SOLVING THE 'LEARNING CRISIS' IN DEVELOPING COUNTRIES THROUGH JUGAAD INNOVATION EDUCATION TECHNOLOGY: A QUALITATIVE STUDY

Thomas Cowley
Pearson Business School, London
United Kingdom

Dr David Atkinson
Keele Management School, Keele University
United Kingdom

Abstract

This study set out to investigate how combining jugaad innovation with Education Technology (EdTech) can help solve the 'learning crisis' in developing countries. The problem centres on education quality; large volumes of underprivileged students in developing countries are attending school, but many fail to learn basic skills (The World Bank, 2018:3). Globally, over 617m students are failing to achieve minimum proficiency standards in maths and reading (UNESCO, 2017). Consequently, the global problem in education is not simply about the provision of learning but also ensuring high quality (Pearson PLC, 2018). This research explores how jugaad innovation, including key themes such as the jugaad innovation process and jugaad operating models, could inspire the development and use of EdTech in order to improve education quality for the masses in developing nations. In order to investigate how jugaad innovation theory and EdTech can help solve the 'learning crisis', this study used a case study approach and four semi-structured interviews. The investigation relied on understanding the interviewees' experiences, how they describe them, and the meaning behind those experiences. As jugaad theory is not well understood in practice (Agnihotri, 2015; Ajith & Goyal, 2016; Jain & Prabhu, 2015), a case study with semi-structured interviews achieved a better insight, through uncovering rich, empirical evidence to answer 'how' and 'why' questions (Ridder, 2017). Jain & Prabhu's (2015) work highlighted three core principles of jugaad innovation: frugality, flexibility and inclusivity. Jugaad is a verb to describe the innovation process itself, and a noun to characterise the process outcomes. Conceptual views suggest jugaad innovators put diffused education technologies through a jugaad innovation process, whilst utilising a human rights-based approach to education quality. Therefore helping to deliver quality learning for consumers at the bottom of the pyramid. However, the findings of this study advocate that although a human-rights based approach is essential; high quality learning content, educational scaffolding, an understanding of factors impacting technology adoption and the use of traditional teaching methods are also important in solving the 'learning crisis'. A partnership operating model is required to combine jugaad innovation with EdTech; and to scale and commercialise such innovations. Findings also identified a fourth, holistic principle of the jugaad innovation process, namely, iterative design. The study's findings put forward ways to implement a frugal, flexible, inclusive and iterative EdTech innovation process. Results confirm that education quality is multidisciplinary (EdQual, 2010). Jugaad innovators must partner with state departments of education and/or NGO's to access their network of learners, resources and capabilities. This will serve learners at the bottom of the pyramid in volume and mitigate against the problem of ultra-thin per consumer margins (Kansal, 2016).

Keywords: 'Learning Crisis', Developing Countries, Jugaad Innovation, Education Quality, Education Technology, EdTech.

Introduction

UNICEF (2018) states that education helps eradicate absolute poverty, whilst supporting peace and democracy. Education improves human capital, through empowering individuals and creating opportunities (Paraschiv, 2017), which in turn drives economic growth (The Economist, 2014). Indeed, as Kuan Chung stated in the 7th Century BC (The World Bank, 2018:3): 'If your plan is for one year, plant rice. If your plan is for ten years, plant trees. If your plan is for one hundred years, educate children'.

Harnessing the true power of learning has never been so important. According to the Education Commission (2016), half of the world's jobs - around two billion - are expected to vanish because of automation by 2030; workers in developing countries face the largest risk of technology-related unemployment, because these economies support

many low-skilled jobs most vulnerable to automation. As a result, educational providers occupy a crucial position within the global economy, because they develop and align the skills of workers to the evolving needs of businesses. However, the provision of education alone is inadequate to really improve people's lives. The United Nations (2017) highlight the importance of a quality education to truly drive sustainable development.

The Problem

The World Bank (2018:3) warn of a 'learning crisis' in global education; underprivileged students in developing countries are attending school, but many fail to learn basic life skills. Consequently, as Pearson PLC (2018) explain, the global problem in education is not simply about provision, but also ensuring quality learning. UNESCO (2017A) states that globally, over 617m students are failing to achieve minimum proficiency standards in maths and reading. If education remains unchanged, it will take approximately 100 years for students in low income countries to reach the learning levels students in developed countries have today (Stanford Social Innovation Review, 2017).

However, the budget needed to solve this problem is practically unobtainable. The Global Partnership for Education (2018) highlight an annual financial deficit of US$39 billion to deliver quality pre-primary, primary and secondary education for everyone in low income countries by 2030. The Federal Ministry for Economic Cooperation and Development (2018), explain that classrooms in developing countries rely on outdated teaching methods; autonomous learning, critical thinking and problem solving, the implementation of educational technologies and the teaching of life skills tend to be disregarded because of constrained financial, infrastructural and human resources.

This paper uses India as a primary research case study to investigate the aforementioned problem. According to The Economist (2017B), India has utterly failed to convert going to school into learning; roughly half of fifth-grade students can't read a book intended for second-graders. Moreover, The Economist (2017C) also emphasises the poor quality of Indian teachers; since 2011, an estimated 99% of would-be teachers have failed their pre-joining test. A primary research case study of India has been selected for two reasons. Firstly, Prabhu *et al.* (2012) explain that most Indians use the concept of jugaad innovation in their daily lives, meaning India naturally fits the aim of this investigation. Secondly, India is earth's largest education system (The Economist, 2017B). Therefore, it can be argued that India sits at the 'heart' of the 'learning crisis'. Tackling India first should make it easier to deal with smaller, less complex education systems.

This research is important, because recommendations will impact approximately 260m students in over 1.5m schools across India (KPMG, 2017). This research also has potential for global impact. UNICEF (2014:7) promote the idea of a 'continuum of action'; recommendations can be shared globally to enhance the quality of education for students worldwide. This is around 617m students (UNESCO, 2017A) as stated above. According to WE Charity (2018), 171m people would escape poverty if all children in developing countries completed school with basic literacy, that's a 12% decrease in global poverty. UNESCO (2011) supports this argument, explaining that one additional year of quality education grows income by up to 10%. However, the importance of this research goes beyond economics. Children are 50% more likely to survive over the age of five if their mother can read (Education Commission, 2016).

The consequences of not educating children must also be considered. Without education, individuals work in low-paying jobs, which decreases tax revenues and negatively impacts the long-term competitiveness of economies (Albada, 2010). Current research in this area has typically focused on the concepts of jugaad innovation, EdTech and the 'learning crisis' in isolation. This paper intends to take the current research forward through bringing together the aforementioned concepts in a way that has not been attempted before. On that account, this unique investigation fills a gap in the existing literature.

Literature Review

The concept of education quality forms a crucial element of this study. However, defining quality in education is problematical. Quality is context specific, subjective, and challenging to measure, therefore, no single definition exists (UNESCO, 2017B; UNICEF, 2000). EdQual (2010) highlight two viewpoints relating to education quality, namely, Human Capital Theory (HCT) and the human-rights based approach (HRBA). HCT favours increasing cognitive success, through enhancing assessment grades, predominantly in maths and literacy. Seong and Patterson (2014) highlight that education within HCT improves a variety of cognitive skills, which help raise productivity; greater productivity leads to increased wages, thus alleviating poverty and improving economic growth. In contrast, the HRBA supports a broader range of learning objectives, beyond simple maths and literacy, to include practical skills, life skills, social attitudes and an understanding of HIV and AIDS prevention.

Marginson (2017) identifies a key limitation of HCT, in that it fails the realism test because it only acknowledges cognitive skills. UNICEF (2007) suggests HRBA provides a more holistic view of education, through recognising several dimensions of quality. It can be argued HRBA is more appropriate to education quality in developing countries; studying life skills and disease awareness would be of greater value to students living in these draconian environments (Epstein & Yuthas, 2012). EdQual (2010) suggest a framework for implementing education quality in low income countries:
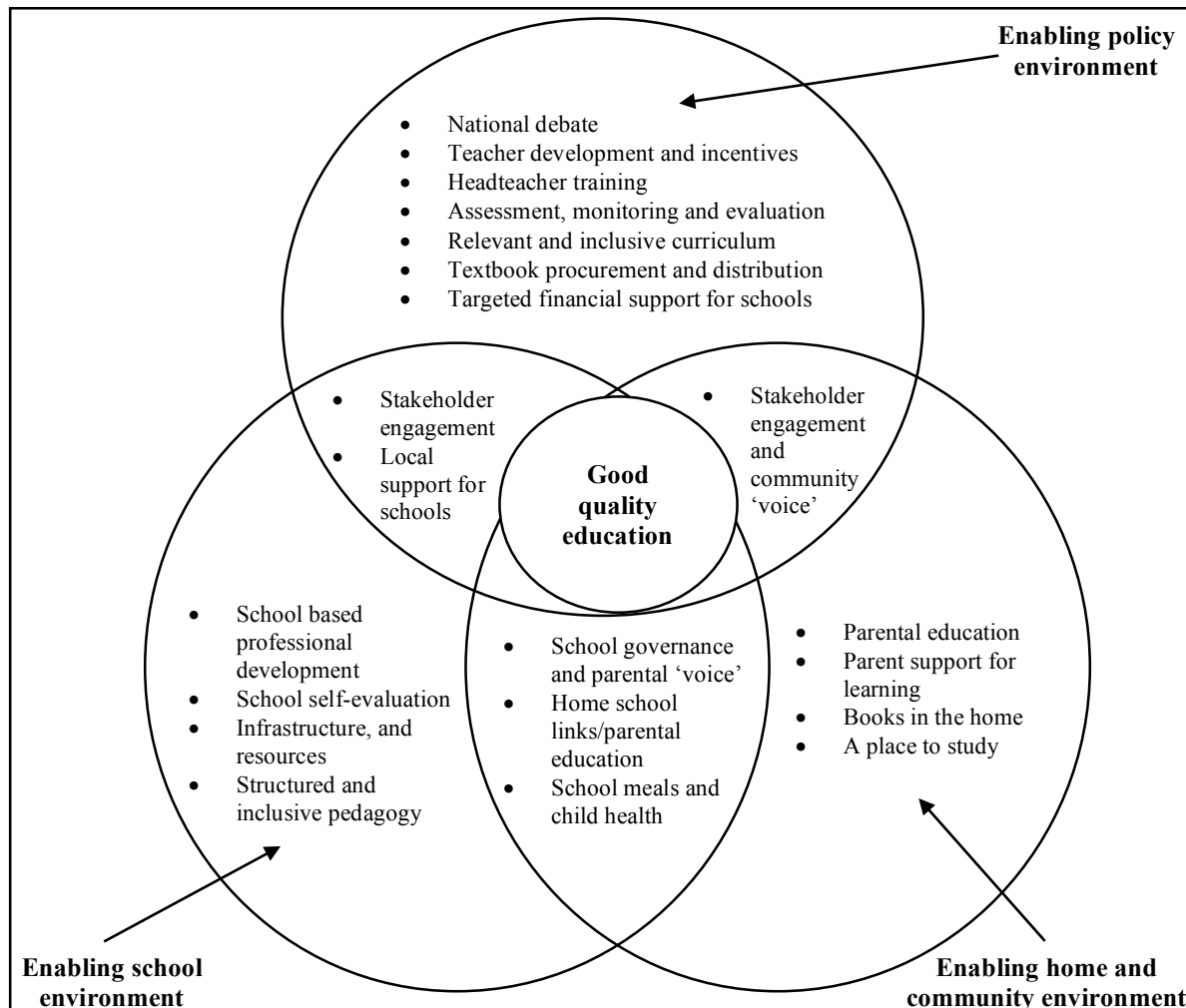

