day. For those who had internet access, time spent on the internet was the same across genders. However, a qualitative follow up to the study showed women perceived having less internet access than men. Men, according to the study, had first access to computers and women felt they had to wait to access them after men were finished. Some women also cited lack of security as a reason they had less access, due to security issues women were restricted at night, whereas men were able to use the computers on campus. Women also suggested that due to responsibilities at home, they had less time to use the computers and internet and therefore only used them for work related purposes and not for entertainment or leisure.

A UNESCO study (West and Chew, 2014) that conducted surveys on mobile phone usage for reading showed that men 'vastly outnumber female mobile readers in the countries studied[8]. On average, there were approximately three male mobile readers to every one female' (West and Chew, 2014: 26) At the same time, however, women hold more positive attitudes toward reading and reading on their mobile phones, showing that the issue is more one of access than will.

Researchers (Steeves and Kwami, 2017) in Ghana completed a qualitative study which included multiple interviews with 80 participants with head teachers, staff from the MOE, staff from the Millennium Development Project, and children in the study over the course of roughly four years of the project. Amongst a barrage of implementation issues, the study showed that the program 'failed to consider the gendered nature of human interactions with ICTs in the design and implementation of the program' (Steeves and Kwami 2017: 184). As a result, girls were excluded from usage due to their lack of leisure time, whereas boys had much more time and freedom of mobility to use their devices and access internet cafes, allowing boys to practice skills on computers. Due to this, girls had a lack of understanding of technology usage as compared to boys. A small survey, also conducted in Ghana, (Kwapong 2009) showed similar findings. The study showed that women encounter a number of barriers to access, which include language

[8] Ethiopia, Ghana, India, Kenya, Nigeria, Pakistan and Zimbabwe

and geographical location – limiting them from content and connectivity. Kahn et al. (2012) also discuss the issues of implementation in Bangladesh and cite gender as a major issue as women are 'deprived' access to ICT as opposed to men.

Do boys do better than girls?

While it is clear that girls can face more barriers than boys, it still leaves the question of boys' predisposition to technology usage due to learning styles and personal preference. In order to investigate this question, Kim et al. (2012) performed a comparative analysis of a game based learning programme in India. Children aged 6 to 14 played maths games on mobile technology to ascertain if children were able to teach themselves how to use technology and what factors mattered in children's ability to learn to use technology. Researchers found that when dividing participants into three groups (boys only, girls only, and mixed gender) boys-only groups solved more problems than girls-only and mixed groups were able to solve more problems than both (although the latter finding was not statistically significant). The authors were not able to justify or make sense of this finding, but pointed to research on how children perform in gendered groups, rather than ways of using technology, as a likely factor.

In a very different study Aesaert and van Braak (2014), after testing 378 year six students in Belgium on their ICT competencies, showed that girls had better technical ICT skills and higher-order ICT competences than boys. In addition, an analysis of data from the 2013 International Computer and Information Literacy Study, which examines ICT literacy of 14 year olds in 9 European countries showed similar findings (Punter et al., 2013). Girls outperformed boys especially in areas of 'evaluating and reflecting on information' and 'sharing and communicating information.' There was no significant difference between boys and girls' on 'applying technical functionality' (Punter et al., 2013:16).

Yang et al. (2013) tested something similar, asking if boys and girls can equally gain from computer-based education in primary schools in China. Researchers conducted randomized studies in three types of schools: migrant community schools (maths), rural public schools (maths), and Qinghai minority rural schools (Chinese Language). They found there was no difference in learning outcomes for boys and girls and found positive outcomes for all those attending CAL schools. Similarly, findings from a study conducted in India (Muralidharan, et al., 2016, see section 6.2) show comparable conclusions. The supplementary maths and language tests benefited both boys and girls equally, bringing up students who were furthest behind, regardless of gender.

Overall, findings suggest that girls and boys can both benefit from EdTech when barriers are not in place. According to Hilbert's (2010) study which analysed data sets from 12 Latin American and 13 African countries from 2005-08, gendered access to technology is embedded in a large number of societal factors. At the same time, findings showed that lack of interest was not one of these barriers. Hilbert's findings suggest that internet and technology use may be gendered because, as women encounter socio-economic obstacles to access, it ultimately translates into perceptions that women are 'technophobic' or lack interest, which is not the case.

Forgasz (2010) also demonstrates the importance of context, not only in access but in learning outcomes as well. Forgasz finds that results are mixed and highly dependent on the culture. Forgasz cites a study In Australia (Forster 2002), for example, where the introduction of technology seemed to widen the gender gap. The optional use of EdTech introduced in a math class meant children who felt comfortable with tech, mainly boys, opted to use the tech and performed better. Alternatively, a study in Mexico (Ramirez Mercado, 2006) demonstrated the opposite. In this study teachers observed that when a new EdTech initiative was introduced, girls were more willing to ask questions than boys, as boys rarely ask for help, according to the study, because they do not want to be seen as unknowledgeable. Therefore, girls adapted more quickly and gained more from the introduction of tech due to their willingness to seek clarity and understanding.

In an emergency or displaced context these findings are extremely important. Boys and girls perform the same when not facing barriers to access, but barriers to access are both gendered and pervasive and are buried with economic and societal contexts. As evidenced from the above, this has implications for both boys and girls. In an emergency, or any context,

we have to make these barriers known by working closely with local populations before engaging in programmes that may exacerbate inequality in society.

6.3.5 Wellbeing

Very little research has been conducted on the impact of technology use and the wellbeing of children in emergencies. This area is a particularly important concern in emergency and displaced settings, where child wellbeing is already at risk. Questions such as: is too much screen time detrimental to a child's social development, if so, at what point? And, can engaging in too much screen time have negative impacts on a child's physical and mental health, if so, at what point? Having an understanding of these concerns is important in emergency settings. As children already face a large number of barriers to access quality educational institutions, if we try to substitute EdTech at home for traditional education, what risks to wellbeing are children and families facing?

Spitzer (2014) highlights issues related to EdTech and wellbeing, citing distraction and tech addiction as major concerns. Cardak (2013) similarly highlights the dangers of technology addiction, finding that university aged students who were identified as addicted to the internet had significantly lower levels of psychological wellbeing. However, causation is not established as the authors have not identified whether or not internet use causes lower levels of wellbeing or if internet use is a coping mechanism in itself. Either way, over consumption of the internet does not seem to have a positive impact on wellbeing.

At the same time, tech initiatives can also be used to improve wellbeing amongst refugees. Dunn et al. (2012) have demonstrated that combining drama and technology can enhance both learning and wellbeing of refugee students who were resettled in Australia. Drama (as cited in Dunn et al. 2012) has been proven to help language students learn faster and combined with technology may help students to build resilience. Emert (2013) also showed through his study the use of drama and technology to enhance wellbeing. In this study 70 recently resettled refugee boys were engaged in a programme to use digital storytelling to develop literacy and language skills. Findings from this study showed that first, the programme built academic resilience, in that students were invested in the outcome and worked through frustrations. Second, the programme empowered the boys to share their experiences, as they found a medium they enjoyed. This opened doors to communication about culture and problems that they felt were previously closed.

