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Chasing The White Rabbit to Find a
White Elephant: exploring limited/non-
use of education technology in
Mpumalanga, South Africa.

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Abstract

This qualitative, inductive dissertation explores a social enterprise's management of for-profit and not-for-profit missions administered through different programmes. Ineffective balancing negatively impacted the design, development, and implementation strategy of an education technology (EDTech) trial in no-fee government schools in Mpumalanga, South Africa intended to fund a non-profit music academy.

This study builds upon existing literature in information technology management; the implications of managing multiple missions in social enterprises; as well as technology design and development theory. These are used to offer a descriptive account of limited/non-use of education technology in areas facing deep rooted inequalities.

Through adopting a qualitative methodology using semi-structured interviews, observation, and document analysis; rich data was gathered to construct three case studies of individual schools. These case studies are compared to the expectations and reflections of the social enterprise's board and management in light of limited/non use of EDETech.

The research finds high degrees of nuance between schools; even within 5 Kilometres of each other. Such nuance is reflected in uneven provision of devices, educational resources, and infrastructure; varying technology integration strategies between schools; in addition to the individualistic sense-making of education technology by teachers.

This research provides a rich example of the difficulty for social enterprises in balancing disintegrated social and commercial value chains. This increases the risk of such organisations ineffectively allocating resources by prioritising speculative financial gain over social impact; resulting in failure to achieve multiple, differentiated missions.

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1 Introduction

This qualitative and inductive study focuses on the development and introduction of technology in three resource constrained schools (RCSs) within Mpumalanga, administered through a social-enterprise organization. The social-enterprise is made up of two constituent organisations based in White River, Mpumalanga, South Africa.

The first organisation is a for profit education technology company called EDTech Pty. Ltd. who designed and developed a digital library and Virtual Learning Environment (VLE) called EDTech which delivers multimedia learning content through a local server. This feature does not require internet access. Additionally, it offers online assessments and class analytics aimed at teachers to provide more directed revision of topics. This function requires internet access. The second constituent organisation within the social enterprise is a Non-Profit Organisation (NPO) called Independent Music Academy (IMA, henceforth) who deliver music education across various after-school drop-in centres within the province, mainly in townships around Mbombela, Mpumalanga.

The three RCSs involved within this study are within 5Km drive of each other and are situated within Bushbuckridge Municipality, about 2 hours' drive from White River where EDTech/IMA share an office. After reading a funders report, the researcher viewed EDTech/IMA as an interesting case to conduct research in education technology. In a trial of the EDTech technology within Mpumalanga province; the social-enterprise termed it a 'failure'. Failure is the conclusion of EDTech/IMA due to extremely limited use of the technology provided within 11 schools within Mpumalanga Province, three of which were involved within this study.

In practical terms, one of the schools involved within this study was the most successful in implementing the EDTech technology into regular teaching and learning, but in the eyes of the CEO of EDTech Pty. Ltd. only "half functions" (Interview 2 with E-CEO). Every other school involved within the trial either had no reported use of EDTech, or reported usage for a few weeks, after which, no usage was reported. Success for EDTech would be recognised through regular online assessments conducted through EDTech; and corroborated through an improvement in the overall attainment of learners using the system based on previous years at the individual school and subject level.

Through reading critical studies of technology in education; Selwyn (2010, p. 66) calls researchers to explore "the social, political, economic, cultural and historical contexts within which educational technology use (and non-use) is located."

1.1 Research Area

The research report explores the context of three spheres of contemporary life in South Africa, and now explains the basic elements of the legacy of Apartheid on spatial development in the areas of this study; South African education; and the current state of (internet) technology in South African communities.

1.1.1 Context of Former Homelands in South Africa

This research took place within three no-fee, government schools. These three schools operate within what used to be a former 'self-governing territory' during Apartheid time, also known as homelands or Bantustans. The policy of creating homelands was initiated in 1950 and is reflected in Apartheid era legislation such as the Group Areas Act and the political ideology of separate development of races within South Africa (Benwell, 2009).

The former homeland, Gazankulu, was the home of the xiTsonga speaking people group and is where each of the three RCSs involved within this study are situated. Former homelands in South Africa still experienced the practical legacy of Apartheid. Water and electricity supply is not steady. Additionally, former homelands have underdeveloped transport and economic infrastructure. They are plagued with an inheritance of poorly resourced and maintained healthcare and educational institutions (King & McCusker, 2007).

1.1.2 Context of South African Education

In the wake of South Africa's transition to a constitutional democracy; central and provincial governments sought to democratise education through several policies such as prioritising government funding in the poorest schools in the country and prohibiting such schools from levying fees on parents (Mestry & Ndhlovu, 2014); ensuring parents and local communities have direct participation in individual school development through mandatory School Governing Bodies (SGBs) (Karlsson, 2002); and attempts to deracialise school enrolment policies (Mestry, 2014; Spaul, 2012).

Schools are classified as poor based upon their built infrastructure available and the socio-economic status of the population within the schools' catchment areas and based upon a formula set by national government declares what funding is provided to individual schools based upon their relative resource availability (Mestry, 2014). Such resource constraints experienced by no-fee schools manifests itself through many symptoms, but for the purposes of this study, characterised

by infrastructure available within schools; the number of classrooms available; and variable access to technology. Schools with significant fee-based income can afford to invest in, for example, computer labs and due to geographic location, access to effective internet connections. Therefore, in areas privileged by Apartheid spatial policies, education technology interventions have access to more tacit resources such as educated and (relatively) economically stable parents (Yamauchi, 2011); teachers educated to higher standards; and, in the case of generally white and coloured (an accepted term for mixed race individuals in South Africa) learners, the privilege of being able to learn in home languages (English and Afrikaans): the latter being an issue explored in the context of higher education by (Jaffer, Ng'ambi, & Czerniewicz, 2007).

With this in mind, it is therefore reasonable to assert that fee-paying schools operate in significantly different operational conditions than no-fee schools resulting in development interventions requiring a local focus. In more specific terms, an appreciation of the nuanced context of operating in former 'self-governing territory's' schools; and the implications of these historical process on the human resources, skills, and socio-political governance structures within schools is required. With the rise of new digital technologies, developing solutions with users to ensure such contextual appreciation is engrained within development processes resulting in relevant, useful, and potentially profitable products.

1.1.3 The Context of (Internet) Technology in South Africa

Internationally, the idea of a digital divide has characterised the gap between those who have access to technology and those who don't (Donner, 2015). However, when access is considered to live within proximity to wireless telephone masts, regardless of access to devices, digital literacies, and meaningful content, this access can be referred to as theoretical access (Donner, 2015; Selwyn, 2004). Therefore, the dichotomous view of access and digital divide becomes problematic.

South Africa has the second highest inequality rating in the world, measured by the Gini Index (Central Intelligence Agency, 2018). Additionally, there is a broad legacy of Apartheid era-separate development policies in terms of infrastructure (telecommunications, electricity, in this regard) (Kreutzer, 2009). Therefore, South Africans who live in non-urban areas are more likely to find themselves without access to the Internet as comparable to metropolitan areas such as Mbombela's suburbs. This is manifested in the availability of broadband internet access which is not available typically within less economically developed areas of the province such as where the three schools involved within this study are located.

Donner (2015) discusses the implications of the high-cost of mobile data (generally on pay-per-bit model) relative to disposable income as the ‘Metered Mindset’. The pay-per-bit model can be explained as devices owners paying for typically low amounts of mobile data. I.e. buying 20 Mbs for a day browsing. This a serious blockage in developing a fuller utilization of the Internet, particularly in low income communities. It is safe to assume that most mobile Internet user experiences this by thinking twice about what content they access; for how long; and when they access it (peak or off peak).

South Africa is 28th in Africa for the cost of 1Gb of mobile data (\$7.67) (2017 Q2), which is astonishing compared to the 2017 Q2 figure for Egypt at (\$1.25) (Africa Research ICT, 2018). However, South Africa was 21st in Africa for 2017 Q1 (\$7.49) and in 2016 Q1, South Africa was 17th cheapest in Africa (\$6.26) (ibid). This discouraging trend, of increasing prices is concerning. One potential contributing factor for this is the mobile network operators (MNOs) keen interest in ensuring the fastest possible speeds. MNOs have recently announced their readiness to bid for 5G spectrum access (Businessstech.co.za, 2018). As internet access remains unaffordable to those who experience the extremes of inequality; living under a 5G tower is meaningless as the cost of data increases.

Without a means to gain experience with digital, internet technology residents in these areas will lack the suitable digital literacies in order to engage with technology as it takes time to develop skills in using software, devices like keyboards and mice. Therefore, in operating in communities who disproportionately experience structural oppression such as in former homelands, there must be an appreciation of the complex, non-linear, and divergent processes through which people make sense of, find value in, and use technology (Donner, Gitau, & Marsden, 2011). Given the varying digital literacies required between a low-end smart phone and a high performance desktop PC; it is necessary to remember there are distinct differences in what is possible or worthwhile for a particular kind of device: “The Internet is different when it is 2.5 inches wide.” (Donner et al., 2011, p. 591).

1.2 Research Question

Schools involved in the trial of EDTech enacted it to varying degrees if at all, but none to the level EDTech/IMA had hoped to realise its believed transformative potential. Given the significant private and governmental investment in the platform, this research seeks to identify experiences of ‘failure’ as learning opportunities specific to EDTech and education technology actors in South Africa more generally.

The principal research question of this study asks: what factors contributed to limited/non-use of EDTech in a trial in no-fee schools in Bushbuckridge Municipality, Mpumalanga?

This question aims to provide detailed user based accounts to develop an evidence based strategy for EDTech/IMA to develop a relevant, implementable, and meaningful education technology product. Early rationalisations of failure provided through initial conversations, emails, and reports provided to the researcher primarily highlighted issues with external stakeholders such as the Mpumalanga Department of Education (MDoE) through inadequate training and class level integration support. However, this question acknowledges the potential for other factors to have contributed to the failure.

At no point in the initial reports or conversations with the CEO of EDTech Pty. Ltd. were the views of teachers, learners, principals, or support staff' used to explain such limited/non-use of EDTech. The users' voices remained unaccounted for and have the potential to reveal rich details of their decision making process to avoid EDTech. Thusly, there is an opportunity to gain a broader perspective on what EDTech/IMA management came to term a failed trial.

From the primary research question, a secondary research question asks: given the contributing factors to limited/non-use of EDTech, what can be learned from the approach of EDTech/IMA to integrating technology in schools facing resource constraints?

1.2.1 Scope of the Dissertation

This dissertation studies a specific digital library and VLE called EDTech, developed by the social-enterprise, EDTech/IMA based in White River, Mpumalanga. A trial of the technology within 11 schools within Mpumalanga Province took place in 2016, of which, three schools located within Bushbuckridge Municipality, Mpumalanga were identified to participate in this research in partnership with the social enterprise management.

The organisation EDTech/IMA was selected as this represented an interesting case of limited/non-use of technology in education settings. Subsequently, the three schools were purposively sampled to represent cases where EDTech had been used to varying degrees and with varying access to technology.

Semi-structured interviews (individual and group based); participant observation; reports/documents were used as data collection methods in order to gain rich insight into multiple perspectives of limited/non-use of EDTech. A breakdown of the data gathered for this study is shown in table 1 below.

Table 1 – Field Site Data Collection

Data Collection Method	EDTech/IMA	RCSs	Total
Interviews	Management: 3 Staff: 5 Learners: 5	Staff: 5 Learners: 3 groups and 1 individual	Number: 22
Participant Observation	Hours: 100	Hours: 90-105	Hours: 190-205
Reports/Documents	Number: 12	Number: 2	Number: 14

1.3 Research Assumptions

This study assumed that schools operating in Bushbuckridge Municipality, Mpumalanga faced resource constraints which schools in and around towns and cities do not face. This was in most respects true and is reflected in low proximity to larger commercial and transport hubs; and access to reliable broadband internet connectivity.

While each school had varying degrees of internet access and devices for teachers and learners to use; all principals discussed the complexity of managing no-fee schools in rural areas and the impact of smaller student bodies and faculty. Additionally, the relative socio-economic position of learners in the area of the schools, based upon the history of the area and the classification of no-fee status, as a proxy measure, highlights distinct challenges which schools in peri-urban or urban areas may not face such as teacher recruitment and retention, infrastructure development, and local opportunities (for education and employment) for learners to be motivated to pursue and aspire to.

While these schools are considered resource constrained in part due to their remote location and no-fee status; they cannot be considered as representative of all remote nor no fee schools. There have been investments made within these schools in technology resources which do not necessarily represent the experience of schools in comparable locations and socio-economic classification.

1.4 Research Ethics

At no point during the research encounter were lessons; exam preparation or school operations interrupted. Interviews and conversations only took place with learners in an after school setting and only with the participant information sheet explained comprehensively.

In line with both the UCT and GSB ethical conduct, no questions asking for intimate personal details and accounts were asked. Where personal accounts were organically offered through open questions, these were treated with respect, no probing questions, and participants were reminded that at any point now or in the future they could request any data collected to be destroyed and not used.

All participants in interviews signed an informed consent form and consent was obtained from EDTech/IMA management and the management of RCSs, and the Mpumalanga Department of Education to conduct research within places under their jurisdiction (letter of approval in appendix D). Additionally, coming from overseas and being white required the researcher to continually introduce himself as a researcher, overcoming any uncertainty of the reason for his presence.

All organisations have been awarded codes, apart from EDTech/IMA which have been given pseudonyms. Coding for individuals is used and efforts to remove, where possible, references to gender, while the coding of schools and avoiding naming specific villages helps to engrain anonymity so that no principal, teacher, learner or other individual can be immediately identified. This was made clear to participants at the beginning of interactions.

2 Literature Review

“An idea does not by itself solve a problem, but needs to be combined with time to develop it, skilled work to provide evidence for it, rhetorical work to make it plausible to others, and the support to put all of those in place” (Sismondo, 2004, p. 70).

The literature review considers three academic streams relating to perspectives of technology within organisations and education; social enterprises and hybrid organisations to sustainably impact social change; as well as technology design and development methodologies.