Figure 1 (Adapted from EdQual, 2010)

EdQual's (2010) framework indicates that good quality education derives from three interrelated environments, namely, the policy, school and home/community. EdQual's framework demonstrates the complexity of delivering good quality education; quality is in fact multidisciplinary (Epstein & Yuthas, 2012). The framework highlights a significant limitation of using EdTech to solve the 'learning crisis'. In reality, EdTech cannot support all inputs within each environment. For example, EdTech cannot directly influence government policy or school meals and child health.

Notwithstanding this limitation, EdQual (2010) give the impression that two inputs are decidedly important, namely, suitably trained teachers and appropriate learning materials. UNESCO's Institute of Statistics (2018) support this inference, in presenting teachers as the primary driving force behind quality education; teachers are futile without appropriate learning materials to deliver instruction and make knowledge accessible. According to Bauman & Tuzhilin (2018), EdTech can provide suitable training for teachers and appropriate learning materials for students. However, improving the quality of education using EdTech requires effective innovation. Traditionally, organisations have

institutionalised their capacity to innovate, through establishing internal R&D departments and creating structured, homogeneous processes necessary to commercialise new ideas (Prabhu *et al*., 2012).

However, scholars have questioned the effectiveness of Western-centric innovation (Ganapathy, 2015; Sharmelly, 2016; Tournois, 2017). Radjou & Euchner (2016) criticise the Western approach for being expensive, slow, and insular.

According to PWC's Global Innovation Study (2017), the 1000 largest corporate R&D spenders spent USD $702 billion last year. Therefore, Western-centric innovation is expensive. The global business environment is becoming increasingly volatile, unstructured, complex and ambiguous (Johansen & Euchner, 2013). Globalisation and digitalisation are key trends leading this change (Jain, 2017; Yuksel & Sener, 2017). As a result, organisations must innovate quickly in response to new market entrants and disruptive business models. Nevertheless, Western-centric innovation is structured and slow. The best innovations can come from external partners or even customers. However, institutionalised R&D departments thwart collaborative innovation. Consequently, Western-centric innovation is overly insular.

The Western-centric approach is not appropriate for organisations innovating within developing countries (Prabhu *et al*., 2012); resources are limited, environments are highly complex, and innovations must include low income, marginalised consumers (Prahalad & Mashelkar, 2010).

Jugaad directly contrasts with Western-centric models of innovation. Jain & Prabhu (2015) define jugaad innovation as frugal, flexible and inclusive; jugaad describes the innovation process itself, and the process outcomes. However, jugaad is a complex theory; numerous definitions exist. The Economist (2010) argues jugaad does not mean substandard, but rather simplified products through using resources sparingly. Prabhu *et al*. (2012) portray jugaad as an innovative fix; simple and effective solutions are built from cleverness and ingenuity. According to Harvard Business Review (2014), jugaad innovators engineer low cost solutions of good quality. Ganapathy (2015) maintains that jugaad involves solving a problem through improvising an effective solution with limited resources. Ajith & Goyal (2016:6) interviewed 132 rural Indians aged between 18-25, asking: 'What do you mean by the Hindi word jugaad?' The responses were analysed. Key dimensions are presented in the table below:

Dimensions of jugaad	Split of 132 interviewees
Flexibility	20%
Developing something through self-effort	14%
Solve/fix something	12%
Alternate options (in the absence/shortage of original products and services)	12%
Fast/agile/shortcut method	11%
Modify things/develop customised solutions	10%
Manage all situations	9%
Use locally available resources and talent	8%
Affordable/low cost	4%

Figure 2 (Adapted from Ajith & Goyal, 2016)

This paper builds on existing definitions, to define jugaad as solving a problem through creating frugal, flexible and inclusive solutions of good quality, through a frugal, flexible and inclusive innovation process.

Existing literature to date is equivocal as to the true meaning of jugaad (Ajith & Goyal, 2016; Brem & Wolfram, 2014; Ganapathy, 2015). Indeed, while scholarly research has been growing, the concept of jugaad is not well understood (Jain & Prabhu, 2015). As a result, there remains much to learn regarding jugaad theory (Agnihotri, 2015). Moreover, there has been no attempt in the existing literature to bring jugaad and EdTech together, within the context of the 'learning crisis'.

In contrast to jugaad, the existing literature surrounding EdTech is generally well researched; scholars believe that educational reform should leverage technology to drive innovation in learning (Arokiasamy, 2017; Lucas, 2018; Shih & Huang, 2017).

In furtherance of understanding the mechanics behind jugaad and EdTech, the researcher initially outlines the key theories and principles that underpin this topic. Proceeding critical analysis aims to support the creation of research objectives, and semi-structured interview questions.

Fortune at the Bottom of the Pyramid
Firms have often disregarded the poorer segments of society because of their supposed low purchasing power (Kansal, 2016). The theory of fortune at the bottom of the pyramid (BOTP) contends that solving the 'learning crisis' represents both a social and economic opportunity (Hart & Prahalad, 2002). Approximately 4 billion consumers live at the BOTP in developing countries, a market worth $5 trillion (Expo, 2014). Consumers at the BOTP live in relative poverty on annual incomes below USD $3,000 (WRI, 2007). Organisations can educate these consumers through combining jugaad with EdTech.

Jugaad and EdTech both sit within the theory of leapfrogging. In education, leapfrogging is defined as 'any practices, new or old, that enable skill inequality and uncertainty to be far more quickly addressed than the current 100-year time frame would suggest' (Stanford Social Innovation Review, 2017:1). Therefore, leapfrogging brings jugaad and EdTech together, within the context of the 'learning crisis'. Implementing four principles will enable leapfrogging in education:
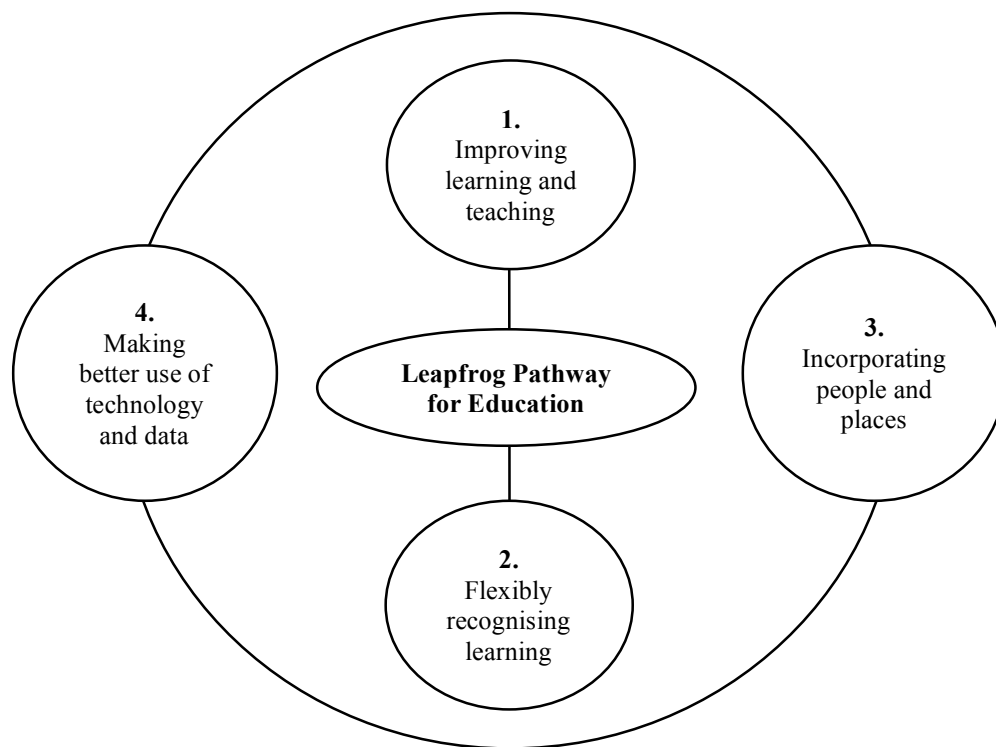

Figure 3 (Adapted from Stanford Social Innovation Review, 2017)