While these EdTech endeavors provided a useful platform, they are again a tool in a larger picture, where facilitators and teachers were invested in outcomes of the students. More research is needed in both understanding how technology negatively impacts children's wellbeing as well as how it can be

Whisnu* would like to work on computers when his is older. Whisnu, 12, can't walk and has been a wheelchair-user since 2013. With Save the Children's help, Whisnu goes to school where he has many friends and enjoys learning science. When he grows up, he'd like to be a computer expert, but he's worried he won't be able to.

*name has been changed for security reasons

7. What are the major gaps in research in emergency and displaced settings?

1. The most obvious and glaring gap in research is the lack of evaluations and impact studies in emergency settings. Granted, RCTs and quasi-experimental designs are extremely difficult to implement in emergency settings, however, the challenges of doing so are not insurmountable. For example, many smart phone and tablet applications can collect data remotely and this can be used to inform EdTech design. However, much of the data currently collected is used to monitor usage and does not seem to provide evidence of learning outcomes. Tech providers need to work more closely with practitioners to ensure that key indicators are identified and collected.

2. Although it is clear that the mere access to ICT in schools or at home does not implicate learning outcomes, more research is needed to understand how and which technology is the most useful when it comes to facilitating the learning process.

3. There is limited research in emergency settings, however this does not mean that we cannot learn from research in other contexts (as we have attempted to do in this review). It appears that there is not a lack of evidence, but a lack of application of the available evidence. While not all of the research is applicable, much can at least provide the foundations for planning and implementation. Simply, if we take the time to understand how children learn and take into account what works in EdTech generally, before designing interventions, we are more likely to be successful in emergency situations.

4. There are many assumptions about self-directed learning when formal or non-formal learning institutions are not available. Some tech companies assume that children and families can direct themselves through an online or virtual curriculum. However, no evidence exists to show that this type of learning has positive outcomes for children or families. No evidence exists as to how such a curriculum might be feasible and what skills (such as time management and dedication) are needed and/or how they might be obtained.

5. In this review of literature we uncovered very limited research that engages with the views, wants, and needs of children and families in emergency settings. What this review has found is that these actors' opinions, attitudes towards technology, and digital literacy levels are all important to successful EdTech usage. Building this understanding should be the first step in developing a clearer understanding of what EdTech is suitable in a given emergency.

6. Findings from this study show that simply having access to technology does not lead to improved learning outcomes, research is needed to address what types of technology are useful, how much time should be spent on them, and what skills the use of technology can generally provide. Having this understanding can help practitioners to incorporate guidance for families in these settings on how to use tech to optimise children's learning, and not the opposite.

7. Scaffolding within EdTech is possible. However, at the moment the form of feedback, or support does not readily promote higher-order thinking (such as reflection, conceptual evaluation) in learners. More evidence is needed as to how, in emergency situations that are increasingly protracted, EdTech can be used to promote such learning, which is crucial to developing skills necessary to negotiate the ever-changing labour markets young people find themselves entering.

8. Evidence is limited regarding the use of EdTech to increase learner's motivation. As is seen in section 6.1.5 evidence does suggest that the use of EdTech can engage students. However, some studies do show that this engagement may diminish over time or may have less of an impact for those students who have had more exposure to EdTech. This means we do not understand how tech and engagement are connected, therefore we cannot be certain about how to maximise engagement with EdTech. This is an important question in emergency settings where children face many distractions from learning such as early marriage, increased household responsibility, and engagement in the labour force.

9. Regarding 21st century skills, a major gap in knowledge concerns how to measure and understand the acquisition of these skills, first. Second, limited research has been conducted as to how EdTech can be used to acquire these skills. Third, limited evidence shows how the acquisition of 21st Century skills can help children to obtain or enhance traditional skills and knowledge. Caution should be exercised when claims are made about the acquisition of 21st Century skills; the ability to use laptops and tablets does not equate to the development of such skills. More research needs to be conducted to develop an understanding around this concept.

10. More evidence is needed on the best ways in which to blend formal, non-formal and informal learning. In emergency settings this is an important factor as regular school attendance is often interrupted, but that does not mean that learning stops. Research needs to consider the best ways to use technology to ensure that informal learning can be maximised and support formal and non-formal education structures. This is particularly important in emergency settings where children and young adults in emergency situations, who have yet to finish their education, are often required to work in the informal sector to assist their families. EdTech could potentially offer the chance to change the manner in which these young adults interface with education yet, there has been little research that addresses this.

11. The impacts of EdTech on the wellbeing of children needs to be further investigated. Sufficient evidence is lacking to determine the risks of EdTech to children's overall wellbeing and how it can be used to encourage positive wellbeing outcomes. In emergency settings, where wellbeing is difficult to attain, this is of particular importance.

12. The most glaring gap in the literature includes the disregard of the use of EdTech by children with disabilities. The literature fails to address a number of aspects. First, the potential implications of the use of EdTech designed for the mainstream on children with disabilities is ignored. EdTech has the potential to leave children with disabilities further behind if done improperly. Second, impact from particular programmes, geared towards children with different abilities, were not discussed.

13. Whilst active learning should absolutely the standard, in many countries rote learning is still standard practice. However, there is no evidence to show how EdTech works in these contexts where rote learning. For example, can active learning through EdTech work when students and teachers only know rote learning practices? And is there a benefit to rote learning through EdTech in these contexts given the potentially low capacity of teachers in some chronic settings?

14. Research and evidence on costing are generally missing from the literature. In addition, any systematic cost benefit analysis of EdTech programming does not exist.

Sali*, 14 years old, lives with her family of three brothers, one sister, her mother and unemployed father in a one room house in Dar Saad district in Aden. Sali has had many difficult experiences throughout the 20 months of war in Yemen.

*name has been changed for security reasons

8. Summary of Findings

1. Research gaps/utilization of research: Although there is an overwhelming consensus of how EdTech can contribute to learning and the facilitation of the learning process, many EdTech initiatives do not take the evidence into consideration when designing programmes to be used in emergency and displaced settings.

2. The provision of hardware alone is not sufficient to improve learning outcomes. The mere access of ICT in schools or at home does not implicate learning outcomes. A number of factors must be in place for learning outcomes to improve.

3. EdTech is a tool that needs to be constructed with the principles of pedagogy in mind, such as active learning, engagement, and content that hooks. EdTech should support cognition and not only present content.

4. EdTech must be implemented in line with the local curriculum. Neglecting alignment will mean that content may not be relevant for the child, but may also increase the workload for the teacher. EdTech needs to be incorporated into a plan for learning that the child can track and will pull from skills and knowledge the child has previously attained. This is extremely important in an emergency setting, where learning is often disrupted, and children often have to step out of the school system and step back in at another time.

5. EdTech must be responsive/adapt to the learners' level. Materials should be at the correct level for the child so that they are challenged, but can also progress. Content should allow children to learn through their mistakes.

6. Scaffolded, appropriate, and adaptive software can be extremely useful in classroom settings. It allows the teacher more time to focus on individuals who struggle. This is especially helpful in emergency settings where schools tend to be over crowded and where children may have fallen behind. EdTech can indeed support teachers and free them up to engage in greater student-teacher interaction, which is important to improving learning outcomes.

7. Examples must be relevant to the learners' context. If not, children will struggle to connect to the examples, and therefore will fail to learn the material. Contextually appropriate material means that children are more likely to engage.

8. Material that is contextually appropriate can be used by families and can help increase opportunities for social engagement. This is important in emergencies where family support is crucial for child wellbeing and can help a child to achieve improved learning outcomes.