The subject of technology within organisations is addressed within a broad range of literatures, but for clarity, this study considers primarily sociomateriality and the practice lens literature. This literature which has developed over recent decades to address the view that technology acts as an “independent variable” (Leonardi, 2012, p. 26) – where technology is applied it effects specific

outcomes, pre-defined, and predictable. However, this perspective fails to account for the breadth of other factors and underplays the role of both social structures and humans on technology (Oliver, 2011; Orlikowski & Scott, 2008; Selwyn, 2010).

There has been an increasing interest in the practice lens beyond technology in organisations, with an increasing interest in sociomaterial analyses in the intersection of education and technology research (Halperin, 2017; Halperin & Backhouse, 2007; Johri, 2011; Selwyn, 2010; Somekh, 2004). These researchers have similar critical perspectives on determinism and thusly recognise what will be explained along the lines of technology and humans as co-constituents, acting upon one another (re)creating social structures they operate within. They challenge the typical education technologist perspective of assumed nascent impacts of technology on driving up education standards. Some, such as Selwyn, explicitly critique and call for research which problematizes assumptions around the transformative potential of technology in education by presenting cases of limited and non-use to counterpoint the perspectives of ever-the-optimist developmentalists. Selwyn (2010, p. 72) describes this research as developing research based on “reality” as opposed to “rhetoric” often espoused by learning technology theorists.

In the context of this study, this literature and theoretical underpinning is appropriate given the context of lower than expected utilisation of the EDTech platform in Resource Constrained Schools (RCSs). This positions EDTech/IMA (the social enterprise) and EDTech (the technology) as a case of limited/non-use of an education technology. The practice lens equips the researcher with a vocabulary and backdrop of related studies with which to explore particular antecedents of non-use (Halperin, 2017; Halperin & Backhouse, 2007) within the EDTech trial. The disposition of the practice lens to root analyses in observable action and practice aids in the provision of insight towards the development of both the EDTech product and the EDTech/IMA social enterprise structure.

The second principal literature stream this study considers relates to the management of hybrid organisations (including social enterprises). These are organisations who seek to make profit/achieve financial sustainability while achieving a social mission. In social enterprises like EDTech/IMA, relationship management, between internal role-players (EDTech Pty. and IMA) and in the broader eco-system of stakeholders, is important. External stakeholders include the Mpumalanga Department of Education (MDoE); a 3rd party, UK based NGO; the RCSs; and the for-profit technology developers. Clearly, managing multiple stakeholders’ perspectives, ideas, and visions becomes important in ensuring that the EDTech’s efforts are not subject to mission drift –

where social purpose organisations, for varying reasons, change their direction, seek more lucrative and potentially less socially impactful goals and fail to realise their initial mission. In some cases differing perspectives and visions of stakeholders are prioritised due to funding opportunities which can be classified as mission drift (Ebrahim, Battilana, & Mair, 2014).

The third literature stream explored is in design of technology and contemporary start-up theory. This section explores the importance of involving users and potential customers throughout an iterative design methodology. The emphasis here is to ensure that solutions are built to address problems which exist; are sufficiently scoped; and that designer and developer assumptions are tested for representativeness. Design thinking is gaining credence within development circles to develop realistic social missions and developing solutions which respond to user contexts (T. Brown & Wyatt, 2010). Additionally, using lean startup theory compliments this in terms of challenging and developing assumptions which a solution is built with and a highly iterative approach to development of a technology (Ries, 2011).

The literature review now turns to exploring the development of the practice lens through a discussion of both deterministic and purely social-constructivist accounts of technologies.

2.1 Development and Background of Sociomateriality Theories

The development of sociomateriality literature in recent decades has drawn on perspectives from a wide range of academic areas, both established and emergent (such as Science & Technology Studies[S&TS]). The literature review now presents the development and theoretical background of Sociomateriality and the Practice Lens.

2.1.1 From Technological Determinism

Traditionally, there has been a view of technology being stable, regardless of its spatial and temporal application (Orlikowski, 1992, 2006, 2009; Orlikowski & Scott, 2014). In this view technology will produce, almost certainly, a particular socio-environmental change, a view which Pinch and Bijker (1984) reject. Woolgar and Grint (1991, p370, in (Orlikowski, 2000)) comment that once a technology has reached “a point of stability”; it becomes fairly clear what a technology can do. This is problematic. Orlikowski (2000) suggests the assumption that an artefact is rigid and temporally and culturally transcendent is blown over when empirical research shows diverse understanding of; meaning given to; and utilization of technology.

Technological determinism holds that because a technology *is*, in one given social and temporal context; that it *will be* across the board, enduring through time and space (M. R. Smith & Marx, 1994).

In order for us to build the fullest picture of technology's influence in projects of modernity – it is important to understand the whole host of narratives of both human and non-human agency. However, viewing 'modernity', a concept with which Brey (2003) considers alongside technology, as a process or goal, is in itself a problematic term with little analytic purchase (Cooper, 2005). Assumptions of a linear path towards development, emerged through 20th century discourse, where “‘modern’ was equated with ‘western’ and ‘progress’” (Christie 2008, p75). Rodriguez and Wilson (2000, p3) posit that these assumptions can be “dangerously wrong”.

Williams and Edge (1996, p880) highlight “the very structure and architecture of contemporary information technology is itself a product of historical processes of social and economic shaping.” With this point in mind, can it be possible to simply retrofit a technology (such as One Laptop Per Child [OLPC] technology) ideated, designed and built the colonial era buildings of MIT, Oxford and Berkley to an emerging market, postcolonial context? Without the deep contextual understanding of the users, these well intentioned endeavours may fall below what was hoped (Warschauer & Ames, 2010).

When developers are far removed from the socio-economic, political, technological context of those whom an intervention is developed, these complex negotiations can often be made without considering the person behind the screen, as a unique, dependant variable – affected by and operating within the context of historical processes (Kraemer, Dedrick, & Sharma, 2009). While EDTech was designed and developed in South Africa with relative proximity to the spaces intended for use; the extent to which this translated into actual observation and consideration of the contexts of users may present similar outcomes of geographical distance. Practically, limited observation of user contexts reduces visibility and involvement of users throughout the design, development, and implementation process, as experienced by programmes such as OLPC (Warschauer & Ames, 2010).

Fraught with political undercurrents; the tendency to view “technology as an independent entity, a virtually autonomous agent of change” (Smith & Marx, 1994, pxi) or an “independent variable” (Leonardi, 2012, p26; Orlikowski & Scott, 2014, p872); technological determinism represents just one framework with which to view technology.

Therefore, to view a technological artefact as stable, to black box it, and assume it as an independent variable is problematic. Returning to this studies concern with young people, in rural South Africa, and their experience of technology (the Internet and mobile devices): Chigona, Chigona, Kayongo, and Kausa (2010) find that technology alone, cannot effect positive change in education. With this in mind, we return to Warschauer and Ames (2010) and their work on the One Laptop Per Child (OLPC) program who find that access to technologies is not enough to make positive contributions to Education; and argue it needs to happen alongside more systemic “integrated education improvement efforts” (p. 34). Thus, dispelling the “utopianism” (Warschauer & Ames, 2010, p. 40) of previous black boxed, technologically deterministic projects becomes of increasing pertinence.

2.1.2 A Pendulum from Determinism to Constructivism

Pinch & Bijker (1984, p406) argue a “sociological theory of technology... should be the explanandum not the explanans” amounting for the fact that technology should seek to be explained, and not be taken as the explanation. In pointing out the flaws of technological determinism, we uncover some of the benefits of the social shaping of technology (SST) (Williams & Edge, 1996) or the Social Construction of Technology (SCOT) (Pinch & Bijker, 1984).

Pinch and Bijker (1984, p. 411) notably outlined the elementary stage of SCOT; but is concerned with “the developmental process of a technological artefact... described as an alternation of variation and selection.”. Their systematic historical analysis of the development of the modern day bicycle highlights the various material alternatives in construction; wheel and suspension engineering; the users, designers and manufacturers (as heterogeneous groups with equally heterogeneous objectives); and various solutions for various interpretations of the problem to be solved. Ultimately, ‘market forces’ combined with sufficient rhetorical work on social factors (such as perceptions of style and safety) consolidated the design of what we would consider the predecessor of the modern day bicycle (Pinch & Bijker, 1984).

The social constructivist approach to S&TS places overt, if not complete, focus on human agency and the roles of human actors in technology studies. However, Pickering (1993, p. 564) discusses the ways in which “the contours of materiality” act as a kind of agency meaning that materiality shapes what action is possible. Similarly, Orlikowski (2006, p. 460) writes “human action is highly dependent on a whole lot of ‘stuff’”.

This acceptance of agency which is beyond the human realm, or alternatively, the rejection of a purely human centred understanding of technology pushes us to consider technology (and scientific fact) with a “posthumanist turn” (Pickering, 1993, p561). There is in fact a third path; one which recognizes the partial truths found in both perspectives – of the material agency (known to technological determinists) and of human agency (argued by social constructivists), and importantly, separating the institutional context (etiquette, norms and protocol) from human agency (Orlikowski, 1992); building on the theory of structuration by Giddens (1984).

2.1.3 Sociomateriality Leading to the Practice Lens

The duality of technology reflects both the human agency enacting technology and technology in its artefactual characteristics. Additionally however, through the structurational model of technology is also “institutional in structure” (Orlikowski, 1992). Through an example of a technology consultancy firm who developed, used and licensed their own proprietary interface design software; we are shown how the rigid institutional properties of the in-house software enact a form of agency over *how* employees work should be done; perhaps more realistically *how not* to perform their jobs. The management within this consultancy firm, designed the technology in a specific way so as to engrain ‘best practice’ into the daily work routines of staff. However, over time the specific interactions between staff and technology were occasionally modified based on the experience of staff within their consulting projects.

Adding this extra layer of complexity (through consideration of the institutional properties), would have forced the founders, managers, and designers of OLPC to consider the wildly varying contexts their technology sought to have impact. Through a less technologically deterministic approach their intervention could have been better incorporated into the daily routines and give dignity to the current structures and practices within which learners learn.

More recent work to this effect by Orlikowski, is termed ‘the practice lens’ (2000). One key takeaway is the separation of technology between its artefactual characteristics such as hard and soft components – its materiality – and the artefact in use (ibid). The practice lens develops some key features of Giddens’ theory of structuration (1984) that social structures (technology) are ‘enacted in situ’; that they are (re)produced over space and time; and through this repeated series of engagements, particular routines emerge.

Depending on the specific materialities enacted, structures informing use, and the sense making capacities of users – various and innumerable versions of a ‘technology-in-practice’ may be

observed. A Technology-in-Practice may be (re)produced over time; though it never attains an enduring ‘stabilised’ perspective as with the possibility to do otherwise lies the potential for innovation, learning, and change.” (Orlikowski, 2000, p. 412).

The Practice Lens, drawing on the idea of structurational modalities, is developed by Orilowski (2000). The ontological nature of the practice lens (in separating a technology from its users and institutional context) is carried over and the author uses intra-connectedness to refer to each component’s co-constitutive nature. This stems from the work of Barad in *intra-action* (2003) which has been applied in Information Systems research to progress from thinking about two discrete entities acting upon one another: “when boundaries dissolve and things pass through each other” (Scott & Orlikowski, 2009, p. 6).

These modalities, as depicted by Orlikowski are ‘facilities’, ‘norms’, and ‘interpretive schemes’ (2000). Facilities refers to the technologies at hand and that are implicated in practice, though an important aspect of this is that specific materiality that isn’t implicated in practice is not considered to be relevant in a Technology-in-Practice account. Norms, or normative conditions refers to institutional forces. This can be thought of elements of organisational culture, accepted work practices, and expectations of how people ought to enact technology to achieve organisational ends. Interpretive schemes are the knowledges and assumptions held by individuals who provoke technology in particular ways. Each of these structurational modalities affect and are affected by each other and sit within broader structures which shape and form what practice could and should resemble (*ibid*). The Technology-in-Practice framework is presented in figure 1 (below).

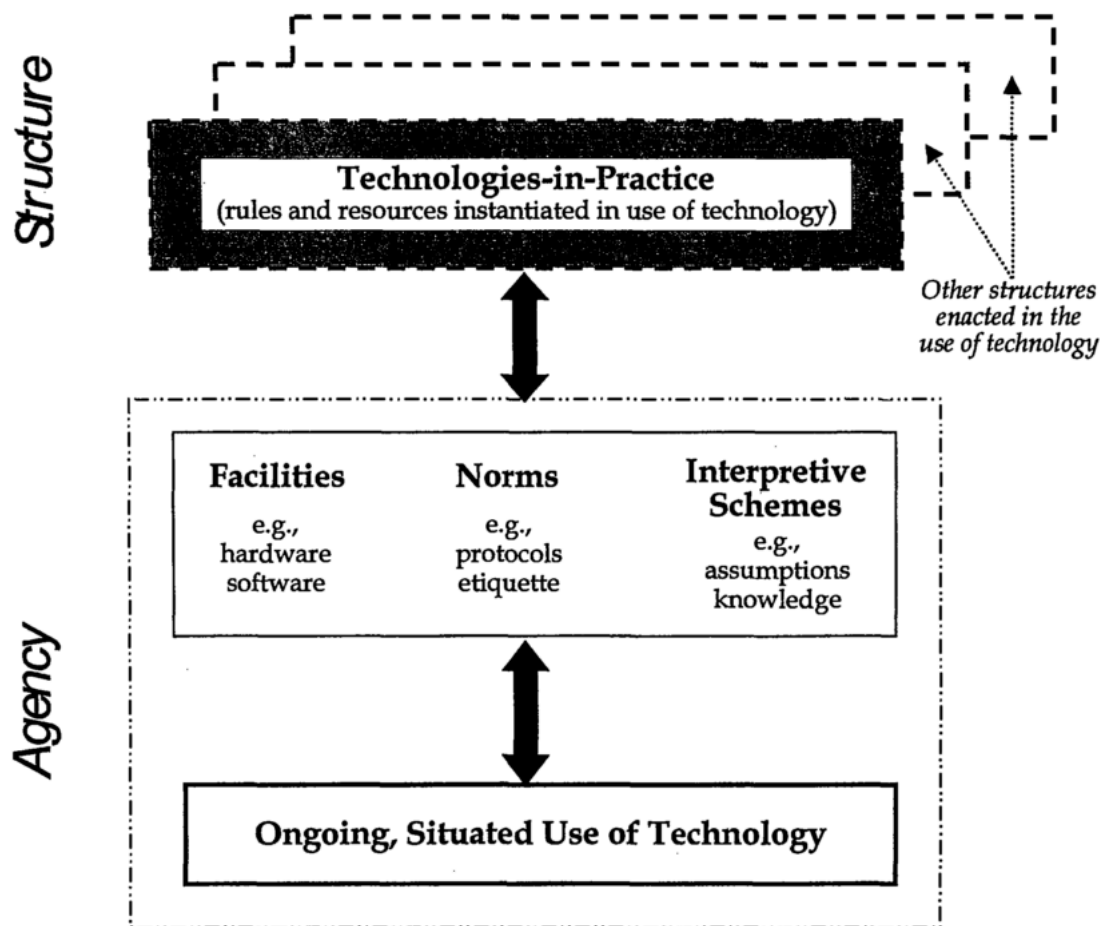


Figure 1 - Technology-in-Practice framework (Orlikowski, 2000)

The practice lens focuses research on actions with technology, and allows researchers to observe diverse interpretations, understandings and norms associated with technology. This provides the basis to observe and account for differences in application of the same technology, particularly within different organizations.