The six principles of jugaad somewhat align with those stated in the Leapfrog Pathway for Education:
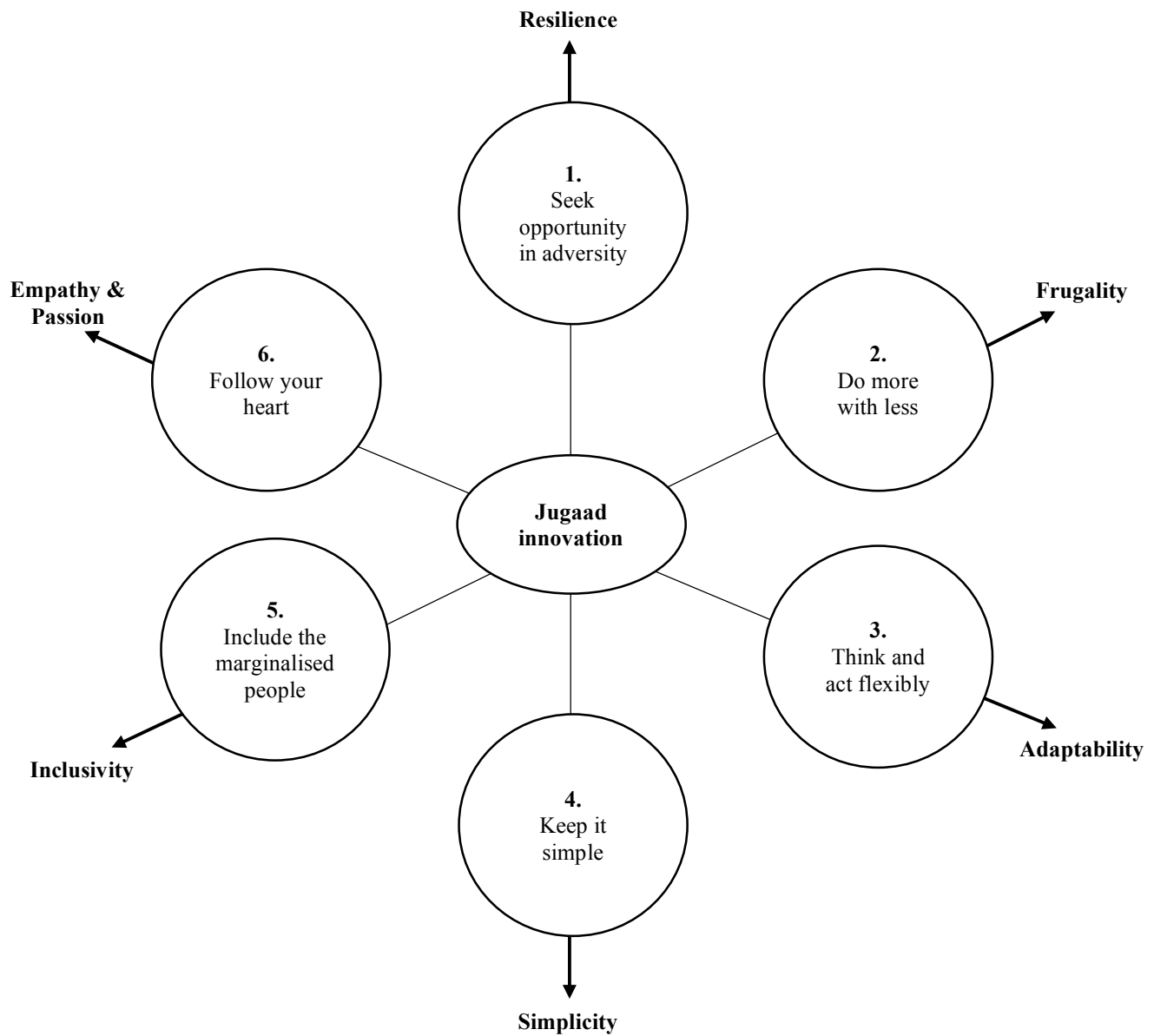
Resilience

Empathy & Passion

1.
Seek opportunity in adversity

6.
Follow your heart

Frugality

2.
Do more with less

Jugaad innovation

5.
Include the marginalised people

3.
Think and act flexibly

Adaptability

Inclusivity

4.
Keep it simple

Simplicity

Figure 4 (Adapted from Ajith & Goyal, 2016, and Prabhu *et al*., 2012)

Pioneers of jugaad seek to improve learning and teaching within the adverse environments of developing countries. Agnihotri (2015) argues jugaad innovation entails using existing technologies in new ways, to create affordable solutions for marginalised consumers. In line with Rogers (1995) Diffusion of Innovation Theory, jugaad practitioners use already diffused technologies; their aim is not to develop new, radical innovations. Livingston (2016) advocates that low cost mobile phones and computers are the most effective diffused learning technologies. Eighty percent of consumers in developing countries own a mobile phone (Santos, 2016), whilst 41.3% have access to a computer (ITU, 2017). Mobile phones and computers are advantageous because they do not require much literacy or numeracy for basic use (UNESCO, 2016). Indeed, the growth of diffused learning technologies is confirmed by estimated ICT spending from consumers at the BOTP (WRI, 2009:128). Prabhu *et al*. (2012) suggest that optimising diffused technologies will enable jugaad innovators to deliver frugal EdTech solutions to combat the 'learning crisis'.

However, scholars have raised concerns over frugal innovations (Ghemawat, 2017; Peterson, 2016; Rambe, 2016). EdTech solutions under jugaad can be of low quality because they emphasise frugality (Ganapathy, 2015; Kumar & Puranam, 2012; Prahalad & Mashelkar, 2010). Therefore, a trade-off exists between quality and cost (Moges, 2013; Stoddart, 2015).

The quality argument is developed further through Communication Channel Theory. Belch & Belch (2004:193) state that personal communication entails direct face-to-face contact, whilst non-personal communication involves no interpersonal correspondence. Ghemawat (2017) postulates that technology cannot entirely replace social interaction because it's a vital element of the learning process. To a large extent, EdTech delivers learning materials using non-personal communication techniques (Abrahams *et al*., 2016). Therefore, it's questionable whether EdTech can improve education quality without social interaction.

Nevertheless, a study from Harvard University and the Massachusetts Institute of Technology (2011) revealed low cost computer and mobile aided instruction enhanced learning for students within developing countries. Similar conclusions have been reached in other studies (Arkorful & Abaidoo, 2014; Hrastinski, 2008). This is evidence to suggest combining jugaad innovation with EdTech can help solve the 'learning crisis'. Moges (2013) opines that EdTech can improve teaching and learning, both from the instructivist and constructivist theories of learning:

Instructivist (traditional)	Constructivist
Teacher driven	Student driven
Solo	Collaborative
Summative assessment	Formative assessment
Teachers 'give' knowledge	Students build (construct) knowledge
Teacher is expert	Students' knowledge is valid starting point
Regurgitation of information; memorisation	Analysis, exploration, synthesis of information (higher order thinking skills)
Content based	Process based
Passive	Active
Clear end point	Ongoing

Figure 5 (Adapted from California State University, 2018)

According to Moges (2013), EdTech's strength resides in its student driven approach to teaching and learning. In line with the constructivist learning theory, EdTech can deliver ongoing, active learning. Therefore, EdTech improves education quality through enhancing learner engagement and motivation, and by enabling individuals to discover and explore rather than listen and remember (Moges, 2013). Within the context of the 'learning crisis', EdTech helps solve the challenges of facilitating the attainment of basic life skills, and achieving minimum proficiency standards in maths and reading. Frugal EdTech, developed through jugaad innovation, will help reduce the annual financial deficit of US$39 billion needed to deliver quality pre-primary, primary and secondary education for everyone in low income countries by 2030 (Global Partnership for Education, 2018). Therefore, combining EdTech with jugaad innovation supports the notion of lifelong learning to drive economic and social participation for consumers at the BOTP (Moore & Martinotti, 2016).

However, the integration of EdTech into developing countries is in its infancy (Malczyk, 2018). Indeed, literature to date is unclear about how jugaad innovators can optimise diffused learning technologies such as low cost mobile phones and computers (Jain & Prabhu, 2015). Moreover, current EdTech studies have not considered education quality through a jugaad lens, meaning the true extent of the cost quality trade-off is unclear (Lucas, 2018). Therefore, existing literature is inappropriate because it fails to answer a pivotal question: To what extent can frugal EdTech solutions, created using jugaad innovation, improve the quality of education for learners in developing countries (research objective 3)? In addition, the jugaad innovation process is inherently ambiguous; jugaad is a verb to describe the innovation process itself, and a noun to characterise the process outcomes (Jain & Prabhu, 2015).

Govindarajan (2012) suggests jugaad innovators implicitly practice co-creation during the innovation process, to deliver cost-effective learning solutions to low income, marginalised consumers. Hamidi & Gharneh (2017) define co-creation, as working alongside consumers during the innovation process; consumers participate in co-ideation, co-design, and the co-development of solutions. Ultimately, the needs of marginalised consumers can only be fully understood and fulfilled by working alongside them.

Ajith & Goyal (2016) proposed the Jugaad Innovation Model (JIM) to depict the jugaad innovation process:
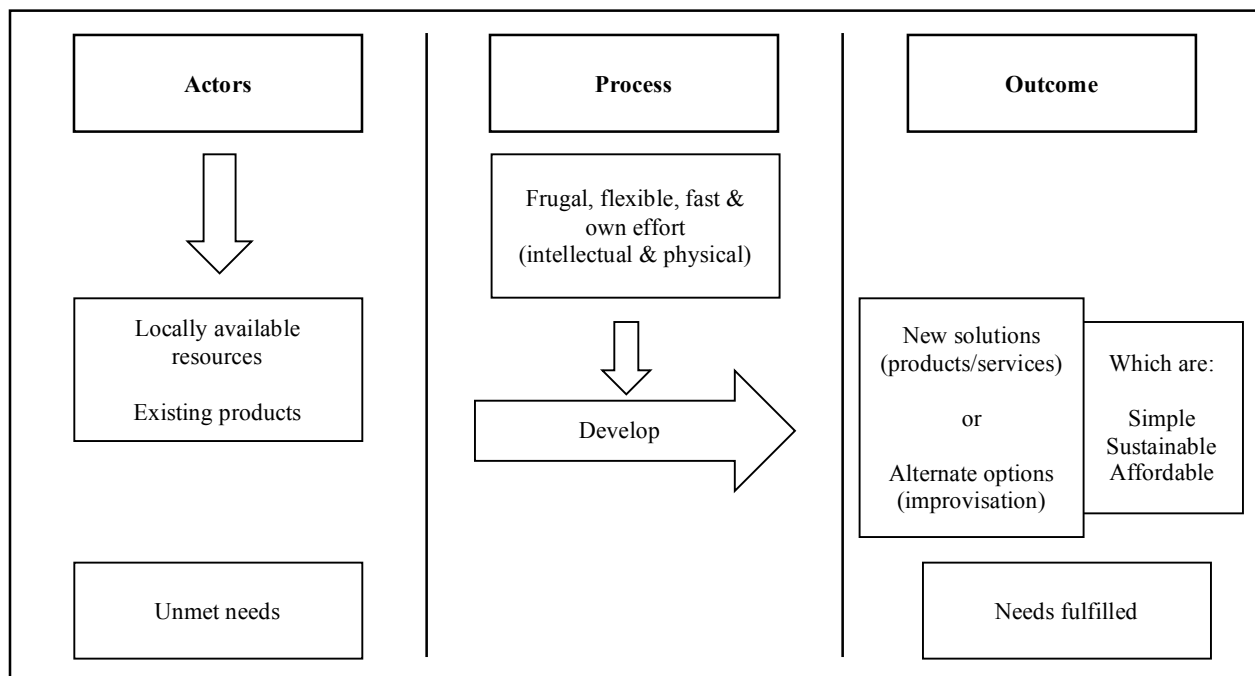