9. Child learners tend to be able to teach themselves how to use technology fairly quickly. Children, do not necessarily need extensive support in learning the technical aspects of simple EdTech devices. In fact, if left to explore the devices at the outset they can collectively build an understanding in a child-centered manner. Although, it does not mean that children could teach themselves the curriculum devised and delivered through the apps or the hardware.

10. Adult/teacher led scaffolding key to productive learner engagement with technology. Adults/facilitators/teachers must be present to assist children through their work. The iterative, affective support that adults can provide is necessary to ensure as in-app scaffolding cannot 'differentiate a careless error from more serious misunderstanding'. Children need guidance, and indeed seek reassurance from adults just as they do in other learning environments, formal or informal. If this support, that spans a range of areas of learning is not provided, then it will affect the learning outcomes of the children using the technology, and even risk the development of poor habits and potentially lead to frustration and disengagement on the part of the learner.

11. EdTech must supplement and not substitute teaching if it is to be successful. The literature covered consistently demonstrates that for optimal results EdTech should support teachers in the classroom and not attempt to substitute them. EdTech could, if appropriately used, increase the opportunity

for 'teacher-student communication and student-student communication'. These interactions are fundamental to building 'improved relationships that in turn help learning productivity.

12. How EdTech is used matters more than what EdTech is used. Analysis from this review provides evidence that Edtech is an important tool to supplement and indeed potentially improve learning outcomes for those who engage with it. For this to be successful it is important attention is paid to how it is used, for example not simply to deliver content to learners. It can, if appropriately utilized, especially in emergency situations where class sizes are often increased, provide very valuable support that has the potential to facilitate teachers in being able to provide more support, and increase the chances of teacher-student interaction. To do this, those who provide, or implement Edtech projects must focus on how it can help, and not replace the need for teaching staff. Teachers are fundamental to positive learning environments, they also hold opinions and beliefs that can positively influence and negatively influence the integration of Edtech into the classroom.

13. We cannot change the learning environment just to utilise a tool. We must avoid the desire to reengineer how students interface with learning environments, just to suit a new educational tool. We must use the evidence of how this tool can improve current practice. This recommendation has learning for those in education in emergency context.

14. Teachers' opinions and perspectives matter when it comes to effective EdTech. Teachers' opinions of EdTech and its relevance to the learner's educational development is important. Teachers' attitudes play a more important role in whether technology is effectively implemented over other barriers, such as teacher training or time.

15. Teachers must be trained and engaged with regularly for EdTech to be an effective tool in the classroom. EdTech is a relatively new educational tool, as with all educational tools the teacher, or primary deliverer of content, needs to be comfortable using it, prior to using it with learners. If the quality of training is better and sustained, then teachers have more options of how to adapt their practice with EdTech. Again, it is not so much the provision of hardware that influences learning outcomes, it is how the teachers use that hardware that impacts on the learners.

16. Poor teacher training leads to poor results. If resources are stretched too thin, or the implementation is rushed, and teacher training is not engaged with readily, then the impact of the intervention on learning outcomes is diminished. Not only does the quality of this initial teacher training need to be of a high standard, it needs to be sustained. Continued teacher development positively correlates with successful EdTech take up.

17. Parents' perception of technology is important for learning. Parents/Primary Care-givers are the most important actors in their children's education and parents have to be supportive of EdTech if it is to be used and used effectively. Taking an active approach to parental engagement can work to alleviate fears they may hold around technology, and indeed promote a positive attitude to the education their children are receiving at school. In addition, the introduction of EdTech offers opportunities to increase education related conversations in a household, and promote intergenerational learning.

18. The history and context of the country and education systems will influence the usage of EdTech for learning. What is evident is that there is a real need to consider the wider culture and education systems of a country, or community, before implementing EdTech interventions. Should the wider cultural context of a country or community be engaged with in a proactive manner then it can go a long way to supporting the successful integration of EdTech which can lead to sustainable improvements in learning outcomes.

19. EdTech can, but does not necessarily, represent the best value for money or sustainability. Educational technology can be expensive. In emergency situations when resources are limited and the infrastructure to support the technology is under strain, the sustainability and feasibility of an intervention has to be established, if long-term improvements in learning outcomes are the aim of the intervention. Technology interventions can become a burden to the communities in which EdTech is integrated if the long term considerations of software updates and maintenance are not considered. The issues that need to be considered regarding value for money include considering the appropriateness of the hardware, sustained training initiatives for teachers, adaptation costs for the learning environment, and capacity building, where

needed, to ensure that broken equipment can be maintained.

20. Infrastructure is a major barrier to the successful utilization of EdTech. A common theme across the literature was the barrier of existing infrastructure in preventing the successful integration of EdTech. Infrastructure will differ based on the region engaged, so too will equity of access within countries, There is a need to look beyond the claimed infrastructure, and policy framework of specific countries, and analyse for what the actual and current infrastructure is best suited. Otherwise, initiatives will lead to wastage and an opportunity cost.

21. EdTech can be effectively used alongside accelerated learning programmes in order to help children to catch up and get back on track in their appropriate learning levels, but only if EdTech programmes are aligned with the curriculum and work as a supplement to accelerated learning programmes.

22. Boys and girls perform the same when not facing barriers to access, but barriers to access are both gendered and pervasive and are buried within economic and societal contexts. In an emergency, or any context, we have to build our own understanding of these divides by working closely with local populations before engaging in programmes that may exacerbate inequality in society.

Samuel*, 15, at his school in Freetown, Sierra Leone. .At the peak of the Ebola epidemic, the health system collapsed and Samuel was unable to get the treatment he needed for an injury to his leg. During this period his condition worsened with infection and became life threatening. Meanwhile his mother and grandmother became infected by the Ebola virus and passed away. Save the Children referred Samuel to an emergency hospital where they were able to amputate his leg and save his life.

*name has been changed for security reasons

9. How can we ethically implement EdTech in emergencies?: Some Guiding Questions

This rigorous review has synthesized and analysed the findings from 135 quality documents. These findings have allowed us to form a holistic picture regarding 'what' and 'how' EdTech works best in both emergency and non-emergency situations. What is clear from our findings and analysis is that EdTech is not a silver bullet, and, in and of itself, cannot solve the global education crisis. We know that children still need assistance and guidance from facilitators, teachers, and parents, and that technology is, in its current state, not sufficiently advanced to bypass this support. We also know that children want and need to learn from one another and can learn more in groups than in 1:1 device settings.

We have seen that the best and most useful EdTech programmes are well thought out and carefully planned and integrated. For example, effective programmes are well aligned with the curricula, have teacher and parent buy-in, are adaptive to the learner's level, and are contextually appropriate. We have also compiled evidence that clearly shows that EdTech, unless implemented with much forethought and planning, can often be costly and wasteful.

This evidence therefore leads to many more questions, but provides us some guidance in which to think ethically about how and what EdTech can be used to help children learn. The evidence has shown that we have to prioritise children and families' needs first. We must ensure that children have opportunities to learn, and only then, ask how EdTech can fit into this picture. Findings from this report show that it should never be the other way around; the needs of the child must always drive the use of EdTech.