Within the confines of this study and given the field sites to be explored, this lens allows researchers and practitioners to understand the rationales that people approach technology with resulting in various degrees of use, potentially looking rather different to one another. Additionally, it uncovers the unforeseen impacts such uses have across various institutions, places, times, given a multitude of factors external to the technology itself (*ibid*).

2.1.4 Existing studies of Sociomateriality in Education Technology Research

Studies such as Johri (2011) and Selwyn (2010) have outlined the tendency of education technology practitioners to focus on assumed impacts of technology on education, and both seek to move towards practice based accounts. Education scholars have for decades proposed the

transformational impacts of technology on education and development more generally. However, as Mercer (2005, p. 243) writes “development interventions which turn the symptoms of poverty into technical problems to be solved with technological responses are inherently flawed”.

Studies of Technology Mediated Learning (TML) have considered the transformation of space and time occurring through internetworked learning technologies. On the issue of space it has been rationalised that learners engaging in TML are simultaneously alone by a computer but co-present in a community of learners in digital space (Loureiro-Koechlin & Allan, 2009). The implications of TML on the temporality of learning have been discussed in relation to consumption of learning multimedia independently and at will (Perrotta, Czerniewicz, & Beetham, 2016) and in terms of the implications on the “freedom” of recipients of electronic communications to the benefit of senders (Loureiro-Koechlin & Allan, 2009, p. 4).

The aim of EDTech in RCSs is to effect a hybrid learning environment which allows students to be physically co-present during school hours, yet allow those with access to personal devices to study from home through the EDTech App. This hybridity of spatio-temporal co-presence and the decentring of teacher from the learning process is socio-politically contentious. As found in other contexts, such redefinition of ‘the teacher’ does not foster effective education technology implementation and practice development (Hodas, 1993). Additionally, viewing them simply as banks of specific units of knowledge to be transferred to receptacles (learners) degrades the importance of teachers – a profession built on centuries of practice. Subsequently, teachers’ refusal to use such ‘transformational’ technologies, from the deterministic, knowledge transfer perspective often results in blame due to the “stubborn backwardness of teachers or inflexibility or insularity of school culture” (Hodas, 1993, p. 9).

Rich accounts of practice within education technology are needed, particularly in cases which do not represent the dominant stream of ‘models of technology’s transformational potential’. This highlights issues in “compromised and constrained social realities of technology use ‘on the ground’ in educational settings” (Selwyn, 2010, p. 66).

The practice lens, with its focus on lived realities and tendency towards observation of action provides a useful theoretical lens with which to critique education technology. With a critical gaze, the researcher can “move beyond asking whether a technology ‘works’ in a technical or pedagogic sense” (Selwyn, 2010, p. 72). Such a move beyond functionality and more explicit focus on critique

can reveal pre-existing conflicts between the powerful and powerless taking into consideration previous historical processes (*ibid*, p. 70).

The practice lens provides a focus on use and technology in practice. The use of the structurational modalities offered through the practice lens, in the context of education technology research “facilitate the inter-linkage between agency and structure which are viewed not as independent and conflicting elements but as a mutually interacting duality” (Halperin & Backhouse, 2007, p. 5).

As opposed to seeing the OLPC intervention as applicable “in spite of [the learners’] schools and teachers” (Warschauer & Ames, 2010, p. 34), a structurational view would have forced the developers and founders to consider the users and their specific needs (of literacy, language, specific content needs, etc.); not to mention the apparent disregard of the value teachers could add. On the issue of the displacement of teachers’ role and power relations with the class; Bass (2009, p. 9) writes about the potentially dramatic difference in success of the OLPC programme if it were “conceived as ‘One Laptop Per Teacher’”.

OLPC’s technologically deterministic perspective ignored the more neutral perspective that “ICT is more of a sociotechnical network than a tool” (Warschauer & Ames, 2010, p. 37). The ‘tool view’ is explained extensively by Orlikowski and Iacono (2001, p. 123) and highlights that a tool can be “passed from hand to hand and used as is, by anyone, anytime, and anywhere”. This may be somewhat an acceptable claim for a hammer (taking inspiration from Leonardi (2012)). However, with its negligible material complexity when compared to a laptop, we begin to see the problematic nature of such a view. This would assume that all laptops, operating systems, input and output devices share a common standard and critically, that users actually possess the skills to engage and make meaning with these tools. In countries such as South Africa where consumer technology tends to be mobile with touch interfaces, desktop/laptop computer literacies tend to be less prevalent. This is evident through Donner’s (2015) idea of theoretical access where access has typically been thought of purely from living within range of mobile phone networks.

The context of EDTech and IMA operating as a social enterprise, blending both for profit and non-profit initiatives requires additional organizational and management theory to provide academic rigour to discussions of strategic direction of the organization(s).

2.2 Organisations Blending Profit and Social Purpose

There are several names given to organizations which combine profit making activities and the achievement of a particular social mission such as Social Enterprises (Bull, 2008; Donner, 2015); Corporations with Social Responsibility Programmes (Banerjee, 2008; Copestake, 2007); Public-Private Partnerships (Miraftab, 2004); corporate-NGO collaborations (Dahan, Doh, Oetzel, & Yaziji, 2010) and the list is almost inexhaustible.

Suffice to say that, regardless of academic and practitioner nomenclature, there is a significant increase in organizations who seek to fulfil social ends with income generation activities. These organisations and activities “lie in a netherworld between economic and political action” (Unger, 2015, p. 234) as both global market capitalism and the nation state have failed to serve adequately (Curtis, 2008; Santos, Pache, & Birkholz, 2015, p. 52).

With varying degrees of a profit/social motives, significant interest has been taken in several market based approaches to social development with equally varying degrees of profitability and impact. Examples in Prahalad (2006, 2014) including ‘Jaipur Foot’, ‘Aravind Eye Care’ within his book show that by innovating (sometimes completely redesigning) traditional business processes such as patient flows in hospitals and clinics; organisations seeking financially self-sustainable operations can radically reduce inefficiencies. This can decrease costs while increasing quality of service delivery and patient throughput, simultaneously.

Both of these sustainable social development organizations (Jaipur Foot and Aravind Eye Care) combine radically reduced manufacturing and supply chain costs, as well as the development of cost recovery focussed business models. These see the minority pay while the majority (90% in some cases) would receive a full package of treatment for free (Prahalad, 2014).

2.2.1 Hybridity Expressed Through Competing Institutional Logics

Hybrid organisations find themselves balancing potentially competing ‘logics’ (Battilana & Dorado, 2010) where logics refer to organizational schemas of how to achieve specific goals; be that profit or social impact. As Smith, Gonin, and Besharov (2013, p. 409) explain; competing organisational objectives “juxtapose divergent identities, goals, logics, and practices, which creates tensions for leaders and their organizations”. This poses a difficult challenge for the leaders of hybrid organisations as they must manage these tensions effectively. However, these tensions manifest themselves in multiple ways, for example, in a prioritisation of financial performance over social mission.

However, interpersonal conflicts between different employees within the same organisation are possible. Some have a role clearly aligned with one or other logic (a production manager vs. an employee support councillor) (Battilana, Sengul, Pache, & Model, 2015). As such, tension between competing institutional logics not only takes place within a negotiation between financial and social performance; but also in employees' identification with one or other logic. Clear organisational leadership and creating mutual appreciation of the role of each logic-identity in achieving "superordinate goal" (Battilana et al., 2015, p. 1678) is important in hybrids.

While organisations seeking to achieve multiple objectives including profitable commercial logics and multiple social impact logics; Garrette and Karnani (2010, p. 42) introduces the idea of "multiple objectives trap". Wach (2012, p. 12) explores this in relation a Danone project which sought to create a yogurt product delivering a dual social objective and an additional profit making imperative. One social objective was to fortify the yoghurt product with health improving vitamins and minerals and the other was to ensure the packaging and waste management was environmentally friendly.

With the triple objectives; Danone realised it wasn't possible to reconcile these three logics and instead removed the focus on environmental impact to ensure profitability of the fortified yoghurt products specifically designed for those on low incomes (*ibid*). Evidently, the managing of many social objectives while remaining profitable was not possible for Danone to justify it as a profitable business venture.

Managing tensions between institutional logics has implications on resource allocation; how management focus is prioritised; and how employees and volunteers see their roles within the organisations. Considering the role of human resources as assets to organisations; Battilana and Dorado (2010) discuss the implications of hybrid organisations in the Micro-Finance sector prioritising employees with a dominant background in finance or social development. They highlight the importance of creating a shared organisational identity to avoid tension between the two groups.

However, such tension between logics also impacts members of staff who are responsible for delivering financial and social value simultaneously. As is the case with many micro-finance organisations; staff members experience this tension through rationalising their "nurturing role" with clients and ensuring acceptable repayment rates as set by management (Dixon, Ritchie, & Siwale, 2007, p. 49).

The notion of strategically employing people who may not fit conventional logic of, in the case of finance, emphasises the imperative for organisations adopting such an approach to ensure adequate training; skills development; and socialisation with the organisational values, vision, and mission to achieve “operational excellence” (Battilana & Dorado, 2010, p. 1435).

2.2.2 Target Group Inclusivity in Staff and Board Membership

Scholars of hybrid organisation theory build on the theme of human resources discuss the value excluded societal groups could bring to hybrid organisations seeking profitable social business models as “antagonistic assets” (Hockerts, 2015). Hockerts (2015, pp. 85–86) argues the imperative to view “marginalised people... as inherently valuable in their own right”. By doing so, Hockerts (2015) gives vivid examples of individuals with Autism Spectrum Disorder (ASD) adding value within the software development process. This is built on the assumption that some individuals with ASD have a preference for repetitive work with attention to detail. While this is just one example of how individuals excluded from traditional organisations can add value; strategically selecting employees from marginalised groups presents potential competitive advantages given their unique life experiences and skill sets (*ibid*).

Viewing people from marginalised groups as value adding assets to organisations may be a social purpose in its own right. However, the inclusion of target service users or end consumers within operations processes or strategy development present opportunities to engrain the voices, experiences, and opinions of beneficiaries within the organisation itself. Furthermore, Mair, Mayer, and Lutz (2015, p. 717) highlight that traditional non-profit boards would tend to reflect “target group, community members, and volunteers”. Such a view would reflect the principle of ensuring such marginalised voices or “antagonistic assets” should be incorporated into hybrid organisations where one institutional logic seeks to achieve a social social mission. Therefore, the extent to which boards have some representation of target groups in decision making processes, may foster more or less balance towards competing institutional logics of commercial viability and social mission.

2.2.3 Perspectives on the Marketisation and Financialisation of Compassion

Within the various literature streams on hybrid organizations and social enterprises more generally, financial sustainability is often mentioned as the main motivation for seeking self-generated revenue streams (Baumann, 2004; Haigh, Walker, Bacq, & Kickul, 2015; Santos et al., 2015). However, there are particular perspectives on sustainability which differentiate between operational sustainability (income cover operational costs) and total financial sustainability

(income covers operational costs plus growth capital) which could otherwise be thought of as complete self-sufficiency (Bogan, 2012).

“Investing in a social business is different from philanthropy in several ways – the social business is self-sustaining and investors get their money back: people who donate to charity do not.” (Yunus, Moingeon, & Lehmann-Ortega, 2010, p. 311). This is the ideal set-up many social enterprises strive for and draws on a core tenet of sustainability which generally underpins the Social Enterprise movement.

While such investments in what Yunus, et al (2010) call ‘social businesses’ may take the lead from Islamic loan philosophy of 0% interest; it allows investors, presumably, to continue to recycle their capital through vehicles akin to venture capital. However, the extent to which this includes a profit margin, and/or how this margin is calculated, remains unclear.

Beyond direct financial remuneration to investors, Dahan, et al. (2010) deal with the collaboration between One Laptop Per Child (OLPC) and Microsoft where Microsoft developed a limited version of the windows operating system which ran on the devices made by OLPC. While there may not have been direct financial remuneration for MS – using their historically dominant market position as *the* computer (as opposed to alternatives like Linux) means for many first time users of computers, Microsoft could very quickly get the Windows brand domesticated in these new markets for long term gain (Kraemer et al., 2009). Likewise, in the short term, Microsoft can reap the ethical rewards for providing for those less fortunate.

Equally troubling, is the assumption that users in resource constrained economies should settle for low-cost/low-performance technology (*ibid*). The power relations in such collaborations are cause for concern due to the assumptions of trusteeship and pervading post-colonial imagination felt towards the African continent (Mercer, Mohan, & Power, 2003). Such trusteeship and viewing service users as beneficiaries presents a potentially imbalanced power dynamic between organisations and those who consume the product or service they produce. It may be tempting for organisations to prescribe solutions from the perspective of their world view based upon assumptions as opposed to the lived realities of beneficiaries.