Figure 6 (Adapted from Ajith & Goyal, 2016)

JIM is inappropriate because it's far too generic; current literature provides no explanation as to how an organisation can implement a frugal, flexible and inclusive innovation process (Ajith & Goyal, 2016). JIM is also problematical because it fails to outline in any detail how jugaad solutions are commercialised (Jain & Prabhu, 2015). Therefore, further research into the jugaad innovation process is needed (Agnihotri, 2015). On that account, a second crucial question remains unanswered: How does jugaad innovation work with EdTech in practice (research objective 2)?

Ajith & Goyal (2016) suggest the jugaad innovation process is non-linear. Prabhu *et al*. (2012) state this is because jugaad innovators think and act flexibly, through persistently questioning the current state of affairs, and ensuring all strategic options remain open to rapidly counter unforeseen environmental changes. However, scholars have criticised jugaad's flexibility. Agnihotri (2015) and Ganapathy (2015) suggest jugaad innovations are not easily scalable or sustainable; unlike Western-centric innovation, jugaad utilises a flexible, unstructured process. Nevertheless, EdTech addresses the scalability and sustainability limitations of jugaad. According to Christensen (1997), EdTech shares a close relationship with Disruptive Innovation Theory. Lyons (2017) states EdTech innovations are easily scalable and

sustainable, because they utilise low cost, digitally led business models. Moore & Martinotti (2016) suggest Demand and Supply Theory can help explain the mechanics of EdTech:
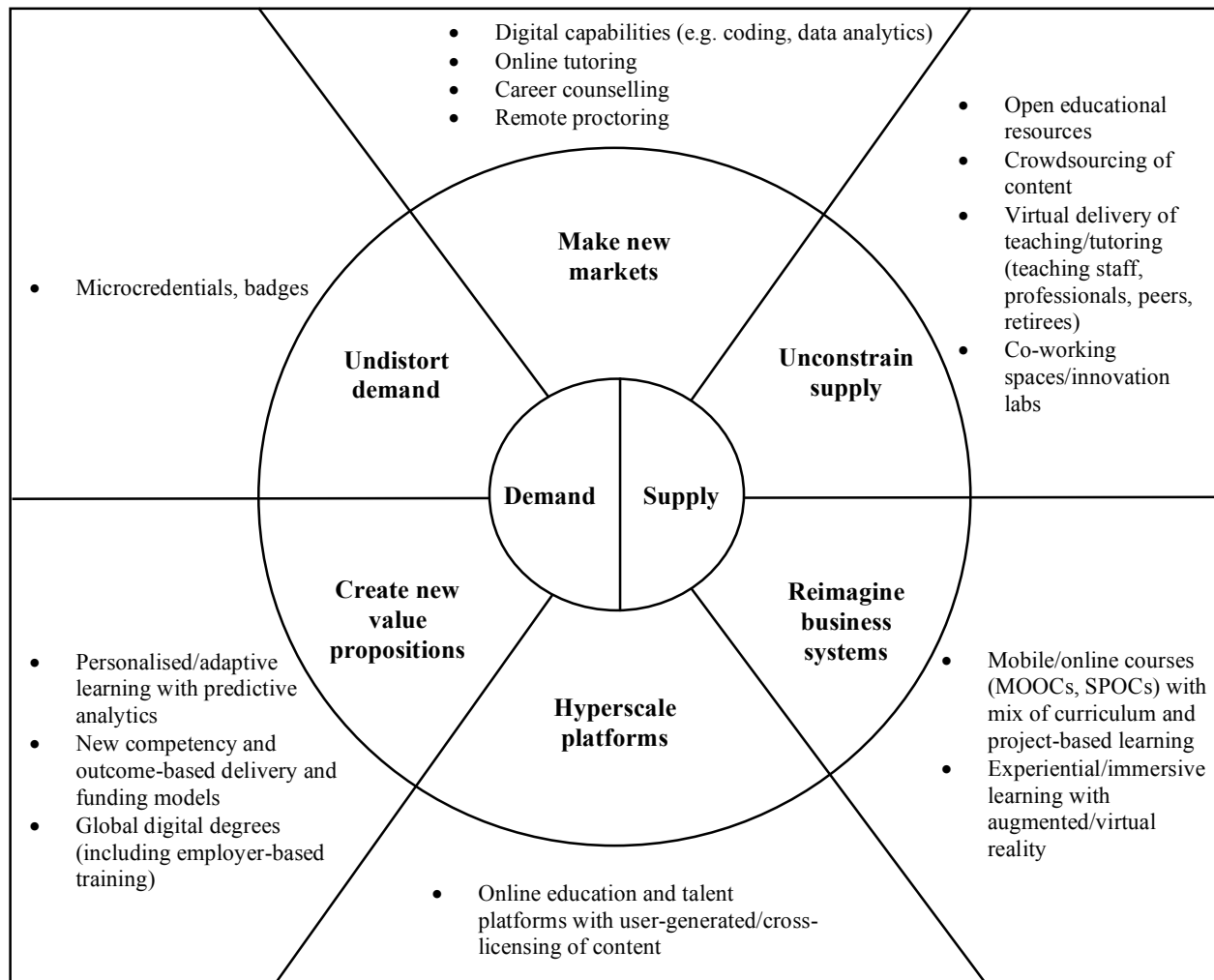

Figure 7 (Adapted from Moore & Martinotti, 2016)

Akin to jugaad, Moore & Martinotti's (2016) framework highlights the tremendous flexibility of EdTech concerning how a human-rights based approach to education can be delivered (UNRISD, 2017). Flexibility with reference to costs, location and time, including the personalisation of content for different learning styles (West, 2015). Therefore, developing countries can leapfrog in education, through using EdTech to flexibly recognise learning.

Moore & Martinotti's (2016) framework does not fit with the outlined problem, because it was designed to show the mechanics of EdTech in Western markets. Indeed, Bourezgue (2016) suggests that EdTech launched in developing countries have, to a large extent, been designed around Western principles. Western principles are inappropriate because they do not fit with the nature of education in developing countries (Gasaymeh *et al*., 2017). Ganapathy (2015) maintains that the future of innovation for successful global organisations will be polycentric; R&D operations are based in developing countries to effectively serve local markets (Radjou, 2009). Therefore, whilst the aforementioned theories provide an insight into the mechanics underpinning this topic, they offer little contextual understanding (Jain & Prabhu, 2015). Consequently, a third question remains unanswered: What does EdTech look like within the context of jugaad innovation, and education quality in developing countries (research objective 4)?

To a large extent, the human-rights based approach to education quality, EdQual's quality framework and the Leapfrog Pathway for Education do help this study. However, the six principles of jugaad do not help that much because they

present jugaad as a mindset (Jain & Prabhu, 2015; Radjou & Euchner, 2016; Schomer, 2014). Consequently, the concept of jugaad is not well understood in practice (Agnihotri, 2015; Ajith & Goyal, 2016; Jain & Prabhu, 2015). For the most part, existing jugaad and EdTech literature is inappropriate to help solve the 'learning crisis'.