To ensure this is the case we need to truly understand an emergency setting and the context. We have to ask some very basic questions to start:

Needs and values of the families

In each emergency setting we need to assess and understand what families and children want and need. We have to understand the families' expectations of learning and how families see and are willing to use technology in the home. For example:

1. Do families have devices at home?
2. Would families see the value in devices for at home learning (or if they are given devices, would they be inclined to sell them to meet basic needs?)
3. Do families prefer their children go to school and how do they see technology as part of that process?

Emergency setting

We need to understand the type of emergency before us, this will help to determine if, how and what technology might be the most useful. For example, short-term disruptions may only require that children keep up with skills and knowledge so they do not fall behind.

1. Is the disruption short term?
   a. What skills do children need to reinforce to ensure they are not left behind?
2. Is disruption long-term?
   a. Do children have access to formal or non-formal education?
      i. If so, how can EdTech help children be get caught up and learn more efficiently at school and at home.
      ii. If not, why.

1. Does the government restrict access for the displaced and is it possible to use the integration of technology in schools as a way to leverage access?
2. If it is unsafe to travel to school, what can children use at home to facilitate learning until a longer term solution is found?

Learning needs of the child

Clearly we have to understand what the child has been through, where in their learning journey were they disrupted, for how long has their learning been disrupted and what do they need to learn to stay the path?

1. What is the age of the child? What curricula were they learning from and how can they move forward in their current situation?
2. What is contextually appropriate for the child, depending on their age and background?
3. How can families be engaged?

Infrastructure

The type of infrastructure that is available will matter. We have to ask ourselves:

1. Is there constant electricity?
   a. Do devices need to be charged and is charging available?
2. Are there classrooms and safe spaces?
3. Are teachers available to help scaffold? If not, can facilitators be trained?
4. Is there internet or data? Does the EdTech depend on this?
5. What is practically available?

Equity of Access

We also have to ask ourselves about accessibility and equality:

1. Will the integration of EdTech leave some children behind, such as girls and children with disabilities?
2. What are the barriers that are in place that may affect some children's access to EdTech – exacerbating pre-existing divides? And how do we circumnavigate, or even dismantle, these barriers?

Cost and Feasibility

Once we are able assess this information, we can ask if technology can enhance the learning environment, and if so, what type of technology would be useful, when is the appropriate time to integrate it, and is it worth the cost?

1. Is the infrastructure in place to support the technology, and are the time, money, and skills available to ensure the sustainability and cost effectiveness of the programme?
2. Is time allocated to training teachers and families and is there on-going support?
3. What is the cost, and are there more cost effective alternatives out there that will support education in the same manner?
4. What are the pros and cons of each device? (See Appendix 4 for an overview)

Overall, the above list of questions is not exhaustive, but can help us to understand what factors are important if and when EdTech is implemented in an emergency setting. Findings from this report show that implementing EdTech efficiently and effectively requires sufficient time and consideration and should not be seen as a simple solution to an extremely complex problem.

Alister*, reviews the sms message on his mobile phone confirming a cash transfer has been made to his family's account in the Binga district of Zimbabwe.

*name has been changed for security reasons

References

Abdul Jabbar, A. I., & Felicia, P. (2015). Gameplay Engagement and Learning in Game-Based Learning: A Systematic Review. *Review of Educational Research,* 85(4), 740–779.

Aderinoye, R. (2008). Literacy and communication technologies: Distance education strategies for literacy delivery. *International Review of Education,* 54(5–6), 605–626.

Aesaert, K., & van Braak, J. (2015). Gender and socioeconomic related differences in performance based ICT competences. *Computers & Education,* 84(C), 8–25.

Agarkar, S. (2016). Role of Open Educational Resources to Support School Science Education in India. In M.-H. Chiu (Ed.), *Science Education Research and Practice in Asia* (pp. 409–441). Springer.

Ale, K., Loh, Y. A. C., & Chib, A. (2017). Contextualized-OLPC education project in rural India: measuring learning impact and mediation of computer self-efficacy. *Educational Technology Research and Development,* 65(3), 1–26.

Ames, M. G., & Rosner, D. K. (2014). From drills to laptops : designing modern childhood imaginaries. I*nformation, Communication & Society,* 17(3), 357–370.

Ananiadou, K. & Claro, M. (2009). 21st Century Skills and Competencies For New Millenium Learners in OECD Countries, OECD, Education Working Paper no.41. OECD.

Arguel, A., Lockyer, L., Lipp, O.V., Lodge, J. M., & Kennedy, G. (2017). Inside Out: Detecting Learners Confusion to Improve Interactive Digital Learning Environments. *Journal of Educational Computing Research,* 55(4), 526–551.

Arndt, P. A. (2016). Computer usage for learning how to read and write in primary school. *Trends in Neuroscience and Education,* 5(3), 90–98.

Ausubel, D. P. (1968) Educational psychology, A cognitive view. New York: Holt, Rinehart and Winston, Inc.

Bando, R., Gallego, F., Gertler, P., & Romero, D. (2016). *Books or Laptops? The Cost-Effectiveness of Shifting from Printed to Digital Delivery of Educational Content.* Working Paper

Bandura, A. (1994). Self-efficacy. In V. S. Ramachaudran (Ed.), Encyclopedia of human behavior New York: *Academic Press.* (Reprinted in H. Friedman [Ed.], Encyclopedia of mental health. San Diego: Academic Press. Vol. 4, 71-81.

Banerjee, A., Cole, S., Duflo, E., & Linden, L. (2007). Remedying Education: Evidence from Two Randomized Experiments in India. *Quarterly Journal of Economics,* (August), 1235–1264.

Barrera-Osorio, F., & Linden, L. L. (2009). The Use and Misuse of Computers in Education: Evidence from a Randomized Controlled Trial of a Language Arts Program. *Policy Research Working Paper Series – The World Bank,* (March).

Beers, S. R., & De Bellis, M. D. (2002). Neuropsychological function in children with maltreatment-related posttraumatic stress disorder. *The American Journal of Psychiatry,* 159(3), 483–486.

Belland, B., (2014) Scaffolding: Definition, Current Debates, and Future Directions. In: Spector, J, M. Merill, M, D., Elen, J., Bishop, M., (eds) *Handbook of Research on Educational Communications and Technology (4th edition),* New York, Springer.

Blackwell, C. K., Lauricella, A. R., Wartella, E., Robb, M., & Schomburg, R. (2013). Adoption and use of technology in early education. The interplay of extrinsic barriers and teacher attitudes. *Computer and Education,* 69, 310-319.

Blikstad-balas, M., & Davies, C. (2017). Oxford Review of Education Assessing the educational value of one-to-one devices : have we been asking the right questions? *Oxford Review of Education,* 4985(May), 1–21.

Bloom, B., Englehart, M. Furst, E. Hill, W., Krathwohl, D. (1956) Taxonomy of educational objectives: The classification of educational goals. Handbook 1: Cognitive Domain. New York, Toronto: Longmans, Green.

Buckner, E., & Kim, P. (2012). Mobile innovations, executive functions, and educational developments in conflict zones: a case study from Palestine. Educational Technology Research and Development, 60(1), 175–192.

Çardak, M. (2013). Psychological well-being and Internet addiction among university students. *TOJET: The Turkish Online Journal of Educational Technology,* 12(3), 134–141.