Regarding public and third sector collaborations; the contractualisation of social welfare, for example, through the tendering of services from governments to third-sector organisations is arguably “radically restructuring these institutions along market-friendly, not client-friendly, paths

of development.” (Evans, Richmond, & Shields, 2005, p. 93); potentially a kind of pseudo-privatisation (McHugh, Sinclair, Roy, Huckfield, & Donaldson, 2013).

Examples within social care in South Africa have recently caused dramatic concern such as the Life Esidimeni case where the outsourcing of psychiatric care contracts coupled with poor patient management practices and the prioritisation of cost-cutting had fatal consequences for more than 100 patients (Dhai, 2017b, 2017a). Whether through poor tendering processes and due diligence; lack of oversight; a risk that comes with the model; or more realistically a mix of some of these factors, it is clear there are issues in the implementation of public-private-partnerships; and the contracting of social welfare programmes regardless of country (Miraftab, 2004).

2.2.4 Balancing Profitability and Impact

Beyond a few examples of sustainable social enterprises (Aravind Eye Care, Jaipur Foot, etc.); is it possible for all hybrid organizations to achieve the appropriate mix? Creating revenue streams sufficient to support operations and maintaining a strong social objective can be realised in different ways.

Alter (2007) explains the ways in which revenue streams can be aligned (or not) with the social programmes offered (figure 2, below).

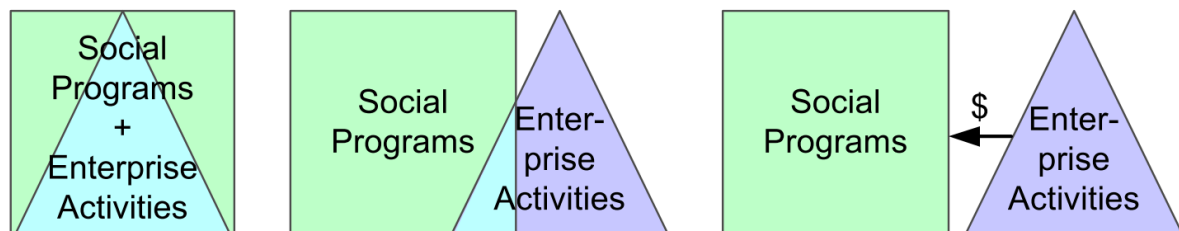


Figure 2 - 'level of integration between social programmes and business activities' Alter (2007)

There are evidently ways in which the specific configuration of both activities can be completely aligned such as traditional Microfinance where the social programme is inseparable from the enterprise activity (on the left of figure 2). This represents an alignment of business performance and social mission where service users/beneficiaries are customers. These have been termed “integrated hybrids” (Battilana, Lee, Walker, & Dorsey, 2012, p. 52; Ebrahim et al., 2014, p. 83).

While it may be rhetorically possible that microfinance serves Bottom of the Pyramid (BoP) consumers effectively; treating ‘poor’ as a complete categorical rather than accepting nuance and

varying levels of poverty; MFIs themselves may engage in ‘poverty market skimming’ activities serving the *least poor* of the *poor* (Cull, Demirgüç-Kunt, & Morduch, 2008; R. L. Meyer, 2002).

However, in the region between integrated and separated social/enterprise activities lies the area in which many social enterprise organisations, such as EDTech, operate in. While the categorisation offered by Alter in figure 2 (2007) appears as more of a continuum, there is significant scope in all sides to loose focus on one or both fundamental aspects of the hybrid organization.

Ebrahim, Battilana, and Mair (2014, p. 83) stipulate, organisational governance is important in the “proper alignment and prioritization of diverse and sometimes conflicting interests” which involves balancing financial objectives with social outreach. However, Ebrahim, et al. (2014) go on to classify social enterprises based upon the degree integration of financial objectives and social objectives where differentiated hybrids reflect organisations like EDTech where clients (schools and provincial education departments) and beneficiaries (learners at IMA drop-in hubs) are different.

Through the addition of an extra axis, Santos, et al. (2015, p. 36) provide a more comprehensive matrix describing the categorisations of “aligning business models and organizational design”.

Dimensions	Clients = Beneficiaries	Clients ≠ Beneficiaries
Automatic Value Spillovers	<p>MARKET HYBRID <i>Examples: BOP initiatives for access to basic services (energy, health)</i></p> <p>Risk of Mission Drift: Low</p> <p>Financial Sustainability: Easy</p>	<p>BRIDGING HYBRID <i>Examples: integrated business model with job matching for people with disabilities</i></p> <p>Risk of Mission Drift: Intermediate (lower risk for more integrated models)</p> <p>Financial Sustainability: Moderately Difficult</p>
	<p>BLENDING HYBRID <i>Examples: Microfinance, integration models that require regular support or change of behavior for value to be created</i></p> <p>Risk of Mission Drift: Intermediate</p> <p>Financial Sustainability: Moderately Difficult</p>	<p>COUPLING HYBRID <i>Example: Work integration social enterprises that require a dual value chain that serves both clients and beneficiaries</i></p> <p>Risk of Mission Drift: High</p> <p>Financial Sustainability: Difficult</p>

Figure 3 - Aligning Business Models and Organizational Design - from Santos, et al., (2015, p.45)

Figure 3 provides a richer account of aspects of hybrid organisations' convergence between revenue streams and where social value is created. The principal risks as outlined by Santos, et al., (2015) are difficulty in achieving financial sustainability and critically, a high risk of mission drift.

For organisations where the consumption of a product or service does not directly or 'automatically' deliver social value; the realisation of social value emerges from a specific set of behaviours or actions. For example, in Microfinance the purported social value creation is contingent on service users/consumers utilising extra income to benefit the family through improved nutrition through more/better quality food, investment in better assets (e.g. a more energy efficient stove), etc. (*ibid*). In comparison, the example of Danone's fortified yoghurt, social value is created through consumption of the product and therefore, the value spillovers can be said to be automatic.

This is a critical issue when considering the potential to scale social innovations, particularly in the Microfinance example. Not only does the access to credit need to be scaled to reach more individuals; the cost of educating, encouraging, and ensuring clients utilise this extra income in effective ways to realise the transformative potential. Such training, monitoring, and evaluation require significant hidden costs in ensuring the most social value possible can be created.

2.2.5 Scaling Social Impact

As social welfare and social development are increasingly being contracted from the public sector to the private and third sectors; social enterprises (who naturally straddle these lines) are experiencing increasing concern to scale up positive impact (André & Pache, 2016; Moore, Riddell, & Vocisano, 2015). As a result; funders, donor agencies, and philanthropists are increasingly auditing organisations they invest in to ensure they are getting the most out of their money (Ebrahim & Rangan, 2014).

For organisations whose customers are their beneficiaries and where social value is derived through consumption of a product or service; scaling can be relatively straightforward in principal (Battilana et al., 2012) – particularly where a product (such as fortified foods) or utility (including clean, safe, or renewable energy) is provided (Santos et al., 2015).

Social enterprises are being compelled to scale and grow their impact in the face of success (Dees, Anderson, & Wei-skillern, 2004). However, such calls for an expectation of growth and scale neglect to recognise the importance of social ties, relationships, and local contexts within hybrid

organisations which are threatened as organisations grow (W. K. Smith et al., 2013). On this note, André and Pache (2016, p. 660) ask: “can they [caring entrepreneurs] still care while going to scale?”. Additionally, scale brings increasing complexity to organisational governance; under developed and researched vehicles and strategies for achieving it; and a broader picture of how best to achieve large scale, societal change (Moore et al., 2015).

As success is realised in core activities and impact of a given programme, intervention, or product; organisations – particularly with sustainable income – may seek to expand to positively impact wider communities. While, in a technology focussed organisation such as EDTech/IMA, this may be possible through considering the core elements of diffusion of innovation theory (Rogers, 1983) or through employing more contemporary technology start-up theory such as the lean startup (Ries, 2011); for social enterprises or hybrid organisations more generally with a dual objective of social impact beyond profitability – growth and scaling impact become more difficult (Dees et al., 2004).

As such, recent scholarly work has been done to understand differing approaches to achieving an increase in an organisation’s track record of social impact (Dees et al., 2004; Hockerts & Wüstenhagen, 2010; Moore et al., 2015). However, few organisations will find the process of growing impact as relatively straightforward as private sector companies, particularly in social franchising models of scaling social impact (Doherty, Haugh, & Lyon, 2014; Mulgan, 2012).

Various approaches to and strategies for achieving scale are outlined by different authors. Moore, et al., (2015) describe scaling out (reaching greater numbers through replicating programmes, increasing the number of beneficiaries, etc.); scaling up (using experience of a social innovation to influence law and policy); and scaling deep (developing, strengthening sense of community and culture). Others such as Dees, et al., (2004) describe three strategies for achieving an increase in numbers reached such as dissemination (the sharing of ideas, values, programmes, etc. with other organisations and supporting implementation); affiliation (e.g. creating umbrella organisations for organisations with similar visions, missions, and values to share best-practices); and branching (where replication of the intervention takes place in new areas under centralised control/management).

Scaling social impact comes at a time after there is evidence of social impact as an outcome of administering a particular programme, system, product, etc. (André & Pache, 2016). Part of the complexity comes from the change in monitoring impact depending on the specific growth strategy selected (André & Pache, 2016).

Depending on the strategy or mechanism for growth selected, management becomes a pertinent issue given the inherent complexities of monitoring impact – even at simply a local scale. “How, for instance, can an underprivileged student’s increased self-confidence be measured?” (André & Pache, 2016, p. 667). Additionally, at what point can the impact of this social impact be seen to have tangible benefits on such an individual? The latter could conceivably be years after the service user left the education system and entered employment.

However, there seems to be very little concern within the literature for alternatives to increasing an organisations footprint within existing communities by diversifying programmes, increasing engagement with communities already involved, and problematising the seemingly natural expectation that organisations amplify their social impact. Scholars such as Westley and Antandze (2010) wouldn’t consider such organisations to be innovating and rather lower their profile to social inventions.

However, as is common with start up businesses, growth and the entrepreneurs drive for scaling up a business is not always a priority, nor a goal in itself given that many businesses operate on smaller scales such as ‘arm chair enterprises’; ‘lifestyle businesses’. Not every entrepreneur seeks to build a formidable business empire. As such, perhaps social entrepreneurs can be content with a manageable project; with a niche geographical focus; and clear missions.

In avoiding such tensions associated with growth and mission drift (André & Pache, 2016; Battilana et al., 2012); there is an argument, under developed within the literature for niche organisations to focus on their core beneficiaries and rather than seeking growth through serving greater numbers of service-users; or local growth through working in partnership with other organisations; there is potential for growth to be realised by ‘scaling in’; by deepening relationships, complimentary services/programmes, and ultimately scaling the impact of one organisation but with existing beneficiaries and within successful networks.

2.2.6 Missions and Mission Drift in Social Purpose Organisations

“The mission is what inspires the founders to create the organization... Yet even as non-profits are stuck to their mission, they are also pulled by market forces.” (Rangan, 2004, p. 114). Even in the case of non-profit organisations, “market forces”, experienced for example through donor funding opportunities provoke organisations to pursue and avoid certain opportunities.

Social enterprises often find themselves in a position where rationalising competing, traditional institutional logics progresses towards a more or less financially focussed aim (Battilana & Dorado, 2010; Mair et al., 2015); thus either compromising the resources available to deliver particular social outcomes or undermining the sustainability of the organization – potentially liquidating the organisation and having no resources to achieve the social purpose (Ebrahim et al., 2014).

Given the narrow line upon which social enterprises operate, the literature tends to warn against mission drift caused by focussing on financial sustainability, rather than criticising unsustainable social programmes.

Much of the contention between achieving social impact and self-generated revenue comes from misaligned or conflicting objectives and outcomes. MFIs who express themselves as ‘Integrated Hybrids’ may operate within a pro-poor space (Battilana et al., 2012); but are criticised for not reaching the poorest of the poor on account of the higher relative costs of serving *bottom of the pyramid* markets (Copestake, 2007).

Additionally, along the lines of using the social enterprise as a marketing gimmick, some social service providers engaging in Public-Private-Partnerships (PPPs) may be argued as ‘Trojan horses’; where what appears to be civic society, government, and business working in partnership; results rather in more typical privatisation such as the case of post-apartheid housing policy (Miraftab, 2004). Such an outcome shows there is real potential for PPPs to experience mission drift as in the face of poor performance and underrepresentation of civil society results in fully privatised service delivery (*ibid*). One possible implications of such PPP or pseudo-privatisation is a drain on public funds and that service delivery is dependant on private contractors’ financial health.

Conversely, organisations espousing dedication to serve ‘poorest of the poor’ sectors may struggle for financial sustainability and depending on management responses could abruptly cease to exist (Santos et al., 2015, p. 38) or potentially worse, cause harm. Dixon, Ritchie, and Siwale (2007, p. 47) found that loan officers developed “inappropriate methods to compel further repayments” from clients at risk of defaulting. Therefore, being ethically incompatible with the mission of enhancing the economic opportunities of the poor, in these cases, Microfinance could in fact deepen the plight of clients both psychologically and materially (Hulme, 2000).

Social enterprises therefore run the risk of perpetuating inequalities. This may also be observed in cases of prioritising loan repayments over the well-being of clients whose loan application may not have been suitable for disbursement or by encouraging loans to be disbursed in specific informal sectors already saturated by micro-enterprises (Hulme, 2000). Alternatively, by uplifting those *almost* at the bottom, while allowing those at the bottom to remain unserved – deepens their relative experience of poverty, potentially entrenching deeper social inequity.

Warschauer and Ames (2010, p. 44) suggest in the case of OLPC in Paraguay, the provision of the laptops through the programme “might exacerbate divides rather than overcome them” because evidence suggested mostly learners from higher socio-economic backgrounds used the OLPC’s XO computers for creative ends. The old adage holds – good intentions are not enough.

2.3 Lean Startup, Design Thinking, and Design Philosophy

It is important, in the context of this dissertation, to consider how hybrid organisations (and their services/products) can be systematically designed and managed with a view to achieving (in full or in part) financial sustainability *alongside* achievement of the social mission(s). In general entrepreneurship theory and practice, seeing and realising market success is difficult (Blank, 2013). However, to realise the dual objectives of hybrid organisations, what might contemporary start-up and design theory reveal for organisations seeking two or more, competing institutional logics?