Based on the literature review, the researcher proposes a conceptual framework to elucidate how jugaad innovation and EdTech combine to solve the 'learning crisis' in developing countries:
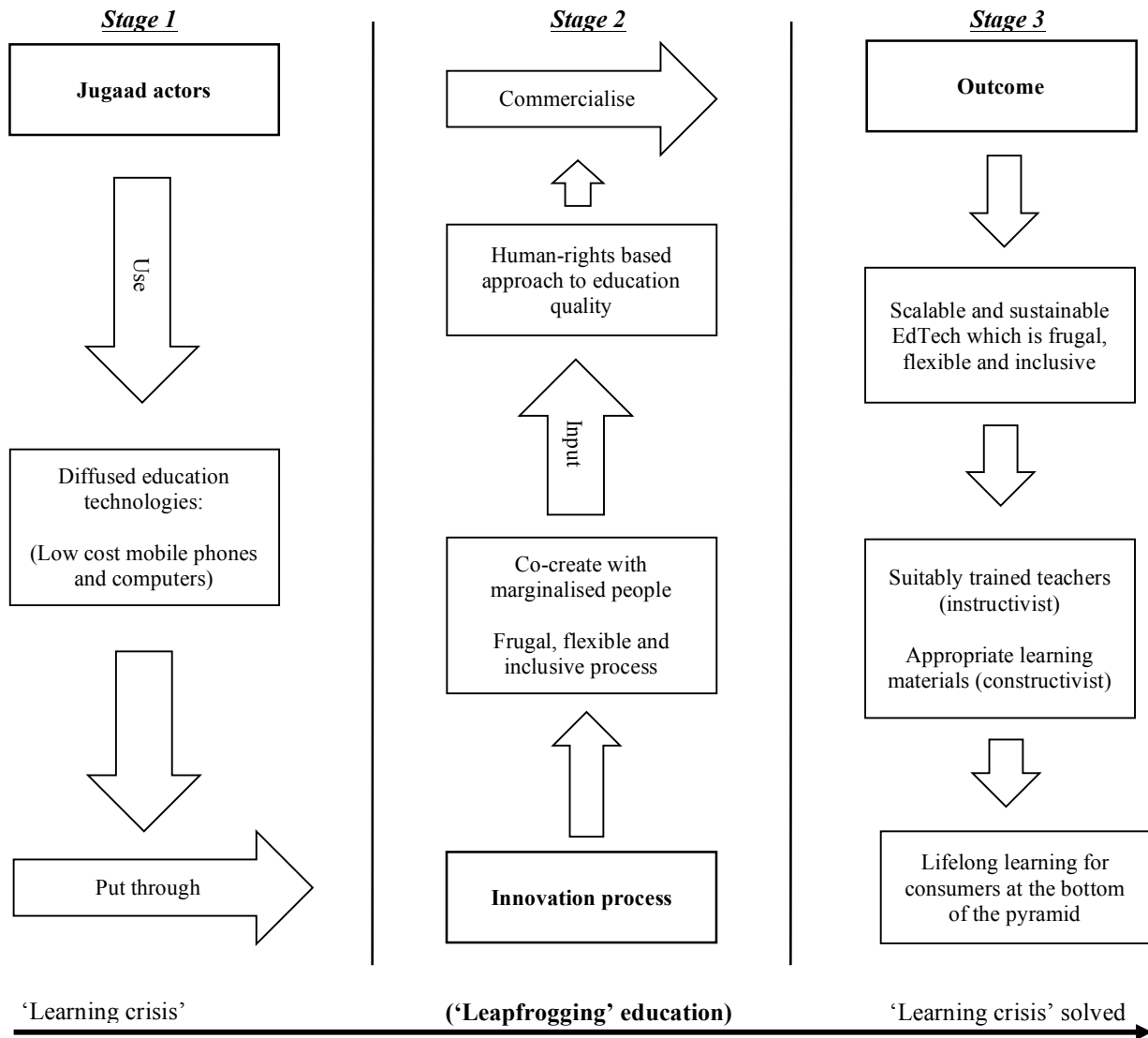
Figure 8 (Researcher's creation)

Research Objectives

Aim
To investigate how combining jugaad innovation with EdTech can help solve the 'learning crisis' in developing countries.

Objectives
1. To explore, critically review, and apply the existing literature concerning jugaad innovation and EdTech in developing countries.

2. To investigate a case study combining jugaad innovation with EdTech in a developing country, to understand how it's played out in practice.

3. To determine the extent to which jugaad innovation and EdTech can improve the quality of education for learners in developing countries.

4. To understand how key findings refine what EdTech looks like within the context of jugaad innovation, and education quality in developing countries.

5. To discuss the implications of jugaad innovation and EdTech within the context of the 'learning crisis', and formulate strategic recommendations to EdTech companies and schools.

Methodology
According to Saunders *et al*. (2016) this research study takes an inductive approach, through building a theory on how jugaad and EdTech work together within the context of the 'learning crisis'. This study was approved in line with Pearson College London's research ethics policy.

The researcher adopted a subjective interview approach, using the interviewee's views and interpretations, and asking questions, responding to the interviewee's views, and interpreting findings through qualitative analysis (Heyl, 2005). The research interview entails a reasonably free flowing exchange of thoughts between two or more individuals (Townsend & Saunders, 2016). Informal semi-structured interviews and a case study were the chosen research methods to allow a focused exploration into the topic (Singh *et al*., 2017). Semi-structured interviews address predetermined themes and questions, but not always in the same order, to maintain flexibility and support the answering of additional questions (Crocker *et al*., 2014). A case study is a detailed investigation into an organisation within its real-life setting (Yin, 2014). The case to be studied is Slate2Learn. Case studies provide the ability to develop theory from a practical standpoint, whilst uncovering rich, empirical evidence to answer 'how' and 'why' questions (Ridder, 2017). A single, holistic case was selected to explore and contextually analyse Slate2Learn as a whole (Yin, 2014). Whilst a single case cannot provide generalisations, combining it with a series of semi-structured interviews helped confirm the validity and credibility of findings (Zainal, 2007). The case study resided in the form of a semi-structured interview.

A case study and semi-structured interviews were selected because they provide rich and detailed qualitative data to understand the interviewees' experiences, how they describe them, and the meaning behind those experiences (Rubin & Rubin, 2012). Therefore, semi-structured interviews are appropriate for the nature of this study; jugaad is not well understood (Agnihotri, 2015; Ajith & Goyal, 2016; Jain & Prabhu, 2015) and EdTech literature does not fit within the context of this study (Bourezgue, 2016; Gasaymeh *et al*., 2017; Moore & Martinotti, 2016). Moreover, semi-structured interviews allowed the streamlining of discussions into key areas of the conceptual framework designed through the literature review. This supported a deep investigation into complex areas, particularly around the jugaad innovation process and the commercialisation of new ideas. The case study helped answer research objective 2. The semi-structured interviews helped answer research objectives 3 and 4.

Questionnaires were discounted because they are unsuitable for research that asks a considerable amount of open-ended questions, and they stop the researcher following up ideas and clarifying issues (Saunders *et al*., 2016). Focus groups were also discounted because they are difficult to control and manage, meaning they can hinder the main focus of the discussion (Ohio State University, 2012).

The first interviewee was Dr. Jaideep Prabhu, a professor from the University of Cambridge who has been an academic for nearly 25 years. Jaideep is a specialist researcher of innovation within emerging economies. Jaideep proposed the theory of jugaad in his book 'Jugaad Innovation: Think Frugal, Be Flexible, Generate Breakthrough Growth'. Jaideep was chosen for his specialist knowledge on jugaad innovation. This interview was conducted on 08/04/18 at 12am, and lasted just under 60 minutes.

The second interviewee was Clémentine Vignault, Founder & CEO of Slate2Learn. Clémentine has been working on Slate2Learn for the past 3 years, developing adaptive EdTech for learners in India. Clémentine was interviewed to develop a research case study; Slate2Learn actively combine jugaad innovation with EdTech. Clémentine is trained as an Engineer and an Economist, and has undertaken a lot of research in developing economics in various countries. This interview was conducted on 10/04/18 at 4pm, and lasted just over 90 minutes.

The third interviewee was Priyanka Agarwal, MD of Connect2Teach who have been in business for around a year and a half. Connect2Teach helps connect both industry professionals and academics with opportunities to teach at organisations around the world. Priyanka was chosen to explore the Connect2Teach approach to innovation, which closely follows the principles of jugaad. Priyanka's background is in company turnarounds; devising and implementing new business strategies. This interview was conducted on 14/04/18 at 9am, and lasted just over 60 minutes.

The fourth interviewee was Ritchie Mehta, MD of Learn *et al.* who provide digital learning solutions for corporates, universities and business schools. Ritchie was interviewed for his role as a fellow at Cambridge Business School, which involves him developing an understanding of how to create innovation within school environments. This interview was conducted on 14/04/18 at 11am, and lasted just over 60 minutes.

The fifth interviewee was Neville Mehta. Neville is the Managing Trustee of Boys' Town School & Junior College based in India, which is owned by his family. The school teaches 2900 students from nursery up to A Level. Neville was chosen to provide an insight into how jugaad innovation and EdTech could be applied within a school setting. Neville has been running this school for 12 years. This interview was conducted on 15/04/18 at 9am, and lasted just over 60 minutes.

A sample size of five was chosen based on the assumption that sufficient insight could be obtained to answer the research aim and objectives (Fischer *et al*., 2014; Patton, 2015). Nevertheless, Saunders *et al*. (2016) argues against researchers making generalisations about whole populations when research is based on a small, non-probability sample. This highlights a key limitation of this study.

All interviewees were chosen using purposive sampling, a form of non-probability sampling, whereby selection is based on the researcher's judgement (Laerd, 2012). The case study was selected using critical case sampling, whilst all other interviewees were selected through expert sampling. Both approaches are types of purposive sampling. Existing literature is complex and inappropriate to deal with the outlined problem; purposive sampling allowed the researcher to hand-pick opinion leaders from within their network of contacts, who can help move the research forward.

To mitigate against data quality issues, the researcher followed the interview preparation advice from Fischer *et al*. (2014) and Saunders *et al*. (2016):

A sufficient knowledge level concerning the 'learning crisis', jugaad and EdTech was obtained, through devising the literature review, searching the university library website and the wider internet. A pilot interview was carried out to mitigate against risks of bias through non-verbal behaviour (Castillo-Montoya, 2016). A cultural reflexivity approach was used to overcome potential cultural differences between the interviewer and interviewees (Brinkmann & Kvale, 2015). This was important because all interviewees were from the Indian culture. Reflection was based on the nature of the relationship between the interviewer and interviewee, and on the possible impacts of cultural differences and similarities (Court & Abbas, 2013). Cultural reflexivity helped initiate rapport and secure acceptance. An interview guide was created to outline the nature of this research, and key interview themes and questions to be asked to participants. The same interview guide was sent to all interviewees prior to each interview. This enhanced data validity and reliability, through informing the interviewees about the key areas of interest in advance to give them time to

prepare. Jaideep and Neville received the same questions worded differently because they do not run an EdTech company.

Semi-structured interviews create potential for interviewer and interviewee bias (Alshenqeeti, 2014) which can compromise the validity and credibility of results (Dörnyei, 2007). To mitigate against such biases, the researcher followed the interview conduct advice from Fischer *et al*. (2014) and Saunders *et al*. (2016):

The interviewer started with obtaining informed consent, outlining the interviewee's rights and describing the nature of the research project (Edgley & Ibrahim, 2015). Each interview utilised open, probing and specific question typologies, to explore answers further and guide the conversation into formulary unconsidered areas (Britten, 1995). Probing questions helped to compare and contrast the interviewee's experiences. Abstract and philosophical questions were avoided. A dictaphone was used to provide audio recordings of each interview. Notes were taken to compose points to encapsulate back to interviewees to check understanding, and create follow-up question probes. Notes also helped document interpersonal dynamics to assist with interpreting answers. Synchronous (real-time) electronic interviews were conducted using Skype. Skype was chosen because of its convenience in terms of access, distance and time considerations, whilst allowing visual interaction (Hanna, 2012).