Carlson, S., (2013). Using technology to deliver educational services to children and youth in environments affected by crisis and/or conflict. USAID

Cayton-Hodges, G. A., Feng, G., & Pan, X. (2015). Tablet-Based Math Assessment: What Can We Learn from Math Apps? *International Forum of Educational Technology Journal of Educational Technology & Society,* 18(2), 3–20.

Chang, A., Tilahun, L., & Breazeal, C. (2014). Visualisations of Data from the Literacy Tablet Reading Project in Rural Ethiopia. *Proceedings of the EVA London 2014 on Electronic Visualisation and the Arts,* 142–149.

Chiong, C., & Shuler, C. (2010). Learning: Is there an app for that? Investigations of young children's usage and learning with mobile devices and apps. *The Joan Ganz Cooney Center at Sesame Workshop.*

Chukwuere E. Joshua, Mavetera Nehemiah, and M. E. (2015). A Conceptual Culture-Oriented e-Learning System Development Framework (e-LSDF): A Case of Higher Education Institutions in South Africa. *International Journal of Trade, Economics and Finance,* 6(5).

Crea, T. M. (2016). Refugee higher education: Contextual challenges and implications for program design, delivery, and accompaniment. *International Journal of Educational Development, 46,* 12–22.

Cristia, J., Ibarrarán, P., Santiago, C., Santiago, A., & Severin, E. (2012). Technology and Child Development : Evidence from the One Laptop per Child Program. IZA *Discussion Paper No. 6401.*

Cronje, J. (2008). Lessons from Africa. In H. H. Adelsberger, Kinshuk, J. M. Pawlowski, & D. G. Sampson (Eds.), *Handbook on Information Technologies for Education and Training,* Berlin Heidelberg, Berlin pp. 423–438.

Cummings, C., & O'Neil, T. (2015) Do digital information and communications technologies increase the voice and influence of women and girls? *A Rapid Review of the evidence* Overseas Development Institute.

Dave, R. (1967). *Psychomotor domain.* Berlin: International Conference of Educational Testing.

Dahya, N. (2016). Education in Conflict and Crisis : How Can Technology Make a Difference? A Landscape Review. INEE.

De Melo, G., Machado, A., & Miranda, A. (2014). The Impact of a One Laptop per Child Program on Learning: Evidence from Uruguay, IZA *Discussion Papers*.

Dunn, J., Bundy, P., & Woodrow, N. (2012). Combining drama pedagogy with digital technologies to support the language learning needs of newly arrived refugee children: a classroom case study. *Research in Drama Education: The Journal of Applied Theatre and Performance, 17*(4), 477–499.

Elbert, T., Schauer, M., Schauer, E., Huschka, B., Hirth, M., & Neuner, F. (2009). Trauma-related impairment in children-A survey in Sri Lankan provinces affected by armed conflict. *Child Abuse and Neglect, 33*(4), 238–246.

Fisher, K. E., Bishop, A. P., Magassa, L., & Fawcett, P. (2014). Action!: Codesigning Interactive Technology with Immigrant Teens. *In Proceedings of the 2014 Conference on Interaction Design and Children* pp. 345–348.

Fisher, K. E., Yefimova, K., & Bishop, A. P. (2016). Adapting Design Thinking and Cultural Probes to the Experiences of Immigrant Youth: Uncovering the Roles of Visual Media and Music in ICT Wayfaring. In *Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems* pp. 859–871.

Flewitt, R., Messer, D., & Kucirkova, N. (2015). New directions for early literacy in a digital age : The iPad. *Journal of Early Childhood Literacy,* 15(3), 289–310.

Forgasz, H. J., Vale, C., & Ursini, S. (2010). Technology for *Mathematics Education: Equity, Access and Agency. In C. Hoyles & J.-B. Lagrange (Eds.), Mathematics Education and Technology-Rethinking the Terrain: The 17th ICMI Study* (pp. 385–403). Boston, MA: Springer US.

Garcia, E., Elbeltagi, I. M., Dungay, K., & Hardaker, G. (2015). Student use of Facebook for informal learning and peer support. *The International Journal of Information and Learning Technology, 32*(5), 286–299.

Genlott, A. A., & Grönlund, Å. (2016). Closing the gaps – Improving literacy and mathematics by ict-enhanced collaboration. *Computers and Education, 99,* 68–80.

Gómez, F., Nussbaum, M., Weitz, J. F., Lopez, X., Mena, J., & Torres, A. (2013). Co-located single display collaborative learning for early childhood education. *International Journal of Computer-Supported Collaborative Learning, 8*(2), 225–244.

Gulati, S. (2008). Technology-enhanced learning in developing nations: A review. *International Review of Research in Open and Distance Learning, 9*(1), 1–16.

Hall, R. (2007) Vygotsky Goes Online: *Learning Design from a Socio-cultural Perspective, Learning and Socio-cultural theory: Exploring Modern Vygotskian Perspectives International Workshop, 1* (1), p.94-107.

Hamm, S. Drysdale, J. Moore, D. (2013). *Towards a Mobile Learning Pedagogy.* In Hamm, S. Towards a Mobile Learning Pedagogy and Perspectives on Teaching and Learning, IGI Global, 1-19.

Hashemi, M., Azizinezhad, M., Najafi, V., & Nesari, A. J. (2011). What is mobile learning? Challenges and capabilities. In *Procedia – Social and Behavioral Sciences,* Vol. 30, pp. 2477–2481.

Haßler, B., Major, L., & Hennessy, S. (2016). Tablet use in schools: A critical review of the evidence for learning outcomes. *Journal of Computer Assisted Learning, 32*(2), 139–156.

Hennessy, S., Onguko, B., Harrison, D., Kiforo, E., Namalefe, S., & Naseem, A. (2010). Developing the Use of Information and Communication Technology to Enhance Teaching and Learning in East African Schools: Review of the Literature. *Africa, 2*(May), 121.

Higgins, S., Xiao, Z., & Katsipataki, M. (2012). The Impact of Digital Technology on Learning : A Summary for the Education Endowment Foundation Full Report. *Education Endowment Foundation.*

Hilbert, M. (2011). Digital gender divide or technologically empowered women in developing countries? A typical case of lies, damned lies, and statistics. *Women's Studies International Forum, 34*(6), 479–489.

Hirsh-Pasek, K., Zosh, J. M., Golinkoff, R. M., Gray, J. H., Robb, M. B., & Kaufman, J. (2015). *Putting Education in "Educational" Apps. Psychological Science in the Public Interest,* Vol. 16 (1). 3 – 34.

Hirshleifer, S. R. (2016). Incentives for Effort or Outputs ? A Field Experiment to Improve Student Performance What incentive contracts are most effective at motivating effort in order to improve outcomes ? 1-45.

Hosman, L. (2010). Policies, Partnerships, and Pragmatism: Lessons from an ICT-in-Education Project in Rural Uganda. *Information Technologies & International Development, 6*(1), 48–64.

Hsin, C. T., Li, M. C., & Tsai, C. C. (2014). The Influence of Young Children's Use of Technology on Their Learning: A Review. *Journal of Educational Technology & Society, 17*(4), 85–99.

Hubber, P. J., Outhwaite, L. A., Chigeda, A., McGrath, S., Hodgen, J., & Pitchford, N. J. (2016). Should touch screen tablets be used to improve educational outcomes in primary school children in developing countries? *Frontiers in Psychology, 7*(JUN), 1–4.