The lean start-up provides a rich language and set of tools and methodologies to increase the likelihood of a start-up succeeding (Blank, 2013; Ries, 2011). In ‘The Lean Startup’, Ries (2011), proposes several key processes (such as ‘build, measure, learn’; to iterate quickly and often between development, measuring outcomes, and learning from the results) and philosophies (such as avoiding a ‘build and they will come’ mentality). One key takeaway The Lean Startup provides is to ensure a more efficient use of resources; in the right area, at the right time, and knowing when to reallocate them.

The imperative is to avoid developing a product which solves a problem or satisfies a market need/want which doesn’t really exist or is too small to become financially sustainable. Rather, expect that assumptions made in the early phases of a (technology) startup may need significant development or may simply be wrong. Solving for problem definitions that aren’t accurate or nuanced enough may be met with rejection by end users (Markus & Keil, 1994). Rejection of technology is also discussed in terms of the practice lens (Orlikowski, 2000) and as can be seen by technologists ‘over-selling’ the benefits of education technologies (Russell, Bebell, O’Dwyer, & O’Connor, 2003). It is therefore important to develop cooperative design practices that feed ideas,

user feedback, designs, and prototypes between designers, developers, and users. While this shares similar attributes to the testing of assumptions in ‘Theory of Change’ (Kail & Lumley, 2012; RSA & Univeristy of Cape Town, 2014); the Lean Startup principals go into significant detail of the design and development of activities and specific products.

One of the attributes of hybrid organisations is their ability to innovate within the context of limited resources (Doherty et al., 2014; Mair & Martí, 2006). This forces these organisations to fundamentally rethink how they go about achieving a social mission, such as radical cost reduction in products/processes where service users on extremely low incomes e.g. Jaipur Foot or Aravind Eye Care (Mair & Martí, 2006; Prahalad, 2014).

Successful hybrid organisation innovators may operate in what is termed by Prahalad (2006) as a ‘sand box’ where rigid boundaries can be set for innovators to play with the shifting sands they contain. Inviting playful creativity lends itself to towards breaking down or augmenting assumptions; something which design thinking’s “overlapping spaces” (differentiated from a linear process) strives to communicate (T. Brown & Wyatt, 2010, p. 33).

Design thinking emphasises key characteristics of those involved within product/service development. Such characteristics are empathy in hearing multiple alternative perspectives; asking deeper questions about why assumptions are assumed to be; fostering human experience and emotion throughout the project through story telling; being creative with ‘boundaries’ and ‘requirements’; though this is not exhaustive (Beckman & Barry, 2007; T. Brown, 2008; T. Brown & Wyatt, 2010). When blended with the rapid, highly iterative prototyping approach of the Lean Startup principals; there is some evidence that social enterprises can target resources on projects, services, products and experiences where there is ever increasing evidence of success (T. Brown & Wyatt, 2010).

A key philosophy is to expect and embrace failure, even seeking failure, fast and often, shared with Lean Startup principals (Blank, 2013). Failure is a departure point for learning and challenging assumptions of developers. In the context of working in emerging economies and resource constrained settings far removed from end-users; it should be expected. Where products/services/experiences are designed based upon untested assumptions, as is presented through EDTech’s case; failure should point towards untested assumptions (Liedtka, 2015, p. 936). When a well designed user experiment or test is carried out, learning should be a systematic and planned endeavour (Blank, 2013; Ries, 2011).

Alternative processes, philosophies, and methodologies such as the Lean Startup and design

thinking provide a strong evidence base to subvert the traditional ‘consult the client; design and build in a lab *for* the client; deliver solution to client’ approach. Lean thinking can help mitigate the worst case scenario of developing a solution for the wrong problem (or based on the wrong assumptions); while wasting resources for an issue that pervades. This is the major issue with the ‘build and they will come’ mentality (Ries, 2011).

2.4 Summary of Literature Review

Sociomateriality and the practice lens provides a theoretical underpinning to oppose determinist accounts of technology. This can be shown more generally in information systems research, but also in the more specific context of education technology to account for and explain limited/non-use of technologies (Halperin, 2017; Halperin & Backhouse, 2007; Orlikowski, 2000).

Given that education, as a social institution, is so important to society; the importance of ‘getting it right’ is a contentious issue imbued in politics and dependant on individuals’ worldviews (Hodas, 1993).

Recognising the historical processes within South African communities, the continent and the global south more generally, ensuring sufficient ‘hearing’ and collaboration is important so as to avoid deterministic, homogenising views of communities with a post-colonial imagination (Mercer, 2005; Mercer et al., 2003).

Technology is not apolitical; and in the case of education technology; it’s usually always political (Hodas, 1993). In rejecting hard and soft definitions of technology, particularly in education, a more fluid appreciation for the role technology could play within schools can be rooted in practice and experience, rather than an intrinsic determinism and false belief in technology to achieve particular, desirable transformations (Selwyn, 2010).

The practice lens differentiates the artefact from what happens when artefacts are placed in the hands of users in different contexts (Orlikowski, 2000); and such contextualisation of ‘technology-in-practice’ allows more substantial appreciation of the individual, social and institutional factors which affect technologies’ use; what such use actually looks like; and thusly their potential and actual impact.

Technology-in-practice, while operating within existing structures, tends to recreate such structures, therefore users are recursive in their implementation of technologies and the

establishments of routines is expected (Giddens, 1984; Halperin & Backhouse, 2007; Leonardi, 2011; Orlikowski, 2000). Therefore, human agency can be said to reproduce the structures which enable action (Giddens, 1984, p. 2).

By rooting analysis of the uses and implications of technology in practice, it engrains a sense of what is actually happening as opposed to the politics laden, deterministic ‘this is what should happen’ perspective. Additionally, in the context of this study (in light of the generalizable failure of EDTech in RCSs) eliciting experiences of the technology and uncovering what reasons there were for limited/non-use of the technology may reveal valuable insights for EDTech/IMA. When compared with the ‘whats’, ‘hows’ and ‘whys’ of other technology uses in school settings, this can provide EDTech with a more impartial, practice based account of what is actually happening within the schools observed.

In managing the relationship EDTech/IMA has with the MDoE, mission drift is arguably one key area where failure can be imagined as the project was aligned more towards the mission of the MDoE than EDTech, but rationalised through the promise of funding (Rangan, 2004). A kind of lucrative, utopian rabbit hole emerged where the promise of funding and the simplicity with which EDTech/IMA viewed the transformation of the South African education landscape for funding an arts programme, is revealed.

Such a myopic view of achieving a revenue stream for an arts programme can be highlighted through assumptions made by EDTech in how RCSs *should* use technology. These assumptions were made in a vacuum of end-users; those with a contextual appreciation for RCSs; overestimating the access of schools to the internet; and RCSs having staff with both the skills and motivation to implement their vision and a lack of integration support and training.

In the context of this study, a political differentiation between ‘Westerners’ and ‘Africans’ (as portrayed by Mercer, et al., (2003)) is potentially problematic as designers, developers, and managers were all South African. However, it is still important to recognise distance between development and use beyond pins on maps to account for the diverse cultures of South African society accounting for distance based upon socio-economic, political, racial, lived experiences, and the impact of historical processes as opposed to distance literally measured by kilometres.

This kind of projection of the problem and building based on inaccurate assumptions highlights the validity of a more inclusive design process such as design thinking which places empathy at the

heart of the whole design process from problem definition, through ideation, design, development, testing, and implementation.

Resource utilisation is an important consideration of both third sector organisations and start-ups in the eyes of the lean methodology. Hybrid organisations are often heralded for the frugality from which innovation emerges (Hockerts, 2015); lean thinking emphasises the importance of frugality and the strategic employment of resources, and critically, the importance of identifying sunk costs, and the need to pivot early (Blank, 2013). This is one such benefit from adopting a lean start-up approach to organisational development and its predisposition towards seeking failure and intentionally learning from it (Blank, 2013; Ries, 2011).

From the literature review, a conceptual model connecting these various literature streams to this study have been created. Firstly, a conceptual model is created. This highlights the interconnectedness of of hybrid organisation theory with the value of rooting technology design and development in practice lens analysis. This is presented in figure 4 below. This presents a series of tensions arising from the management of competing organisational logics. Secondly, a literature consistency matrix has been developed which shows various publications; their methodological approach; and their links to this dissertation's research questions. This is shown in table 2 below.

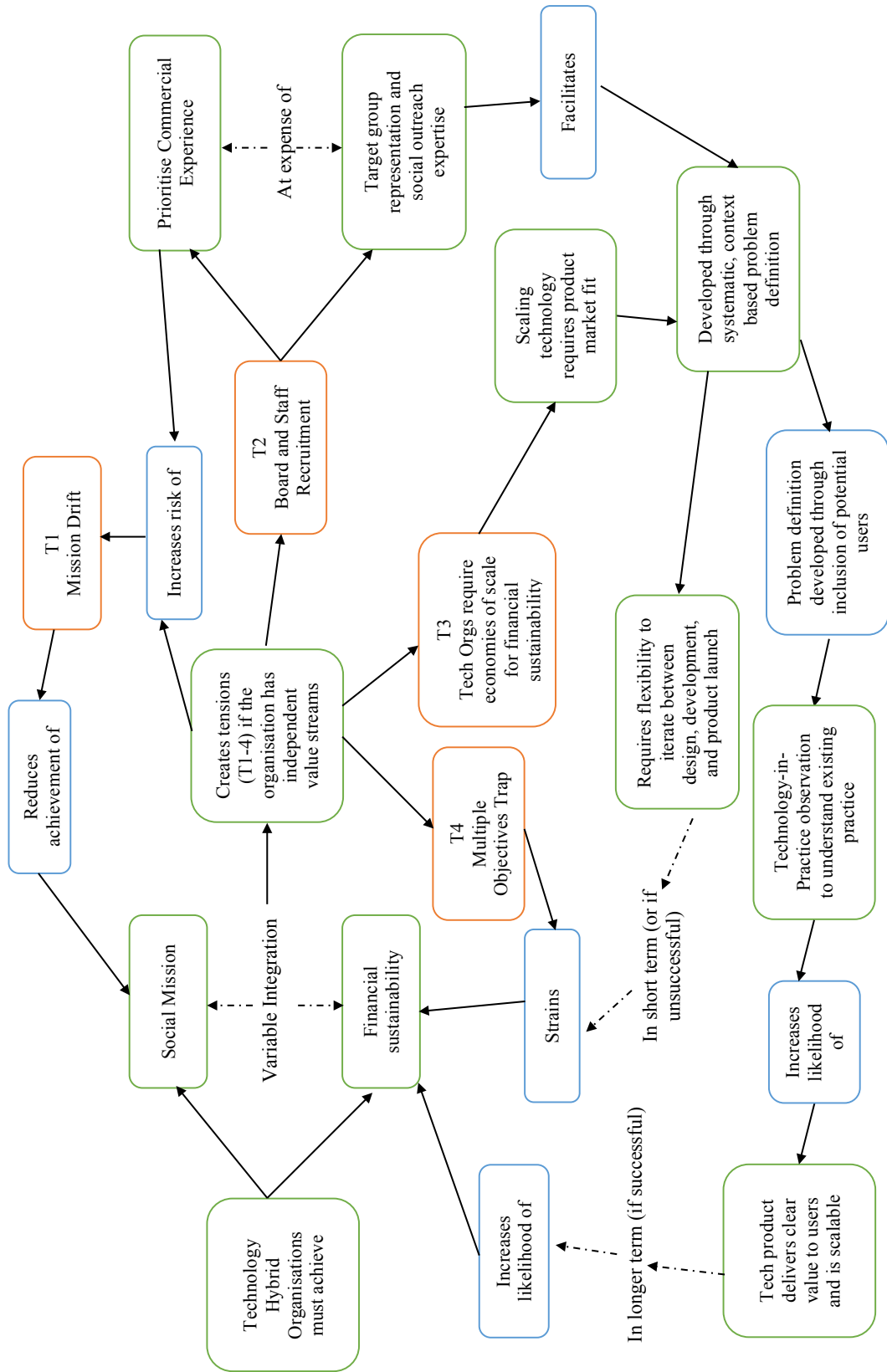


Figure 4 - Conceptual Model Linking Literature Streams

Table 2 - Literature Consistency Matrix

Thematic Area	Study	Methods	Theoretical Underpinning/ Research Findings	Link with Research Questions
Foundations of the Practice Lens	Orlikowski (2000)	Case Study: Re-use of observation, unstructured interview, and materials data from previous studies.	Structures are enacted by users, not inherent strictly within technologies or institutions	Seeking practice based accounts of technology use and non-use
	Feldman and Orlikowski (2011)	Authors' personal narratives of practice lens use	Practice creates organisational realities useful in exploring and effecting change in organising	Developing understandings of current practice to inform how technology in RCS can effect change in T&L practice
	Orlikowski and Scott (2008)	Analysis of 207 articles in leading journals to assess research in technology in organisational life	Advancing the views of inseparability between technology and social dimensions	Research seeking to develop social and contextual understandings of technology use
Practice Lens in Education Technology	Halperin (2017)	Case study: Online and offline observations, Interviews, informal conversations, documentary	Application of the practice lens in education technology studies for holistic conceptualisation of education technologies	Application of a practice lens in education technology to develop rich accounts of broad context
	Johiri (2011)	Case Study: Re-use of previous research data: multiple surveys, focus groups	The importance of balancing technological and social accounts of education technology research concerning design	Providing contextual and technical aspects of Learning Technology to appreciate holistic and rich contexts
Sociological Studies of Technology in Education	Selwyn (2010)	Conceptual paper advancing the importance of critical studies in education technology research	Critical studies of education technology allow a deeper probing of power, control, and broader social justice issues	recognising the locus of design and development carries assumptions, socio-economic and political power and the ability relinquish responsibility for 'failure' – how can such assumptions be discovered and challenged?
	Perrotta, et al. (2016)	Conceptual paper using ANT to examine MOOCs, a relatively new phenomena	Sociological enquiries of global digital education platforms provide insight into uneven participation across socioeconomic and privilege boundaries and potential reasons for this	Implications of socio-economic variability and inequalities among users with regards to empirical education technology research
	Oliver (2011)	Conceptual paper highlighting value in ANT, SCOT, Activity Theory, and Communities of Practice Theory to	Countering technological determinism (incl. cause-effect/Input-process-output) in 'learning and technology' research// critical approaches to	Challenging deterministic assumptions of the contexts of use and the cause-effect results excepted through use of EDTech