All interviews were transcribed verbatim by the interviewer. Interview transcript summaries were used to help qualitative analysis. Thematic data analysis was adopted because of its flexibility, richness, and detail to identify common themes across interviews (Vaismoradi *et al*., 2013). Martins *et al*. (2014) highlight a limitation of thematic data analysis, in that views are interpreted without a feedback loop to verify the accuracy of interpretations. Analysis was conducted in line with the best practice advice from Braun & Clarke (2006) and Saunders *et al*. (2016):

Data familiarisation, which was achieved through listening and re-listening to audio recordings; transcription of audio recordings; coding data sets; looking for themes and identifying relationships; and refining key themes and testing propositions.

Findings

This section presents the key findings from the case study and semi-structured interviews. Thematic data analysis explores the Slate2Learn case study, and thereafter key questions across the semi-structured interviews.

Research Objective 2 – Case Study (Slate2Learn, 2017)

Slate2Learn are a microfranchise of digital learning centres in India:

(Slate2Learn, 2017)

There are three Slate2Learn centres in Delhi; ten more centres are preparing to open this summer. Students come to a centre and use the Slate2Learn learning app on a tablet for 40 minutes each day, for less than $4 per month. Students receive individual attention, tailored to their learning needs. For the first time, parents understand what their children do, how much they learn and what they learn through a digital classroom monitoring tool. Centres run offline and on battery backed-up technology:
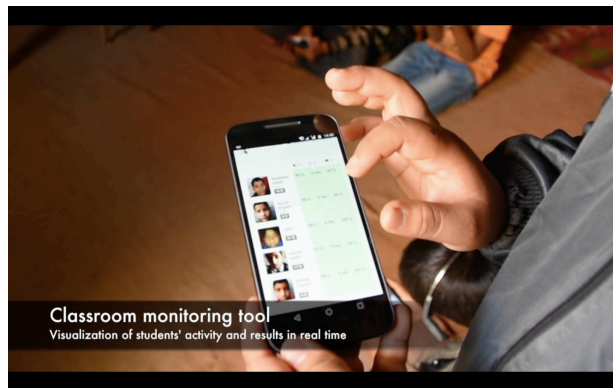
(Slate2Learn, 2017)

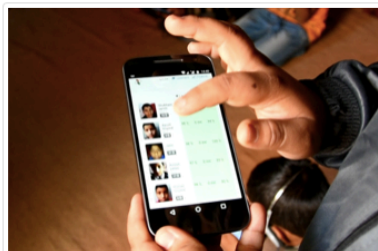Slate2Learn implement 3 innovative technologies:

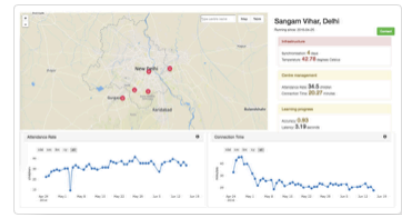| **1 - Intelligent digital tutor**	**2 - Tuition centre in a box**	**3 - Management platform**
Slate2Learn has developed an innovative learning technology based on micro learning components and memories.	Our classroom technology enables tutor-entrepreneurs to monitor each child's learning progress in real-time, and share progress reports with parents.	Our business management platform allows our managers to visualise financial, and learning indicators for each digital tuition centre in real-time.

(Slate2Learn, 2017)

Theme 1 – operating models	
Sub-themes	**Quotes**
Digital learning centres (old model)	'We would find people in slum areas who were delivering after school education, and recruit them into operating digital learning centres'. 'We would come with a box, with a certain number of android tablets, a micro server and headsets, some documentation, train them in using the software and running a class, then they would run a centre from their own house and it would be their business'. 'It's very difficult to scale the digital learning centres model'. 'People employed in digital learning centres have a very unpredictable life; you need to recruit new people all of the time'. 'We reach 2-3 thousand learners'.
Partnerships (new model)	'We now deal with organisations who are big and already handle learning environments, it can be a state department of education, an NGO who runs a lot of learning centres or a big organisation that runs schools'. 'We don't want to deal with individuals, the micro entities, these are very difficult to manage, and it's not a good use of our organisation's skills'. 'Physically borrowing someone else's network; if you're a not for profit organisation that's the best way to do it'.

Figure 9

Theme 2 – education quality	
Sub-themes	**Quotes**
Assessing current knowledge	'We use something called scaffolding in education'. 'We tailor knowledge to the needs of the child'. 'You need to know the current knowledge of the child and to be able to measure at what stage the child is at'. 'We take data on every click and you measure that data'.
Learning through EdTech	'You can learn on low cost hardware, we've done it, it works'. 'A touch screen gives a richer interaction, we do a lot of drag and draw, so it feels more natural'. 'The improvement in learning doesn't come from the model of tablet, it comes from what you put on it'. 'Software typically focuses on practising a certain skill, not on acquiring that skill from scratch'.

Figure 10

Theme 3 – jugaad innovation process	
Sub-themes	**Quotes**
Frugality	'Testing solutions as early as possible limits your costs'. 'There are certain things you can do low cost, others you can't'. 'Graphics are not that important'. 'Content design cannot be low cost'. 'You can't cut costs on pedagogical insights or on getting the right content for the context'.
Flexibility	'The children across our digital learning centres experiment with some kind of virtual manipulative'. 'We use rapid prototyping'.
Inclusivity	'We quickly design a prototype and give it to children who fit with our target socio-economic and language group'. 'We measure and assess whether the prototype is clear and if they understand it'.
Iteration	'We have a process which is iterative and very experiential'.

Figure 11

Research Objectives 3 and 4 - Semi-structured Interviews

Theme 1 – education technologies	
Sub-themes	**Quotes**
Devices	'Desktops are difficult to operate because of the electricity problem'. 'Laptops are too expensive'. 'What you can do with non-smart phones is pretty limited and low end'. 'Tablets have really become the medium of choice'.

Figure 12

Theme 2 – education quality	
Sub-themes	**Quotes**
Teachers	'Good quality education starts with teachers; how do we improve their standards and engagement?'. 'If you can make changes in conjunction with the teacher, it will work'. 'Can mobile phones and computers replace a teacher? The answer is categorically no'.
Measuring quality	'I don't think anyone in education has successfully been able to measure learner outcomes in a holistic way yet'. 'How could we measure learner outcomes in a way over and above just marks?'. 'How can we actually determine whether people are learning the right skills to help them tomorrow?'.
Content	'We are not user funded. If you target the bottom of the pyramid you can't produce quality, because the market is geared towards low quality content'. 'Someone will come with cheap content and undercut you'. 'Bring a higher level of personal understanding, a higher level of skills and a higher level of knowledge in children'.

Figure 13

Theme 3 – operating models	
Sub-themes	**Quotes**
Learning centres	'Poor people end up sending their kids to private school, which are not very grand schools, on the contrary they are pop up booths in urban slums'. 'The after-school learning system is mainstream in India'. 'Look at the quality of what we are getting out, not the input'.
Partnerships	'We work with the institutions that help the learner'. 'We don't work with learners directly because that's harder to scale'. 'Start-ups or social enterprises don't have either the capabilities or resources to scale solutions'. 'Larger organisations have resources to scale, but often not the time or motivation to really understand individual communities'. 'Opportunity for partnerships between the government, private sector organisations, NGOs, social innovators and local communities'.

Figure 14

Theme 4 – operational challenges	
Sub-themes	**Quotes**
Scalability	'How do you manage to address the cost at such low revenue potential?'. 'Scaling is the major challenge'. 'Don't just look at jugaad innovation as a way to develop the technology, but as a way to take that technology to market'.
Technology adoption	'User adoption is a big problem'. 'It's really important to define that what will get this product faster adoption'. 'A teacher who has taught for ten years finds it very difficult to change their method'. 'We don't run the programme, we don't deal with hardware, we don't deal with convincing teachers to use it'.
Technology optimisation	'Tablets are only used once a day for half an hour because the teachers want to go home earlier'. 'Content is not delivering the efficacy aspect (learning the right skills) and it's only delivering the marks aspect'.

Figure 15

Theme 5 – jugaad innovation process	
Sub-themes	**Quotes**
Frugality	'Work backwards from the need, then see what can be done using existing resources'. 'We can reduce our costs ten-fold by adopting the borrowing concept as opposed to the building concept'. 'We borrow third party platforms at minimal cost per month'. 'We use existing course templates to shorten the product lifecycle, and free-lance developers'.
Flexibility	'We believe in failing fast, if somebody comes up with an idea, they have to come up with a reason why their idea might fail'. 'You have got to empower your people and give them the ability to make changes'. 'Flexibility can only be in infrastructure and methods of teaching'.
Inclusivity	'All jugaad solutions require engagement with the community or beneficiaries'. 'Everyone is part of the process, including our customers, we are constantly taking feedback, constantly involving the community, every single team member is part of the same discussions'.

| Iteration | 'Keep iterating that process, keep iterating that technology; part of jugaad is the process never ends'. |
| | 'You offer a solution and you iterate that solution'. |

Figure 16

Discussion and Recommendations
This section answers the research objectives. The primary research findings are discussed in comparison to the literature review to formulate recommendations. See page sixty-two for the outlined problem.

Objective 2
'*To investigate a case study combining jugaad innovation with EdTech in a developing country, to understand how it's played out in practice'*.

Due to the amount of research collected, this section does not discuss the jugaad learning solutions (innovation process outcomes). Therefore, discussion focuses on the most important elements of the Slate2Learn case study, namely, the operating model and jugaad innovation process.

Operating Model
Investigating the Slate2Learn case study has revealed a major finding. A partnership operating model is required to successfully combine jugaad innovation with EdTech to combat the 'learning crisis'. '*We now deal with organisations who are big and already handle learning environments'* such as a *'state department of education'* or *'an NGO'* (Figure 9). Findings from the semi-structured interviews support this judgement. '*We work with the institutions that help the learner*' (Figure 14). A partnership model *'physically borrows someone else's network'* (Figure 9), meaning an organisation can access a far greater number of learners. Serving low-income consumers in volume would mitigate against the problem of ultra-thin per consumer margins (Kansal, 2016). This finding supports the literature on fortune at the bottom of the pyramid (Hart & Prahalad, 2002). As a result, partnerships are the best way to '*address the cost at such low revenue potential*' (Figure 15).