Islam, M. S., & Grönlund. (2016). An international literature review of 1:1 computing in schools. *Journal of Educational Change, 17*(2), 191–222.

Jalbout, M. (2015). Opportunities for Accelerating Progress on Education for Syrian Children and Youth in Jordan. Their world.

Jantjies, M., & Joy, M. (2015). Mobile Enhanced Learning in a South African Context. *Source: Journal of Educational Technology & Society Educational Technology & Society, 18*(181), 308–320.

Keengwe, J., & Bhargava, M. (2013). Mobile learning and integration of mobile technologies in education. *Education and Information Technologies, 19*(4), 737–746.

Khaddage, F., Müller, W., & Flintoff, K. (2016). Advancing Mobile Learning in Formal And Informal Settings via Mobile App Technology: Where to From Here, and How? *Educational Technology & Society, 19*(3), 16–26.

Kim, P. H. (2009). Action research approach on mobile learning design for the underserved. *Educational Technology Research and Development, 57*(3), 415–435.

Kim, P., Buckner, E., Kim, H., Makany, T., Taleja, N., & Parikh, V. (2012). A comparative analysis of a game-based mobile learning model in low-socioeconomic communities of India. *International Journal of Educational Development, 32*(2), 329–340.

Kim, P., Hagashi, T., Carillo, L., Gonzales, I., Makany, T., Lee, B., & Grate, A. (2011). Socioeconomic strata, mobile technology, and education: A comparative analysis. Educational Technology Research and Development, 59(4), 465–486.

Kim, P., Miranda, T., & Olaciregui, C. (2008). Pocket School: Exploring mobile technology as a sustainable literacy education option for underserved indigenous children in Latin America. *International Journal of Educational Development, 28*(4), 435–445.

Kleine, D., Hollow, D., & Poveda, S. (2013). *Children, ICT and Development Capturing the potential, meeting the challenges.*

Kolodziejczyk, I. (2015). Mixed methods for study of gender issues in access, application, and attitudes toward ICT in higher education institutions in Papua New Guinea. *SAGE Open, 5*(2), 1–15.

Koops, M. C., Verheul, I., Tiesma, R., de Boer, C.-W., & Koeweiden, R. T. (2016). Learning Differences Between 3D vs. 2D Entertainment and Educational Games. *Simulation & Gaming, 47*(2), 159–178.

Koutromanos, G., Sofos, A., & Avraamidou, L. (2015). The use of augmented reality games in education: a review of the literature. *Educational Media International, 52*(4), 253–271.

Kumar, A., Reddy, P., Tewari, A., Agrawal, R., & Kam, M. (2012). Improving literacy in developing countries using speech recognition-supported games on mobile devices. *Proceedings of the 2012 ACM Annual Conference on Human Factors in Computing Systems – CHI '12,* (April), 1149 – 1158

Kwapong, O. A. T. F. (2009). A comparison of ICT knowledge and usage among female distance learners in endowed and deprived communities of a developing country. *E-Learning, 6*(2), 164–174.

Lewis, K., & Thacker, S. (2016). ICT and the Education of Refugees: A Stocktaking of Innovative Approaches in the MENA Region: Lessons of Experience and Guiding Principles. World Bank Education Technology & Innovation: *SABER-ICT Technical Paper Series;* No. 17 World Bank, Washington, DC.

Linden, L. L. (2008). Complement or Substitute ? The Effect of Technology on Student Achievement in India. *JPAL Working Paper,* Columbia University , June 3, 2008.

McManis, L., & Gunnewig, S. (2012). Finding the education in educational technology with early learners. *YC Young Children, 67*(3), 14–24.

Melo, G. De, Machado, A., & Miranda, A. (2014). Working Papers The Impact of a One Laptop per Child Program on Learning : Evidence from Uruguay October 2014 The Impact of a One Lap to per Child Program on Learning : Evidence from Uruguay, Germany Discussion Paper No. 8489.

Menashy, F., & Zakharia, Z. (2017). *Investing in the Crisis: Private participation in the education of Syrian refugees. Education International.*

Morpeth, R., Creed, C., Cullen, J., Page, E., Raynor, J., Jabeen, N., Crofts, K. (2009). *Open and Distance Learning for Basic Education in South Asia: Its potential for hard-to-reach children and children in conflict and disaster areas.*
UNICEF, Paris

Mouza, C., & Cavalier, A. (2013). Emerging Technologies for the Classroom, The Role of One-to-One Computing in the Education of at-Risk High-School Students p.145-159.

Muralidharan, K., Singh, A., Ganimian, A. J., Banerjee, A., Bergman, P., Bharadwaj, P., Walters, C. (2017). Nber Working Paper Series Distributing Education? Experimental Evidence on Technology-Aided Instruction in India. Experimental Evidence on Technology-Aided Instruction in India. Working Paper.

Murphy, P. (1996) Defining Pedagogy, in: Murphy, P. F., & Gipps, C.V., *Inequity in the Classroom: Towards Effective Pedagogy for Girls and Boys,* UNESCO.

Nedungadi, P., Jayakumar, A., & Raman, R. (2014). Low cost tablet enhanced pedagogy for early grade reading: Indian context. *Proceedings of the IEEE Region 10 Humanitarian Technology Conference 2014, R10 HTC 2014, 2015–Janua,* 35–39.

Neumann, M. M. (2016). Young children's use of touch screen tablets for writing and reading at home: Relationships with emergent literacy. *Computers and Education, 97*, 61–68.

Neumann, M. M., & Neumann, D. L. (2013). Touch Screen Tablets and Emergent Literacy. *Early Childhood Education Journal, 42*(4), 231–239.

Northropp, L., & Killeen, E. (2013). A Framework for Using Ipads to Build Early Literacy Skills, *Source: The Reading Teacher, 66*(7), 531–537.

Passey, D., Laferrière, T., Ahmad, Y.-A., Bhowmik, M., Gross, D., Price, J., Shonfeld, M. (2016). Educational Digital Technologies in Developing Countries Challenge Third Party Providers, 19(3), 121–133.

Paterson, A. (2007). Costs of information and communication technology in developing country school systems: The experience of Botswana, Namibia and Seychelles. *International Journal of Education and Development*

Using Information and Communication Technology, 3(4), 89–101.

Perry, K. H., & Moses, A. M. (2011). Television, language, and literacy practices in Sudanese refugee families: "I learned how to spell English on Channel 18." *Research in the Teaching of English, 45*(3), 278–307.

Petko, D., Cantieni, A., & Prasse, D. (2017). Perceived Quality of Educational Technology Matters. *Journal of Educational Computing Research, 54*(8), 1070–1091.

Piper, B., Jepkemei, E., Kwayumba, D., & Kibukho, K. (2015). Kenya's ICT Policy in Practice : The Effectiveness of Tablets and E-readers in Improving Student Outcomes. *Forum for International Research in Education, 2*(1), 3–18.

Power, T; Mathew, R and Siddique, A (2015). Changes in teaching and learning: what counts, who to, and how is it counted? In: UKFIET 2015 Conference Papers, 13th International Conference on Education & Development. UKFIET: The Education & Development Forum.

Pruet, P., Ang, C. S., & Farzin, D. (2015). Understanding tablet computer usage among primary school students in underdeveloped areas: Students' technology experience, learning styles and attitudes. *Computers in Human Behavior,* pp. 1131–1144.