		overcome determinism in 'learning and technology' research	give descriptive accounts of practice and action, uncovering negotiated meanings	
Competing Logics in Hybrid Orgs	Battilana and Dorado (2010)	Comparative Case Study on 2 MFIs in Bolivia over 3 fieldwork periods using interviews and observation. Contextual data was gathered through smaller interactions with loan officers of other companies	Institutional Logics in HOs are tricky to manage and internalise. Recruitment and socialisation of employees appears to be an important factor to manage when developing HO operations, identity and impact	Highlights some strategies to manage a dual profit and social outreach motive in HOs and identifies the importance of HRs and processes to develop organisational identity in staff
	Mair, Mayer, and Lutz (2015)	Using survey data from 70 Social Enterprises to conduct comparative analysis and using secondary sources to build richer pictures of what they find	Some SEs thrive in balancing dual logics where they can see innovation opportunities and act quicker than traditional/single logic organisations// there is great heterogeneity between cases in how duality is managed	Provides alternative organisational structures and approaches to managing dual logics by interrogating how different organisations react and manage the complexity of organisational fluidity
	Morduch (2000)	Literature discussion deconstructing claims within MFI literature and practice and that commercial banking best practice leads to the best performing pro-poor MFIs	There is a nuanced approach to understanding drivers of inclusiveness, achieving missions, and funding mixes and anecdote based evidence doesn't account for the complexity of serving poor clients nor serve as a platform for innovation	Highlights hybrid organisations (in the context of Microfinance) need to have systematic approaches to assessing impact and effectiveness – rhetoric and a few positive success stories are not sufficient.
Convergence in social programmes and enterprise activities	Ebbrahim, Battilana, Mair (2014)	Comparing existing literature // leads to a discussion on how HOs can avoid mission drift by seeking to overlap their outreach and income generating activities and the role of the board	HOs face distinct challenges in accounting to many different stakeholders within and outside the organisation. This includes boards, clients, funders, etc. Critical to success is being able to prioritise and balance these perspectives and HO dualities	The paper raises important aspects about HO governance how multiple perspectives must be balanced// relevant to EDTech in light of little representation of service users and the specific organisational structure of the HO as 2 separate legal entities.
	Santos, Pache, Birkholz (2015)	Developed based upon existing literature// compares and collates findings into a new model for understanding the implications on organisational	Developed a matrix of 4 social hybrid organisation models based upon the degree of convergence between clients and beneficiaries (x axis) and whether value is automatically created or	EDTech/IMA operate multiple programmes where beneficiaries and clients are mixed in a complicated fashion. This typology matrix provides key management and mission issues faced by

		performance based upon the kinds of integration and value spillovers within each category	contingent on other success factors (y axis)	organisations within each category and the difficulty of achieving financial self-sustainability
Mission Drift	Copestake (2007)	Compares secondary data from IMP-ACT (a multi-country action research programme) against a theoretical framework to assess strategies to achieve a social mission	Mission drift is loosely defined and suggests where goals, performance assessment, and management processes are weak; mission drift is a likely possibility – managers can be reactive to trends and with weak importance placed on specific social outcomes, drifting is more likely	Given the questions orientation to impact and less than expected use (leading to poor results); the paper suggests more clearly defined performance indicators and goals can help avoid changes in organisational rationalisation of competing profit and social performance logics
	Miraftab (2004)	Case study of South African housing policy and the public private partnerships (PPPs) to highlight some practice/policy outcomes of privatised service delivery.	Highlights the risks of PPPs becoming a route to privatisation and not fully serving the contractual requirements outlined in the partnership in neo-liberal economies, such as South Africa.	Given the contract between EDTech/IMA and the MDoE; the significant investment (multi-million rand grants and tenders) as well as informal contractual redefinitions set the scope for underperformance and poor multi-stakeholder management.
Scaling social impact	André and Pache (2016)	Extensive literature review comparing the importance of “care” during the social enterprise scale process with the traditional enterprise scale process	Social enterprise scaling follows broadly similar processes/stages as for profit enterprises though the importance of embedding ethics of care into organisational governance policies and ensuring that the founding principles of the organisation are steadfast throughout the scale process is important.	The rapid growth expected by EDTech to develop a sustainable revenue stream, led to a lost sense of the founding mission and principles of care. Prior to scaling social impact, 1. social impact must be evident and 2. The values and contexts which make this successful must be translated into organisational governance processes to allow the caring principles of education development not to get lost during scaling efforts.
	Moore, Riddell, and Vocisano (2015)	Case study of ongoing scaling within social purpose organisations using focus groups and surveys	Scaling strategies for social enterprises require multiple strategies to happen effectively blending typical dissemination and replication approaches with for example working with government or civil society organisations to	This paper provides rhetorical work to challenge the traditional view of scaling from a business-orientated replication/diffusion perspective. It offers alternative avenues for social enterprises to scale

			influence policy and systemic change; or deepening emphasis on changing values, cultural practices, or relationships	to achieve the change they want to see. This is valuable for EDTech to problematize their chosen scale strategy and whether it was too early for EDTech to scale up efforts within government schools.
	Dees, Anderson, and Weiskillern (2004)	Practice based article in the Stanford Social Innovation Review using examples of social enterprises different approaches to scaling	Highlights the experience of different scaling strategies from varying organisations. It provides different language from Moore, et al., (2015) and presents a 5R framework to understand the innovation's and organisation's readiness to scale	Provides description of how social enterprises and their management teams strategized their scaling practices and the factors they considered to achieve scale. Different organisations should approach scaling impact in different ways. Scaling is not uniform and there are a range of options which EDTech could have considered to scale their impact.
Organisation development and product design	Blank (2013)	Practitioner article in HBR to give overview of the lean startup principles, processes, and justifications based upon academic and professional consulting experience.	Provides a brief overview of the cogent arguments in favour of the methodology for start-up companies.	As EDTech is a tech start-up; this explanation of the methodology provides a broad overview of the benefits of its application within this space. It highlights the iterative nature of successful start-ups product development and blends with ideas of Product-Market Fit
	Ries (2011)	Book which introduces the practice based accounts of Eric Ries using examples of tech start-ups he has led and consulted with.	This book builds upon the body of theory on just-in-time inventory and lean production/ manufacturing pioneered by Toyota. The emphasis is on iteration in design, development and product launches and planned product testing where learning is a priority.	This is a salient philosophy within modern technology companies and start-ups. The methodology places an emphasis on delivering value early on with customers through. This relates to EDTech as they adopted an opposite methodology referred to in the book as 'build and they will come' where products are designed in a vacuum and launched as large, standalone products as opposed to incremental developments. Lean startup approaches prioritise

				failing fast and often as vectors of organisational learning and customer development.
T. Brown and Wyatt (2010)	Practitioner article aimed at emphasising the value of design thinking to social purpose organisations designing their programmes and interventions referring to existing case studies	Design thinking forces a new way to think about product design. It is a user-centred design methodology where key traits of designers are emphasised through “empathy”. While users/customers/service users are not always aware of what they want (of they have preconceived ideas of what a solution should be); good design should understand the problem and the context through which the problems are experienced to address root causes.	EDTech followed a design methodology where the context of government schools was not considered and deterministically believed their solution would translate to any learning context from IMA. This theory (and the body of work this article aligns with) is relevant to EDTech to develop empathy for the context rather than building products based on untested assumptions and rationalising failure as coming from outwith their control. This is not strictly true, based upon a reading of the data.	
Liedtka (2015)	Academic literature review paper incorporating cognitive bias theories with design thinking to use design thinking to overcome such biases	Design thinking provides much hope for developing useful solutions which match the needs of users, service users and customers. This paper advances this by highlighting particular cognitive biases which may be reduced by a design thinking approach to product/service development	EDTech have shown through multiple annual and funder reports to overestimate the value of their product with a limited empirical base to justify it. This paper highlights how alternative approaches to design, development, and importantly the empathetic involvement of users can reduce these biases to develop more realistic, acceptable and successful interventions.	

3 Research Methodology

The objective of this research report is to describe and compare various enactments of the same technology within different spaces. The goal is to explore antecedents of ‘less than expected’ utility of a digital education platform (EDTech) in three RCSs as compared to an ‘ideal-use case’. Through employing qualitative methods (semi-structured interviews; active and passive observation; and use of organisational reports); this inductive study builds on multiple cases study; one for each field site juxtaposed by perspectives of EDTech/IMA as a hybrid organisation.

3.1 Research Approach and Strategy

The construction of case studies based upon multi-site fieldwork was chosen due to its inherent strengths in allowing the comparison and contrast of cases (Eisenhardt, 1989). This strategy allowed me to address the research questions, which are structured towards generating rich descriptions of non/limited use and a comparison with the ‘ideal case’. In keeping with the studies adoption of a practice lens; observing the technology in situ provides rich accounts of limited/non-use and gave me the opportunity to observe potential alternatives to EDTech which teachers would employ in their teaching.

The decision to conduct research within IMA was pursued when the CEO/Principal of EDTech/IMA invited the researcher to do so in 2016. Research was scoped and observation and interviews carried out with EDTech/IMA staff and learners. Research was conducted in schools in July. Within the 3 schools studied, a period of between 4-7 days was spent in each site and this was dependant on factors such as school holidays and breaks as well as the availability of transport between Bushbuckridge Municipality and White River. Follow-up research happened within the IMA drop-in music school in July and the first week of August 2017.

Research can therefore be considered to have taken place over 3 main stages: initial observations and interviews in EDTech/IMA offices; school based observations (a total of 3 weeks); lastly follow-up interviews and observations in EDTech/IMA office and the drop-in music school in Mpumalanga. There is a time break between data collection times as the researcher had to return to the UK to save for the remainder of the data collection. For summaries of the field sites and the specific quantities of semi-structured interviews etc., see table 3.

Table 3 - Classifying and Detailing Field Sites

	Purpose of Research in Each Case				
	Organisational Context	Ideal Use-Case	Limited/Non Use-Cases		
Field site Code	<i>EDTech Pty.</i>	<i>IMA</i>	<i>RCS-A</i>	<i>RCS-B</i>	<i>RCS-C</i>
Duration of research	5 Weeks (time divided between considering EDTech/IMA as an organisation and IMA as a place of education technology use and allow the researcher time to acclimatise to the research process)		7 days (including one weekend)	5 days (including one in-service day with no learners)	6 days (including one day of researcher led in-service training [active observation])
Data gathered	<u>Semi-structured Interviews (5)</u> -2 with CEO/principal -1 with Board Member -4 with Employees Organisational Reports (12) Informal conversations	<u>Semi-structured Interviews (5)</u> -5 learners -1 tutor Observation (passive) -observing technology-in-practice -diary entries and photographs Informal Conversations	<u>Semi-structured Interviews (3)</u> -2 groups of learners -1 individual learner -1 teacher Observations (passive) -observing technology-in-practice -diary entries and photographs Informal Conversations	<u>Semi-structured Interviews (3)</u> -1 principal -1 group of learners -1 technology facilitator Observations (passive) -observing technology-in-practice -diary entries and photographs Informal Conversations	<u>Semi-Structured Interviews (2)</u> -1 principal -1 teacher Observations (passive and active) -observing technology-in-practice -diary entries and photographs Informal Conversations

None of the informants were known to the researcher prior to research commencing other than the CEO/Principal of EDTech/IMA whom the researcher had known since the early inception of the EDTech platform. This had implications on gaining the trust of informants which is highlighted as a concern in relatively short exposures in the field (Wilson, 1977). Additionally, as Cricco-Lizza (2007) explains the power elements involved in research involving researchers of different races. However, this was remedied through a rapport building strategy drawing on for example: sharing personal life experiences; showing an interest and actively learning seemingly small greetings in xiTsonga; and explaining that the researcher lived within the communities.

Furthermore, as indicative within building theory from qualitative data as developed by Gioia, et al., informants are viewed as knowledgeable agents (2012, p. 17). This recognition engrained within the mind of the researcher that the best people to explain limited/non-use of technology within educational settings are those who choose (not) to utilise a given technology.

Simply, showing a desire to learn from informants as opposed to ‘studying them’ was adopted and having an empathetic, relationship building approach with informants aided in the development of

trust in similar ways to Cricco-Lizza (2007). As many of the teachers and staff members had access to smart phones, the researcher provided his personal cell number to communicate with informants through WhatsApp, Facebook, and Messenger, though not for the purposes of data collection. Furthermore, having the buy-in and endorsement of the research by each principal and their existing relationships with one another facilitated ease of data collection.

3.2 Population and Sampling

After face-to-face meetings and emails with the CEO/Principal of EDTech/IMA respectively, the research encounter had been broadly scoped together and commenced the following week.

Prior to the development of EDTech as a technology and an organization, IMA, its predecessor, developed a model of music tuition which seeks to provide a comprehensive music education in resource constrained communities. Starting in 2011, 3 'hubs' were created using grant funding from Department of Culture, Sports and Recreation (DCSR) and private donor funding. Comprehensive music education takes the form of music theory classes; introductory instrumental lessons; band formation and performance; and other industry relevant skills such as band management.

EDTech as a technology (not a formal organization) was developed in 2012 as a project to enable consistency in the delivery of music theory and instrumental lessons. This was developed in part through funding from a private software development company in Johannesburg. EDTech was chosen for this study as the context of a 'failed trial' interested the researcher and fitted within broader discussions of non-use of technology within education (Selwyn, 2010). While the CEO was known to the researcher prior to research commencing; this was limited to roughly 3 informal conversations dating back to 2013 around the early inception of the EDTech product range.