The Slate2Learn digital learning centres model is '*very difficult to scale*' (Figure 9). Findings from the semi-structured interviews support this judgement. '*We don't work with learners directly because that's harder to scale*' (Figure 14). Therefore, partnerships provide the most effective way to scale and commercialise jugaad innovations. '*Social enterprises don't have either the capabilities or resources to scale solutions; larger organisations have resources to scale, but often not the time or motivation to really understand individual communities*' (Figure 14). This finding contrasts with the literature from Lyons (2017) and Moore & Martinotti's (2016) Demand and Supply framework (Figure 7). EdTech innovations are not easily scalable when created through jugaad innovation, because social enterprises need the capabilities and resources of larger organisations. The research on partnerships contributes to the literature on how to scale and commercialise jugaad and EdTech innovations, to help solve the 'learning crisis' (Jain & Prabhu, 2015). Partnerships also refine the commercialisation aspect of the conceptual framework (Figure 8) developed through the literature review.

Jugaad Innovation Process
Slate2Learn use a frugal, flexible and inclusive innovation process to develop EdTech (Figure 11). This finding supports the literature from Jain & Prabhu (2015) in their definition of jugaad innovation, and Ajith & Goyal's (2016) Jugaad Innovation Model (Figure 6).

Slate2Learn '*test solutions as early as possible'* to *'limit costs'* (Figure 11). Therefore, resources are not wasted developing flawed solutions. This delivers the frugal aspect of the innovation process. Findings from the semi-structured interviews contrast with those of the Slate2Learn case study, in that frugality primarily involves '*using existing resources*' (Figure 16). '*We can reduce our costs ten-fold by adopting the borrowing concept as opposed to the building concept*' (Figure 16). For example, '*we borrow third party platforms at minimal cost per month, and use existing course templates to shorten the product lifecycle*' (Figure 16). This finding supports the literature from

Agnihotri (2015) and Roger's (1995) Diffusion of Innovation, in that jugaad innovation involves using existing resources in new ways to reduce costs.

Slate2Learn use '*rapid prototyping*', and '*experiment with some kind of virtual manipulative*' (Figure 11) to maintain a flexible innovation process. This means solutions are designed and quickly changed in response to learner feedback. Findings from the semi-structured interviews support those of the Slate2Learn case study. Flexibility involves '*empowering people, and giving them the ability to make changes*' (Figure 16). Moreover, flexibility includes a notion of '*failing fast, if somebody comes up with an idea, they have to come up with a reason why their idea might fail*' (Figure 16). These findings support the literature from Prabhu *et al*. (2012), in that jugaad innovation involves both acting, and thinking flexibly.

Slate2Learn operate an inclusive innovation process, through '*designing a prototype, and giving it to children who fit their target socio-economic and language group*' (Figure 11). As a result, learners are included in the innovation process through co-creation, to fully understand and fulfil their needs. Findings from the semi-structured interviews support those of the Slate2Learn case study. '*All jugaad solutions require engagement with the community or beneficiaries*' (Figure 16). These findings support the literature from Govindarajan (2012), in that jugaad innovators practice co-creation innovation.

This research has identified a new, holistic principle of the jugaad innovation process, namely, iterative design. Slate2Learn's '*process is iterative*' (Figure 11). New literature explains this concept. The Interaction Design Foundation (2018:1) present six steps of iterative design:

1. Identify a user need.
2. Generate ideas to meet that need.
3. Develop a prototype.
4. Test the prototype of see if it meets the need in the best possible way.
5. Take lessons learned from testing and amend the design.
6. Create a new prototype and start the process again.

Iterative design by definition is frugal, flexible and inclusive. Prototyping is low cost (Medlej *et al*., 2017). Iteration amends designs in a flexible way (Lizarralde *et al*., 2016). Testing the prototype with end users is inclusive (Humphreys, 2015).

Findings from the semi-structured interviews support those of the Slate2Learn case study. '*Keep iterating that process, keep iterating that technology; part of jugaad is the process never ends*' (Figure 16). These findings contrast with the literature from Agnihotri (2015) and Ganapathy (2015), in that jugaad utilises an unstructured process. Iteration entails following a sequential process (Interaction Design Foundation, 2018). Therefore, when using jugaad within the context of EdTech, the innovation process is not unstructured.

Research on the jugaad innovation process contributes to the literature through explaining how an organisation can implement a frugal, flexible and inclusive innovation process to develop EdTech solutions that help combat the 'learning crisis' (Ajith & Goyal, 2016). Another contribution is the identification of a new, holistic jugaad principle, namely, iteration. This research also refines the jugaad innovation process aspect of the conceptual framework (Figure 8) developed through the literature review.

Objective 3
'*To determine the extent to which jugaad innovation and EdTech can improve the quality of education for learners in developing countries*'.

Education Quality
Quality education for learners at the bottom of the pyramid focusses on bringing '*a higher level of skills and knowledge in children*' (Figure 13). This finding supports the literature from EdQual (2010), in that a human-rights based approach to education quality is most appropriate for learners in developing countries. Nevertheless, '*how can we determine whether people are learning the right skills*?' (Figure 13). Moreover, '*content is not delivering the efficacy aspect (learning the right skills) and it's only delivering the marks aspect*' (Figure 15). Therefore, a significant

research gap exists in the measurement of learner outcomes '*over and above just marks*' (Figure 13). Fulfilling this research gap is vital to understand the extent to which the 'learning crisis' is being solved.

Devices
A key finding is that '*tablets have become the medium of choice*' (Figure 12) to deliver quality learning. '*A touch screen gives a richer interaction, we do a lot of drag and draw, so it feels more natural*' (Figure 10). This finding contrasts with the literature from Livingston (2016), in that low cost mobile phones and computers are not the most effective learning mediums. '*What you can do with non-smart phones is pretty limited and low end*' (Figure 12). '*Desktops are difficult to operate because of the electricity problem, and laptops are too expensive'* (Figure 12). This finding contrasts with the conceptual framework (Figure 8), in that tablets should be used to deliver content that helps solve the 'learning crisis'.

Content
Delivering good quality education requires high quality content, that fits the learner's socio-economic and language group. '*You can't cut costs on getting the right content for the context*' (Figure 11). This finding supports the literature from EdQual (2010), in that appropriate learning materials are decidedly important to improve the quality of education.

However, a major finding is that jugaad and EdTech cannot improve the quality of education for learners at the bottom of the pyramid, through a user funded model. '*We are not user funded. If you target the bottom of the pyramid you can't produce quality, because the market is geared towards low quality content; someone will come with cheap content and undercut you*' (Figure 13). This finding supports the literature, in that frugal solutions can be low quality (Ganapathy, 2015; Kumar & Puranam, 2012; Prahalad & Mashelkar, 2010). Therefore, organisations must target '*state departments of education*' or '*NGO's*' (Figure 9), because these organisations can afford to purchase higher quality content to improve the quality of education, and help solve the 'learning crisis'.

Scaffolding Education
The ability to assess current knowledge is vital for delivering good quality education. Slate2Learn implement the '*scaffolding in education*' (Figure 10) learning theory. New literature explains this concept.

'Scaffolding refers to the steps taken to reduce the degrees of freedom in carrying out some task so that the child can concentrate on the difficult skill she is in the process of acquiring' (Bruner, 1978:19). Therefore, scaffolding involves bringing knowledge of the learning experience that's most appropriate to the current knowledge state of the child (Sawyer, 2006). '*You need to know the current knowledge of the child and to be able to measure at what stage the child is at*' (Figure 10). Slate2Learn '*take data on every click and measure that data*' (Figure 10), using their digital classroom monitoring tool. Scaffolding supports the constructivist learning theory, and Moore & Martinotti's (2016) framework (Figure 7), in that EdTech delivers personalised and adaptive learning experiences based on the needs of the student. Scaffolding will help improve the quality of education, and help solve the 'learning crisis'.

Technology Adoption
Technology adoption is preventing jugaad and EdTech solutions from improving the quality of education for learners in developing countries. '*User adoption is a big problem*', therefore, '*it's really important to define that what will get this product faster adoption*' (Figure 15). New literature explains how technology can receive a faster adoption.

<u>Innovations Diffusion Theory (IDT)</u>
Rogers (1963) outlined five perceived attributes of innovations that determines the rate of adoption:
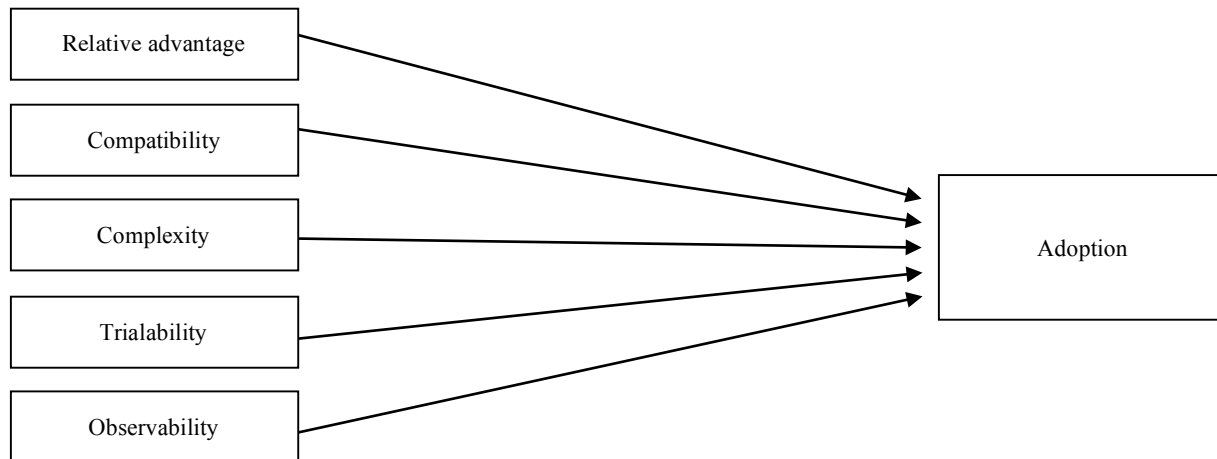
(Adapted from Rogers, 1963)