Punter, R. A., Meelissen, M. R., & Glas, C. A. (2016). Gender differences in computer and information literacy: An exploration of the performances of girls and boys in ICILS 2013. *European Educational Research Journal, 1,* 147490411667246.

Qablan, A. M., Abuloum, A., & Al-Ruz, J. A. (2009). Effective Integration of ICT in Jordanian Schools: An Analysis of Pedagogical and Contextual Impediments in the Science Classroom. *Journal of Science Education and Technology, 18*(3), 291–300.

Raji, M., & Zualkernan, I. (2016). A Decision Tool for Selecting a Sustainable Learning Technology Intervention. *Journal of Educational Technology & Society Educational Technology & Society, 19*(193), 306–320.

Restyandito, Chan, A. H. S., & Lestariningsih, F. E. (2013). A Review on the Use of Technology to Develop Literacy. *International Journal of Information and Education Technology, 3*(6), 611–614.

Sam, S. (2015). Exploring mobile internet use among marginalized young people in post-conflict Sierra Leone. *Electronic Journal of Information Systems in Developing Countries*. 1-20.

Samuelson, K.W., Krueger, C. E., Burnett, C., & Wilson, C. K. (2010). Neuropsychological Functioning in Children with Posttraumatic Stress Disorder. *Child Neuropsychology, 16*(2), 119–133.

Shahadat, M., Khan, H., Hasan, M., Kum, C., & Prof, C. (2012). Barriers to the introduction of ICT into Education in Developing Countries: The Example of Bangladesh. *International Journal of Instruction, 5*(2), 1694-609.

Simpson, E. J. (1972). The Classification of Educational Objective in the Psychomotor Domain. Washington, DC: Gryphon House.

Spitzer, M. (2014). Information technology in education: Risks and side effects. *Trends in Neuroscience and Education, 3*(3–4), 81–85.

Steffens, K. (2014). ICT use and achievement in three European Countries: What does PISA tell us? *European Educational Research Journal, 13*(5), 553–562.

Sultana, R. (2006). Education in Conflict Situations: Palestinian Chidlren and Distance Education in Hebron. *Mediterranean Journal of Educational …, 11*(1), 49–81.

Tamim, R. M., Bernard, R. M., Borokhovski, E., Abrami, P. C., & Schmid, R. F. (2011). What Forty Years of Research Says About the Impact of Technology on Learning: A Second-Order Meta-Analysis and Validation Study. *Review of Educational Research, 81*(1), 4–28.

Tamim, R. M., Borokhovski, E., Pickup, D., Bernard, R. M., & El Saadi, L. (2015). *Tablets for Teaching and Learning: A Systematic Review and Meta-Analysis*.

Tauson, M. (2016). *Seeking Asylum in Bangkok, Thailand: Surviving, Coping, and the Wellbeing Strategies of Palestinian-Syrian Refugees*. University of Sussex, Brighton.

Tay, L. Y., Lim, C. P., & Lim, S. K. (2015). Differences in ICT Usage Across Subject Areas. *Journal of Educational Computing Research, 53*(1), 75–94.

UNESCO and UNESCO Institute of for Statistics and group Talal Abu-Ghazaleh. (2013). *ICT in education in five Arab countries Comparative analysis of the integration of ICT and e-Readiness in Schools in Egypt, Jordan, Oman, Palestine, Qatar.*

UNESCO (2017) UNESCO Global Education Monitoring Report. *Accountability in Education: Meeting our Commitments*. *UNESCO Publishing.*

USAID, Dubad, H. I., Somali, T., Radio, I., Program, I., & Development, I. (2012). Somali Interactive Radio Instruction Program. USAID.

Vadachalam, N., & Chimbo, B. (2017). Using Information and Communication Technologies to teach and learn mathematics in South African schools: A snapshot view of its impact. *Africa Education Review, 6627*(June), 1–23.

Valiente, O. (2010). "1-1 in Education: Current Practice, International Comparative Research Evidence and Policy Implications", *OECD Education Working Papers,* No.44, OECD Publishing.

Valk, J.-H., Rashid, A. T., & Elder, L. (2010). Using mobile phones to improve educational outcomes: An analysis of evidence from Asia. *The International Review of Research in Open and Distributed Learning, 11*(1), 117–140.

Vassilopoulou, A., & Mavrikaki, E. (2016). Can ICT in biology courses improve AD/HD students' achievement? *Improving Schools, 19*(3), 246–257.

Verenikina, I., Kervin, L., Rivera, M. C., & Lidbetter, A. (2016). Digital play: Exploring young children's perspectives on applications designed for preschoolers. *Global Studies of Childhood, 6*(4), 388–399.

Vygotsky, L. (1978) Interaction between learning and development. In Gauvain & Coles (Eds.) *Reading on the Development of Children.* New York: Scientific American Books. Pp.34-40.

Wagner, D. (2014). Mobiles for Reading: A Landscape Research Review. USAID.

Wagner, D. A., Castillo, N. M., Murphy, K. M., Crofton, M., & Zahra, F.T. (2014). Mobiles for literacy in developing countries: An effectiveness framework. Prospects, 44(1), 119–132.

Warschauer, M., & Ames, M. (2010). Can One Laptop Per Child Save the World's Poor? *Journal of International Affairs, 64*(1), 33–51.

Warschauer, M., Zheng, B., Niiya, M., Cotten, S., & Farkas, G. (2014). Balancing the One-To-One Equation: *Equity and Access in Three Laptop Programs. Equity & Excellence in Education, 47*(1), 46–62.

Washington, K., & Rowell, J. (2013). Syrian Refugees in Urban Jordan, Baseline Assessment of Community-identified Vulnerabilities among Syrian refugees living in Irbid, Madaba, Mufraq, and Zarqa. Rapid Participatory Community Assessment, Care Jordan.

Webb, M., & Cox, M. (2004). A review of pedagogy related to information and communications technology. *Technology, Pedagogy and Education, 13*(3), 235–286.

West, M., & Chew, H. E. (2014). *in the Mobile Era. United Nations Educational.*

West, M. (2010) Innovate to Educate: System [Re]Design for Personalized learning – A Report from the 2010 Symposium, In collaboration with ASCD and the Council of Chief State Schools, Officers, Washington, DC.

Wolf, M., Gottwald, S., Breazeal, C., Galyean, T., & Morris, R. (2016). "I Hold Your Foot:" Lessons from the Reading Brain for Addressing the Challenge of Global Literacy Maryanne. *In Children and Sustainable Development* (pp. 225–238).

Wolf, Maryanne; Gottwald, Stephanie; Galyean, Tinsley; Morris, R. (2014). Global Literacy and Socially Excluded Peoples. In *Proceedings of the Pontifical Academy of Social Sciences, Meeting on the Socially Excluded Peoples* (pp. 1–19). Vatican.

Xu, Y., Maitland, C., & Tomaszewski, B. (2015). Promoting participatory community building in refugee camps with mapping technology. *Proceedings of the Seventh International Conference on Information and Communication Technologies and Development – ICTD '15,* 1–4.

Yang, Y., Zhang, L., Zeng, J., Pang, X., Lai, F., & Rozelle, S. (2013). Computers and the academic performance of elementary school-aged girls in China's poor communities. *Computers and Education, 60*(1), 335–346.