3.2.1 Sampling Strategy of RCSs

RCS field sites, were selected based on discussion between the researcher, the CEO/Principal, and the lead platform administrator/trainer of EDTech/IMA. These were chosen based upon varying degrees of use, visible to EDTech/IMA via reporting features built within EDTech. RCS-B was highlighted as the 'most functioning' school (interestingly the only school visited by the CEO), while RCS-A and RCS-C represented schools where data was initially visible, but after a matter of weeks after training and implementation, no usage was detected. Therefore, a theoretical sampling approach was taken to identify field sites, which is typical of qualitative case study research (Eisenhardt, 1989).

While the CEO of EDTech had visited one of the RCSs identified within the sample; the researcher was the first individual to spend more than one or two days at each school. The researcher in this scenario very quickly became a key vector of user level feedback to EDTech/IMA from the RCSs and additionally, being an ‘outsider’ to EDTech allowed for some degree of impartiality as issues users raised about EDTech were not taken personally – as staff of EDTech may be inclined to. Therefore, the field sites which formed the cases were purposively selected so as to represent different aspects of the same phenomena, while facing many similar issues (C. B. Meyer, 2001).

Key informants were identified based on those whom, in the first 2 days of each encounter, relationships with the researcher had developed rapport and presented ‘interesting cases’ based on a number of factors. In the case of teachers factors identified were expressed interest and varying degrees of experience in utilising technology within the classroom and/or identification as ‘the best teachers’. Therefore, additional to the theoretical sampling approach used to identify field sites and cases, individuals were also selected for the qualities they possess and the routines they enact.

Learners in RCS-A were selected for participation in group interviews based upon those who were available after school; were willing to participate; and generally if some level of rapport and trust developed. In RCS-B, learners were selected with the technology facilitator due to the limited time available within the school. These learners didn’t appear to be particularly representative of their peer group. However, given their higher relative socio-economic position at home, this builds aspects of accounting for heterogeneous lived experiences of participants and ensuring a broad representation of backgrounds are accounted for in such diverse research settings.

3.2.2 Population and Data

The numbers of informants and the kinds of data obtained within each field site is shown in table 3. The principal in RCS-A was not available for formal interview during the time spent at RCS-A school due to external responsibilities and commitments. However, as the researcher stayed next door to RCS-A’s Principal, with their sister during the fieldwork in RCSs, there were many informal conversations and other opportunities to engage with RCS-A’s Principal.

3.3 Research Design

Research was designed in partnership with EDTech/IMA CEO/Principal to develop research that was useful to EDTech/IMA and relevant within the academic literature of the study. Research

methods chosen were qualitative to build a rich picture of users' decisions to (not) use EDTech and technology more generally.

3.3.1 Data Collection Methods

Due to the need for EDTech/IMA to understand the factors surrounding limited/non-use of EDTech within RCSs, qualitative methods were selected. These were semi-structured interviews; observations; reviewing EDTech/IMA reports. This approach has been used in various combinations by other similar studies in technology within organisation studies (Orlikowski, 2000; Orlikowski & Gash, 1994); applying a 'practice lens' in education technology research (Halperin, 2017; Halperin & Backhouse, 2007); sociological research in education technology (Johri, 2011); and research into hybrid organisations management of dual objectives (Battilana & Dorado, 2010).

3.3.1.1 *Semi-Structured Interviews*

Semi-structured interviews were selected as a viable method for data collection within this research as they provide a certain flexibility allowing the probing of factors which had previously not been considered (Barbour & Schostak, 2005). Gioia, Corley, & Hamilton (2012, p19) write that semi-structured interviews provide ways to access "retrospective and real-time accounts by those people experiencing the phenomenon of theoretical interest". The flexibility offered by semi-structured vs. structured interviews allowed the researcher to explore issues that emerged organically throughout the interview, particularly when teachers were discussing negative aspects of EDTech.

Because the research question seeks to explore limited/non-use of technology; employing this research method allows the researcher opportunities to engage directly with potential/intended users of the platform.

RCS-C was the first RCS involved within the study. Due to issues such as time and the extra classes being provided in order to finish the curriculum prior to exams, it wasn't possible to find learners to individually engage in research. While the majority of interviews were conducted on a one-to-one basis; in the case of RCS-A and RCS-B learners were generally interviewed in groups. This was due to issues in time available vs. a desire to maximise the number of learner voices captured. The group based learner interviews provided additional advantages such as learners being able to speak with each other in xiTsonga to re-explain in home languages, the nature of the researcher's questions.

The issue of using group based interviews, it should be noted, is not the same as focus groups – particularly as this particular data collection method did not consider group interaction as part of the methodology (Kitzinger, 1995). The researcher used this simply as a method to gather multiple perspectives, therefore, these are considered group interviews, not focus groups. Here, research flexibility is mentioned by Eisenhardt and is viewed as “controlled opportunism” (1989, p. 539).

All semi-structured interviews were recorded with prior informed consent and subsequently transcribed once the researcher had returned from field sites after the research period.

3.3.1.2 Observations and Research Diaries

Observation data is held within diaries kept by the researcher to “provide first person accounts of social situations... they provide insight into situations and activities” (Burgess, 1981, p81). Field notes were organised through both handwritten notebooks and through the cloud based notes management software ‘Evernote’. The latter was used to allow the researcher to keep research data safely stored on the internet in a private form. The main reason for cloud based organisation is the synchronisation between multiple devices.

In line with Singleton and Straits (2005; cited in Sangasubana, 2011); observations were recorded in a diary each dealing with a particular kind of observation and insight. These are: Running Description; Forgotten Episodes; Ideas and Notes for Further Information Use; Personal Impressions and Feelings; and Methodological Notes. Labelling the diary under different headings allows the researcher to organise findings for later retrieval. Observations held in Evernote were mostly recorded in the evenings when the researcher had left the field while handwritten diaries allowed the researcher to observe and take notes without having to worry about battery power of the laptop or tablet.

Observation data includes pictures, videos, printed documents provided to the researcher and lengths of written prose, which recall informal conversations, and occurrences/thoughts that seem potentially useful. Some have used field notes extensively, such as Burrell (2012), while other have used it as part of their research instrument arsenal (Donner et al., 2011).

In order to enhance the richness of data collected and arm the author with a broad range of data sources; photographs were taken during research. These are presented periodically throughout the results to show readers, particular screenshots and interface designs, and the configurations of technology within classrooms and ICT centres. Recent work on education technology employing a

qualitative, ethnographic, multi-case study approach included the use of photographs in order to develop “a substantial corpus of empirical data” (Selwyn, Nemorin, Bulfin, & Johnson, 2017, p. 290)

3.3.1.3 Reviewing Annual Reports, Funders Reports, and Other Documents

Annual Reports of IMA (publicly held) and some private reports by EDTech/IMA to funders (provided by EDTech/IMA management) were used to build a picture of the design and development process over time of each constituent organisation of EDTech/IMA and the development of the EDTech platform over time. These were mainly used to gain a holistic understanding and to compliment information provided by EDTech/IMA management and staff. These reports were analysed in combination with interviews conducted with CEO/Principal of EDTech/IMA and informal conversations with board members. Such an approach was used by Haplerin, and aided in the generation of thick description (2017).

3.3.2 Research Instruments

The semi-structured research instruments were developed initially prior to entering the field and trailed with one participant; then revised; and rolled out as similarly carried out by Appleton (1995). An extract from the interview guideline is presented in Figure 5 (below) where a broad topic with supplementary questions, where felt appropriate by the researcher, to add depth to answers already provided.

Interview	Principal	Education and Technology
Data to Gain:		
<ul style="list-style-type: none"> To explore your leadership of the school To explore the role leadership plays in introducing technology into schools Understanding this school's culture Exploring successes and challenges faced by this school 		
Questions		
1	How do you describe this school to your colleagues?	
	<i>What are the most important things to say about your school?</i>	
	<i>What is your vision for this school? (plan to achieve this, important stages)</i>	
	<i>What are your personal achievements within this school?</i>	
2	How would you describe the school's culture?	
	<i>What makes your school unique?</i>	
	<i>How would you describe your school's culture? How does it compare to others?</i>	
	<i>What best motivates your teachers and learners to excel?</i>	
3	What are your goals in using technology within this school?	
	<i>Tell me about the 'paperless environment' in the computer centre.</i>	
	<i>What are the benefits of using technology within your school?</i>	
	<i>How do you motivate teachers to use technology?</i>	
	<i>How do you approach teachers who might be scared of technology?</i>	

Figure 5 - Extract From Principal Interview Guideline

In each interview, the researcher showed the interviewee the schedule or explained the main question and their intentions and then the first question was always rapport building, to 'ease the participant in', and generally, interviews were concluded on positive points (Heights, 2008). Additionally, the researcher always asked participants if they had any questions or points to add. When the offer was taken up, some participants said they found the interview insightful for unpacking their thoughts and often would then turn to asking more about the researcher's personal life, background, or their perception of the experience.

3.4 Data Analysis Methods

Data was analysed inductively through the use of NVIVO software and drew on the work of (Gioia et al., 2012). Each interview, once transcribed, was re-listened to (to hear as espoused); re-read and coded.

These initial codes were specific given the context of each interview and field site however, through following the process of developing 1st order themes using, as much as possible, references to the language used by informants. This converted roughly over 200 'raw' codes into 1st order themes

where each initial code was considered in relation to others. The author experienced a sense of being “lost” as outlined by Gioia, et al. (2012, p. 20) – an important aspect of the process.

Many of the early, raw codes were over 4 or 5 words and thusly were not as succinct. In generating 1st order themes, the researcher read through the list of nodes/ ‘raw codes’ and began to re-label them. There were cases throughout this process where nodes with longer codes were clearly linked such as issues identified with EDTech App. In this example, these were aggregated under newly created themes and sub-themes recognising that issues with the EDTech App all impacted teaching and learning but in different ways. Thus, ‘raw’ nodes were generally consolidated into 1st order themes iteratively; but in some cases the initial labels were retained to cater for nuanced appreciation at later stages of interrogating the codes.

From here, a level of theoretical abstraction was pursued by using the contextual and broad insights, impressions, and reflections of the researcher from the field to begin to draw first order concepts into broader, more encompassing 2nd order concepts. Moving a step away from the interview transcripts and diaries to consider the relationships between ideas discussed with informants, the researcher began to use their detailed appreciation for the broader encounters within the field sites.

From considering these abstracted 2nd order themes, connections and common threads running through the 2nd order themes, distinct categories were developed – these are termed ‘aggregated dimensions’ (*ibid*). At this level of abstraction, the researcher began to theorise, draw comparisons with the literature in a more systematic manner and at this stage, tended to depart from the grounded theory model. The researcher’s aim here was to capitalise on the academic rigour, but allow for data to add to existing theories of the practice lens in education technology and education technology non-use more generally.

The resulting data structure after following this process are found in figure 6, below. The data structure was used in the construction of the three main subsections of section two of the results chapter. The analyses of structural modalities are presented in the sequential manner starting with facility, named technological conditions; followed by the norms, named institutional conditions/factors; and lastly, the interpretive schemes, named ‘individual factors’.

The presentation of no-fee school data is presented in this way to capitalise on the work developed in applying the structural practice lens (Orlikowski, 2000) in the context of education technology (Halperin, 2017; Halperin & Backhouse, 2007). Given the large volume of observation

based data, ‘technology in practice’ was observed and typically the interactions between individual users and their chosen technology are represented through the second category of ‘experiencing technology in education’.

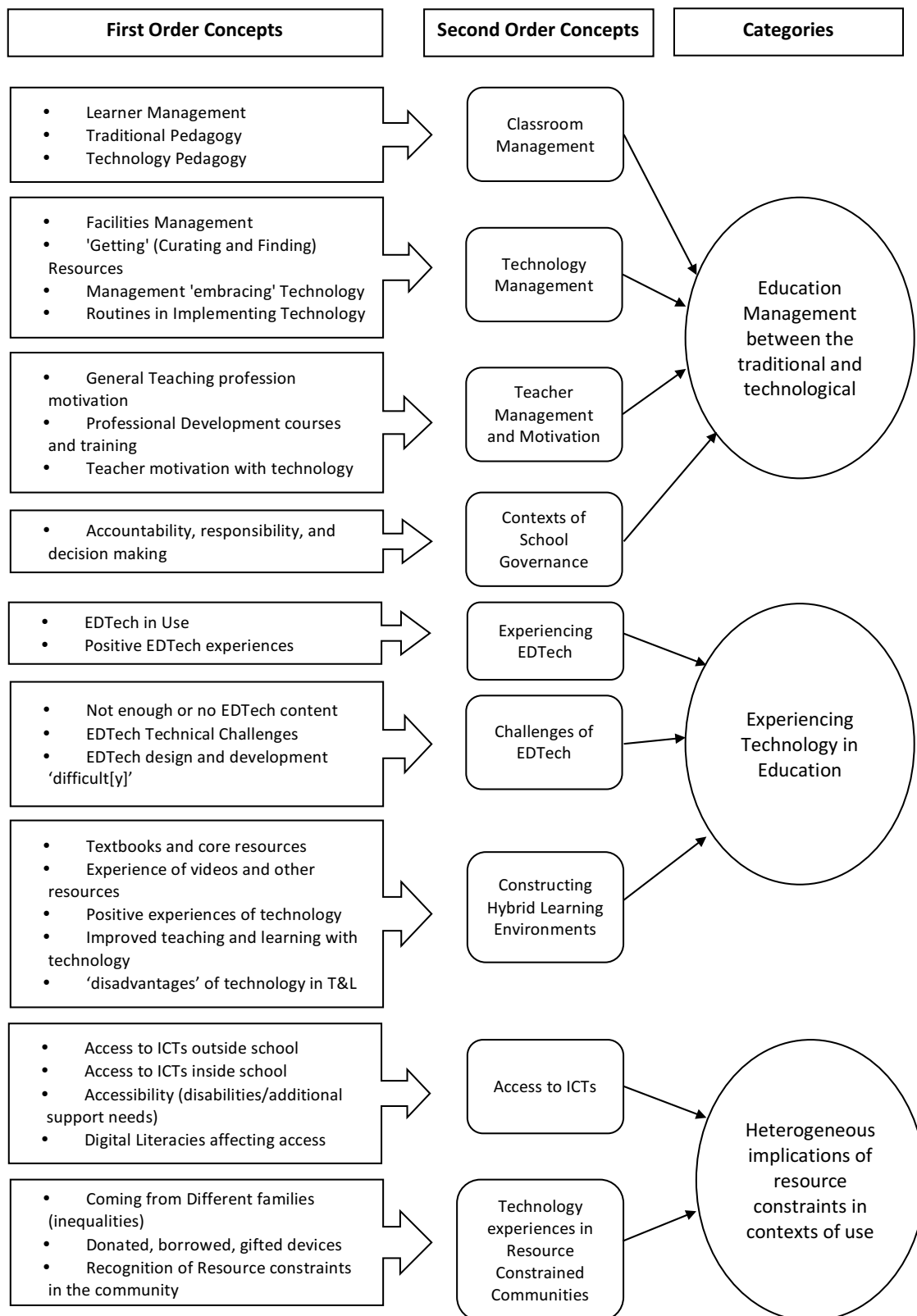


Figure 6 - Data Structure After Coding

3.5 Validity Considerations

“Triangulation is a validity procedure where researchers search for convergence among multiple and different sources of information to form themes or categories in a study” (Creswell & Miller, 2000, p. 126). This study used three different qualitative sources: interviews with multiple stakeholders; passive observation across field sites; and documents including reports, memos and contracts. In order to minimise researcher bias, particularly in the interpretation of results, corroborating each of these sources with each other provided an advantage rather than relying on one method or form of data (Creswell & Miller, 2000).