Technology Acceptance Model (TAM)
TAM illustrates the determinants of computer acceptance (Davis *et al*., 1989). Davis *et al*. (1989) argued that perceived usefulness is a more influential indicator of usage intention than perceived ease of use:
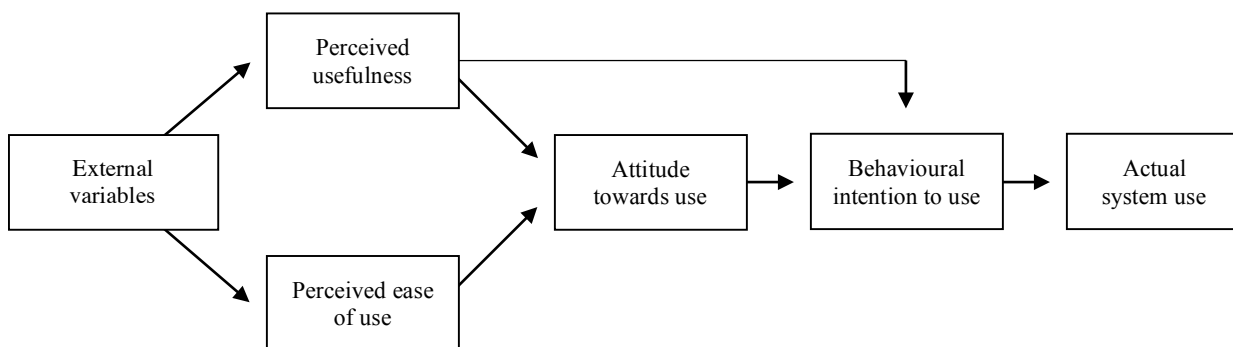
(Adapted from Davies *et al*., 1989)

Jugaad innovators should incorporate the IDT and TAM theories when building and promoting EdTech solutions to help solve the 'learning crisis'. This should increase adoption rates.
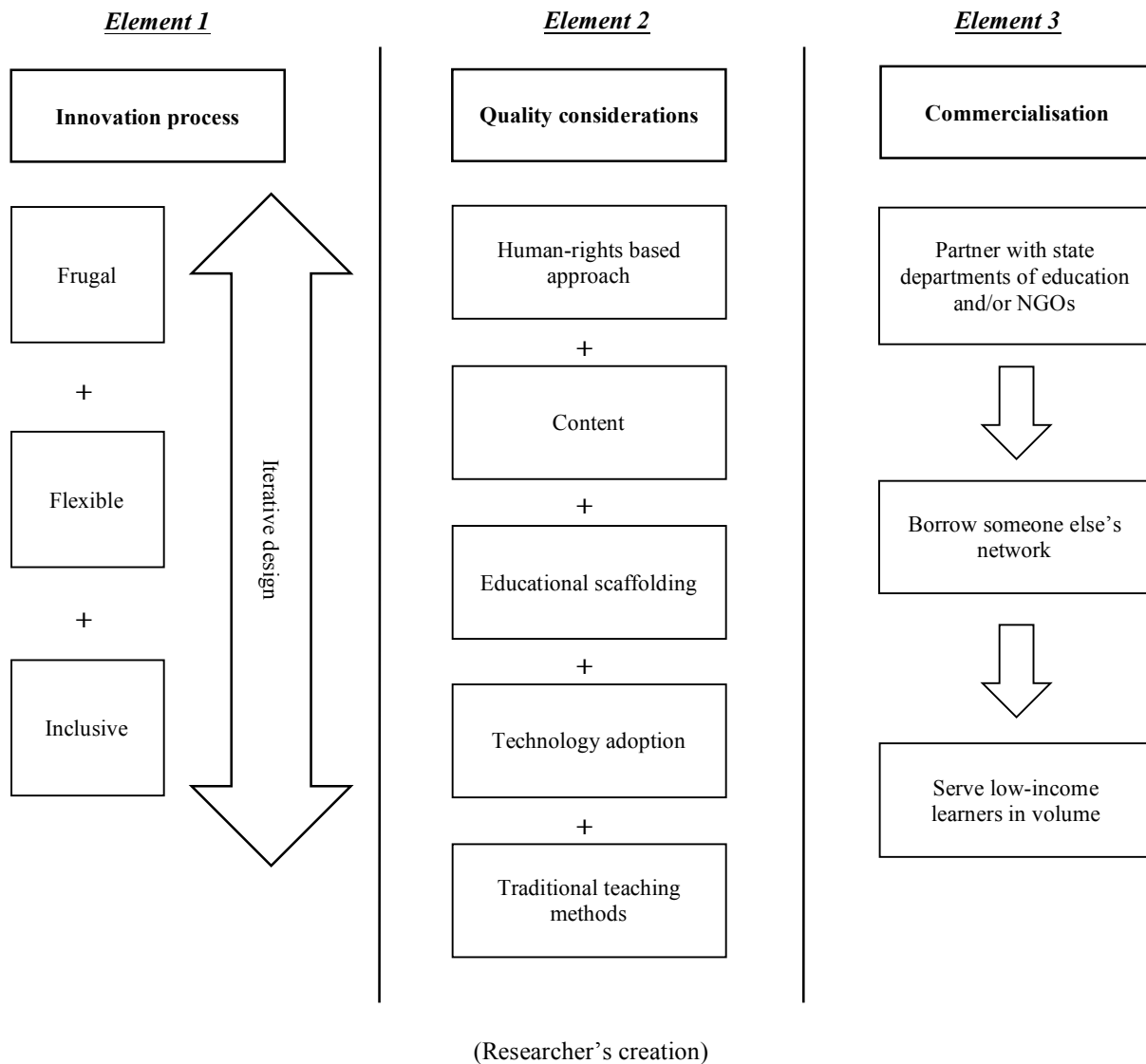
Teachers
A key finding is that jugaad innovation and EdTech must combine with traditional teaching methods to improve the quality of education. '*Good quality education starts with teachers; how do we improve their standards and engagement?*' (Figure 13). This finding supports the literature from EdQual (2010) and Ghemawat (2017), in that suitably trained teachers and face-to-face contact are vital elements to deliver quality education. Nevertheless, suitably training teachers using EdTech is '*very difficult*', 'w*e don't deal with convincing teachers to use the programme*' (Figure 15). This finding contrasts with the literature from Bauman & Tuzhilin (2018), in that technology adoption is hindering EdTech from providing suitable teacher training.

To a large extent, jugaad innovation and EdTech can improve the quality of education for learners in developing countries. Achieving quality requires a human-rights based approach. However, the conceptual framework (Figure 8) was incorrect because it omitted four additional considerations of delivering a good quality education, namely, high quality learning content, educational scaffolding, an understanding of technology adoption, and the use of traditional teaching methods. These four considerations contribute to the literature on how to improve the quality of education to help solve the 'learning crisis'.

Objective 4
'*To understand how key findings refine what EdTech looks like within the context of jugaad innovation, and education quality in developing countries*'.

In furtherance of answering research objective 4, a new, empirically based conceptual framework is proposed. The new framework focuses on the key insights within the findings section, and refines the key elements of the conceptual framework developed through the literature review (Figure 8):

Element 1   *Element 2*   *Element 3*

Innovation process	Quality considerations	Commercialisation

Frugal	Human-rights based approach	Partner with state departments of education and/or NGOs
+	+	
Flexible	Content	Borrow someone else's network
+	+	
Inclusive	Educational scaffolding	Serve low-income learners in volume
	+	
	Technology adoption	
	+	
	Traditional teaching methods	

Iterative design

(Researcher's creation)

Practical Recommendations to EdTech Companies and Schools to Help Solve the 'Learning Crisis'

Operating Model

- Utilise a partnership operating model to combine jugaad innovation with EdTech, and to scale and commercialise innovations.
- Work alongside state departments of education and/or NGO's to access their network of learners, resources and capabilities. This will serve low-income learners in volume to mitigate against the problem of ultra-thin per consumer margins.

The Jugaad Innovation Process

Frugal:

- Use existing resources in new ways to reduce costs.
- Test solutions as early as possible to ensure they fit with the target learner.
- Adopt the borrowing concept as opposed to the building concept.

Flexible:

- Act flexibility through using rapid prototyping and experiment with a virtual manipulative. Empower people through giving them the ability to make changes during the innovation process.
- Think flexibility through cultivating a failing fast mindset; if somebody comes up with an idea, they have to come up with a reason why their idea might fail.

Inclusive:

- Spend time engaging with the beneficiaries of the innovation to fully understand their needs, and co-create the learning solution with them.
- Design prototypes, and give them to children who fit the target socio-economic and language group.

Iteration:

- Keep iterating the innovation process and technology, through adopting the holistic principle of iterative design.

Delivering Good Quality Education

- Tablets should be used as the diffused learning technology to deliver content, because they give a richer interaction.
- Focus on implementing a human-rights based approach to education quality, to support the improvement of academic grades, and the learning of basic life skills.
- Create high quality content that fits the learner's socio-economic and language group. Target state education departments and NGO's who can purchase higher quality content to reach learners at the bottom of the pyramid.
- Use educational scaffolding to bring knowledge of the learning experience that's most appropriate to the current knowledge state of the child. This will help deliver personalised learning experiences.
- When building and promoting EdTech solutions, focus on the technologies relative advantage, compatibility, complexity, trialability, observability and its perceived usefulness, to help increase adoption rates.
- Jugaad innovation and EdTech must combine with traditional teaching methods.

Recommendations to Academia

1. Scholars should examine how jugaad innovators can effectively work in partnership with state departments of education and/or NGO's. Research should therefore seek to provide guidelines for best working practice.
2. Empirical research should explore how educators can measure learner outcomes over and above exam marks. Further research is also needed to understand what basic life skills students in developing countries should be learning, and the extent to which EdTech, developed through jugaad innovation, can effectively teach such skills.
3. Findings have revealed a key limitation of this study; jugaad innovation and EdTech alone cannot solve the 'learning crisis'. Primary research into India's education system has revealed a plethora of complex issues that go far beyond the capabilities of jugaad innovation and EdTech. Therefore, further research is essential

to understand the government policies needed to reform education systems, and improve the quality of education.

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