Yasik, A. E., Saigh, P. A., Oberfield, R. A., & Halamandaris, P.V. (2007). Posttraumatic Stress Disorder: Memory and Learning Performance in Children and Adolescents. *Biological Psychiatry, 61*(3), 382–388.

Zelezny-Green, R. (2014). She called, she Googled, she knew: girls' secondary education, interrupted school attendance, and educational use of mobile phones in Nairobi. *Gender & Development, 22*(1), 63–74.

Zheng, B., Warschauer, M., Lin, C.-H., & Chang, C. (2016). Learning in One-to-One Laptop Environments: A Meta-Analysis and Research Synthesis. *Review of Educational Research, 86*(4), 1052–1084.

Zualkernan, I. A. (2016). Personalized Learning for the Developing World. In B. Gros, Kinshuk, & M. Maina (Eds.), The Future of Ubiquitous Learning: Learning Designs for Emerging Pedagogies (pp. 241–258). Berlin, Heidelberg: Springer Berlin Heidelberg.

Appendices

APPENDIX 1: RESEARCH STRINGS:

EMERGENCIES AND CRISIS	EDUCATION	ICT
conflict	education	radio
war	school	television
natural disaster	nonformal education	laptop
violence	learning centre (center)	tablet
post conflict	vocational	device
post-conflict	training	Mobile phone
emergency	early childhood	cellular phone
humanitarian	skills	software
disaster	Curriculum	hardware
refugee	classroom	technology
internally displaced	teacher	EdTech
violence	youth	EdTech
fragility	adolescent	MOOCS
conflict affected	primary education	Online
conflict-affected	secondary education	internet
terrorism	teenager	digital
attacks	child friendly space	Social media
armed conflict	child-friendly space	ICT
Flood(ing)	safe space	Gaming
crisis	Informal education	EReader
asylum	learning	elearning
displaced	psycho-social	connectivity
relief	psycho social	Smart phone
Earthquake	Emotional learning	SMS
hurricane	socioemotional	Multi-media
drought	social-emotional	Applications
tsunami	socio-emotional	Apps
cyclone	reading	Virtual learning environments
famine	teaching	Mobile learning
landslide	wellbeing	Digital technology
pandemic		Virtual reality
outbreak		
gangs		

APPENDIX 2: ACADEMIC DATABASES AND JOURNALS SEARCHED:

Database Searched
Springerlink
ProQuest
ERIC
Sage Journals
JSTOR
Google Scholar

Selected Journals
Journal of Refugee Studies
Refugee Survey Quarterly
Migration Studies
Journal of Refugee Law
Information Technology and International Development

APPENDIX 3: GREY LITERATURE SEARCH:

Title	Website/Database	Search words
Children, ICT and development : capturing the potential, meeting the challenges	BLDS	(advanced search) ICT and Education
Low-cost devices in educational systems: The use of the "XO-Laptop" in the Ethiopian Educational System	GIZ	ICT, Education
Education in Conflict and Crisis: How Can Technology Make a Difference?		Conflict, Education, Technology
Country ICT Survey for Sri Lanka	ELDIS	Education, ICT, Conflict
Education in Situations of Emergency and Crisis: Challenges for the New Century		War, Technology, Education
Do digital information and communications technologies increase the voice and influence of women and girls?		EDtech, youth
ICT and the Education of Refugees: A Stocktaking of Innovative Approaches in the MENA Region	World Bank	ICT, Education

Title	Website/Database	Search words
Expanding Access to Early Childhood Development		ICT, Education, War
The Jordan Education Initiative A Multi-Stakeholder Partnership Model to Support Education Reform		Refugee, Education, Youth, Technology
Lessons Learned from World Bank Education Management Information System Operations		Learning, IDPs, Technology
Technologies in education across the Americas: *The promise and the peril – and some potential ways forward*		Learning, IDPs, Technology
Information and Communication Technology (Ict) In Education iIn Five Arab States	UNESCO	School, youth, radio
Guidebook for planning education in emergencies and reconstruction		Conflict, school
Technologies for Education		Education, ICT, Youth
'Delivering Quality Basic Education in Challenging Circumstances'	Global Partnership for Education	ICT refugee
ICT4refugee	Google	"ICT" and "refugee" and "education"
Learning for a future: refugee education in developing countries		"ICT" and "refugee" and "education"
UNESCO technology and education presenation		"ICT" and "refugee" and "education"
Policy Report on UNHCR's Community Technology Access Program: Best Practices and Lessons Learned		Evaluation, refugee, ict, education

APPENDIX 4: TECHNOLOGY OVERVIEW

This table provides a snapshot of the positives and issues associated with the main genres of EdTech engaged with throughout this rigorous review and narrative synthesis

Type of Technology	Positives associated with tech	Issues to consider
1 to 1 Computers/Laptops	Work can be personalised to the learners level; Increase learner motivation; can promote self-efficacy can work on a broad range of educational skills.	There is a risk of theft; issues surrounding the sustainability of the hardware in difficult environments; only as good as the software provided; charge and battery life diminishes throughout life of product.
Tablets	Personalised learning capability; can develop self-efficacy can work on a broad range of educational skills; potential for instantaneous feedback; strong assessment potential	Expensive; sustainability issues surrounding hardware maintenance; only as good as the software provided; charge and battery life diminishes throughout the life the product; high risk of theft or potential for exclusion/jealousy.
Smart Phones (3g)	Work can be personalised to the learners level; software can be aligned with a curriculum; increase learner motivation; can promote self-efficacy can work on a broad range of educational skills; allows access to out of school children.	Risk of theft; issues with sustainability of the hardware; limited by the size and resolution of the screen; data packages in developing countries a considerable cost for families and downloads cost data; battery life diminishes throughout life of product.
Mobile Phones (2g)	Relatively cheap to buy; Simple to use; battery life is long; widespread availability of spare parts; cost-effective delivery of content; can be remotely topped up; can help promote literacy	Limited functionality; lack of opportunity to personalise learning; limited by screen size and resolution; limited language settings;
e-readers	Great capacity to hold large amounts of information; literacy focus; cost-effective delivery of content; support teacher instruction.	Limited language settings; lack of personalised learning; no scaffolding; limited by screen size and resolutions.
Television	Infrastructure often established in country; multigenerational medium; multiuser medium; inclusionary e.g. deaf students can use; useful for authentic language acquisition; relatively cheap; wide range of applicable subjects	One way medium; lack of personalisation; limited by electricity infrastructure (no offline use).

Type of Technology	Positives associated with tech	Issues to consider
Interactive Radio	Infrastructure well established across world; multigenerational medium; multiuser medium; electricity not a pre-requisite as wind up radios available; relatively cheap; wide range of applicable subjects; medium lends itself to traditional mediums of communication (storytelling).	One way medium; lack of personalisation; no scaffolding provided by, or enabled through the device itself; can be easily coopted for propaganda purposes.

Ali* attends a Save the Children drop in centre for child labourers where centre staff encouraged him to return to school. He is several grades behind, and receives support from the centre to help him keep on top of his schoolwork. Ali is friends with Tarek who encourages him to stay in school. He is not sure if he will stay in school, but he hopes to become a mechanic some day. He wakes up every morning at 4am to go to work.

*name has been changed for security reasons

Save the Children

EDTECH FOR LEARNING IN EMERGENCIES AND DISPLACED SETTINGS

savethechildren.net