However, scholars such as Denzin (2012, p. 82) write critically about the conflation of triangulation, mixed methods, and the dilution of the term from when “triangulation referred only to the use of multiple forms of qualitative research methods, not the combination of quantitative and qualitative methods”. It is specifically in this way that triangulation is referred to— as a vehicle to add “rigour, breadth complexity, richness, and depth to any inquiry” (Denzin, 2012, p. 82).

In triangulating these three sources of data; three mini case studies of resource constrained schools were compiled and compared these with the organisational context of EDTech/IMA; an aspiring education innovator and sought thicker description from broad data sources. In accounting for multiple perspectives from multiple sources, the researcher expected that differences of opinion and perspectives. In the context of understanding why the technology EDTech was not utilised nearly as much as was hoped, triangulating data sources allowed the researcher to uncover “disconfirming evidence” (Creswell & Miller, 2000, p. 127). This is reflected throughout the results, discussion and conclusion chapters where varying perspectives on EDTech’s strategy and product are presented. Antecedents of limited/non-use in the eyes of informants are compared and contrasted with each other and EDTech management. Such disconfirmation conveys different perspectives of the positives and negatives of EDTech in practice and limited/non-use.

3.6 Presentation of Results

Results are presented in the next chapter and deal with both contexts of IMA and the RCSs separately, then compare and contrast the findings of both. Results are presented ethnographically and discussed in terms of the data structure emergent through the data analysis conducted. In viewing informants as knowledgeable agents with their own interpretations of the context in which they operate (either teaching or learning) provides the researcher with user based accounts and observations of practice.

As a point of uncovering assumptions engrained within EDTech/IMA management; highlighting contextual differences is important as this seeks to provide clarity and key contradictions present in the EDTech/IMA rationalisation of exogenous-only factors affecting the failed trial of EDTech. Additionally, drawing on the practice lens stipulation that ‘structures are instantiated in practice’ (Orlikowski, 2000); by viewing limited/non-use (practice) through this lens alternative conceptions of potential avoidance or limited use can be uncovered.

3.6.1 Structure of Results

Results are structured in two main sections. The first introduces the data from EDTech/IMA office where the researcher spent time observing management dealing with issues with EDTech and managing the IMA space where EDTech was the principal medium of theoretical content delivery. However, given the large volume of data collected over this research experience; a relatively small number of salient quotes are extracted for illustrative purposes in the dissertation.

Data for this section comes primarily from annual reports of IMA (which also detail EDTech’s development over time); interviews with senior and long term members of staff; observation data; and informal conversations with board members and other stakeholders.

The results from RCSs are presented through the structurational modalities, following the structure outlined by Halperin and Backhouse (2007) to explain limited use of technology within educational settings. These structurational modalities were evident at many stages throughout the research process and within each modality; specific issues emerged which led to the development of an empirical model presented in figure 15. In this model, structurational modalities are broken down into different categories and sub-categories, which are then explained sequentially to build up a clear picture of practices observed within the field sites.

In cases where no use of EDTech was present, the researcher took the opportunity to observe other uses of technology within schools and consider the ways teachers explained their non-use of EDTech through discussing why they chose other technologies to implement in class. In the second section of the results chapter; photographs are used more frequently to assist readers unfamiliar with resource constrained schools like those involved within the study to see rather than read the data.

The presentation of results in two principal sections allows the author to convey two alternative accounts of poor utilisation of EDTech which can be compared, contrasted and subsequently insight drawn from divergence of perceptions.

3.6.2 Coding Strategy of Informants

No individual is referenced by name and all informants are referred to by codes. The coding structure is explained in table 4 (below).

Table 4 - Informant Coding Strategy Table

EDTech/IMA Informant Coding Scheme			
<u>1st character</u>		<u>Suffix</u>	
'E'		'CEO' or 'DBA' or 'BM'	
E Refers to someone within EDTech/IMA organisation		Refers to the informants' role within EDTech/IMA CEO = Chief Executive Officer (of EDTech) DBA = Database Administrator/trainer BM = Board Member (of IMA)	
RCS Informant Coding Scheme			
<u>1st character</u>	<u>2nd character</u>	<u>3rd character</u>	<u>4th character (as required)</u>
'R'	'A' or 'B' or 'C'	'P' or 'T' or 'L' or 'F'	<i>Informant Number (for n>1)</i>
R refers to an individual within a Resource Constrained School	This letter refers to the specific RCS an individual was aligned to	This refers to the role of the individual within the RCS. P = principal T = teacher L = learner F = facilitator	The 4 th character distinguishes between two or more informants with the same role in the same school. These numbers are assigned randomly and do not necessarily reflect seniority
<p><i>Examples:</i> E-CEO refers to the CEO of EDTech E-DBA refers to the database administrator of EDTech/IMA E-BM refers to a board member of IMA</p> <p>RAT1 refers to the first teacher within RCS-A RBF refers to the facilitator in RCS-B (there was only one facilitator in RCS-B and none in other RCSs) RCP refers to the principal in RCS-C RAL2 refers to the 2nd learner in RCS-A</p>			

4 Results

This chapter of the dissertation outlines the empirical data and is structured in two main parts. The first section outlines the organisational context of EDTech/IMA as a hybrid organisation/social enterprise. This is followed by a brief on the development process of the EDTech technologies. Lastly, it shows the perspectives of EDTech/IMA management on the failure of EDTech to be integrated into teaching and learning within schools as expected.

The second section of this chapter provides accounts from RCSs on their use of technology in general and probes the varying degrees of EDTech utilisation. As none of the schools observed used the technology as EDTech/IMA had expected (RCS-C didn't use it at all). There are significant differences in opinion of the EDTech platform between the organisation and its users. This mismatch in interpretations of EDTech reveal broader issues relating to teachers use of ICT in teaching and learning; the context of education technology within RCSs; and the importance of designing *with* users and not *for* beneficiaries.

4.1 EDTech Pty. Ltd., IMA, and EDTech Technologies

EDTech was designed to be owned by a for profit entity (a Pty. Ltd. registered company) who could monetise the technology to provide an additional revenue stream for IMA (combined, they are a social enterprise). Monetisation would come through a variety of possible avenues. These include tenders to implement and maintain the platform; generic donations to IMA from individuals, business, or other agencies; other organizations donating 'digital learning centres' to resource constrained communities; or alternatively funding development of particular 'digital learning content' such as maths or physical science. Private companies can do so as fulfilment of Corporate Social Investment/Responsibility [CSI and CSR] obligations or for tax relief.

Implementation of each of these options would be subcontracted to EDTech Pty. Ltd. from IMA with a profit margin added. This is one of the benefits to social enterprises of South Africa's liberal approach to the third sector.

As EDTech (the technology) became more substantial in terms of content and learning developed by and for IMA – EDTech Pty. was established. This allowed for a social enterprise structure to emerge through the close links between IMA (a registered NPO) and EDTech Pty. Ltd. shown in figure 7 (below). This shows the various external and internal actors/stakeholders and flows of value between actors/stakeholder

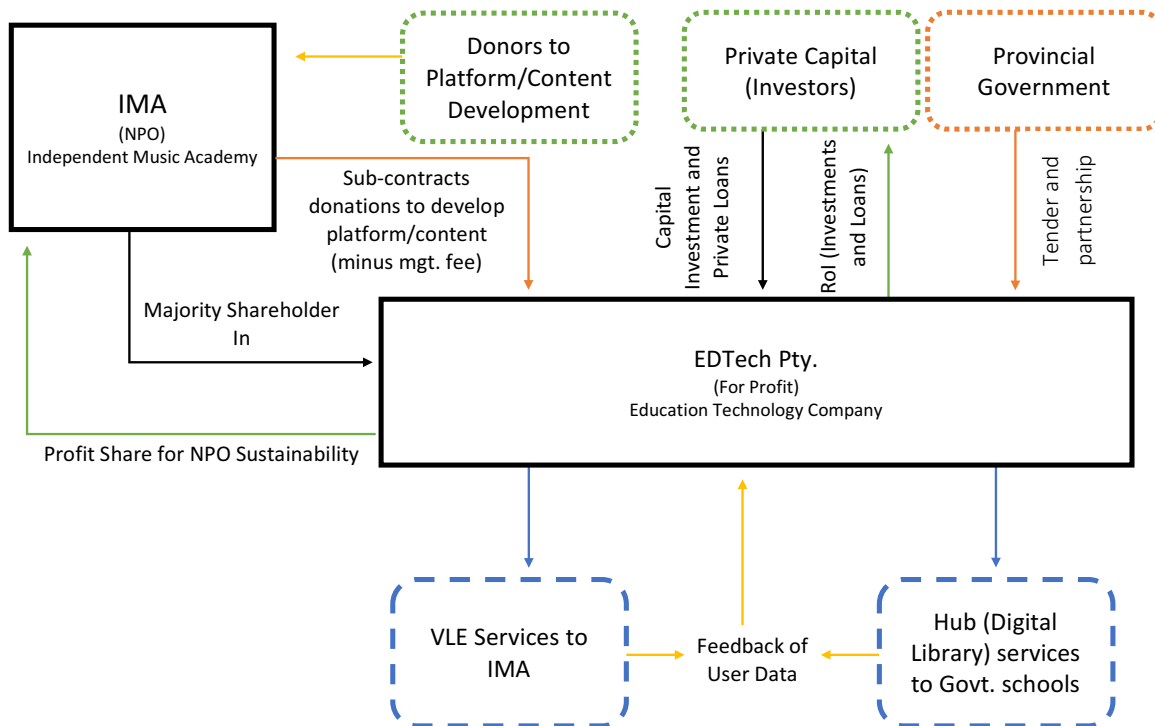


Figure 7 - Social Enterprise Structure with value flows (Author's Own Diagram)

The social enterprise structure (linking a non-profit entity to a for-profit entity) allowed the organization to seek private capital investment and private loans to supplement donations/grants (with the expectation of repayment plus interest). Additionally, EDTech (at the time of writing) is in the process of gaining a government tender to implement the system and training across Mpumalanga schools (reflected in a tender authorised, but not yet released, by the Department of Education).

“The reason we went into the educational programme [in resource constrained schools] was to offer free maths and science [resources] to the kids in the rural spaces we were [working with] ... and by doing this [we thought] we will probably get more [governmental, private sector, and third sector] funding”

Interview 2 with E-CEO

This is to say, the development of the EDTech system was initially started with a view to positively impact on the learning opportunities for learners who attended their drop-in music hubs. This is an important consideration to bear in mind as this enables a more grounded understanding of any enactments of the EDTech platform outwith the IMA structure.

EDTech Pty. Ltd. and IMA operate as a hybrid organisation with the aim of facilitating digital education in Mpumalanga. The aim is to deliver digital education in two broad reaching, substantially different programmes. One is a drop-in creative arts programme where young people can attend free music tuition training partially delivered through the EDTech platform. Secondly, they aim to increase funding for the creative arts programme through a for profit venture to deliver digital, multimedia learning content in government schools where the EDTech product is sold to schools via the MDoE. Both are seen as socially valuable projects by EDTech/IMA; but are differentiated in part through the dual organisational structure (a for profit company part owned by a non-profit organisation).

Depending on the perspective taken on EDTech/IMA as a hybrid organisation; if EDTech is considered a for-profit social enterprise in its own right: clients of EDTech are also beneficiaries. They could be considered individual schools who invest in EDTech's products and would therefore be considered a blending hybrid.

'Value spillovers' from utilisation of the EDTech platform would therefore be contingent on the ability of individual teachers within a facilitating school environment to enhance education through digital education. Such dependence on teachers' willingness to change practices and ensuring schools are facilitating environments for such change may prove costly in terms of training and support. Furthermore, ensuring sufficient rhetorical work to ensure such a vision for change is internalised by all stakeholders external to EDTech may prove difficult. This is in keeping with practice based accounts of technology where determinisms are rejected to prioritise the intricate roles individuals play in enacting technology within the context of organisations (Orlikowski, 2000). Were value spillovers automatic in education technology; research into education technology would not be marred by the disparity between rhetoric from technologists and failure often experienced in education technology projects.

However, EDTech should be considered alongside the additional creative arts and music tuition programmes of IMA.

For IMA to achieve its social objectives; focus, and financial and human resources must also be dedicated to ensuring the successful implementation of these programmes. This would result in EDTech being classified as a coupling hybrid where the clients are the individual government schools integrating EDTech into their teaching and learning; whereas beneficiaries are learners

attending the after school music programmes. Importantly, clients and beneficiaries completely separate resulting in two independent value streams (Santos et al., 2015).

As such, the complexity of the organisational structure and its various projects is heightened. This is explored in the context of the conceptual model presented in figure 4, balancing financial and social objectives has implications on mission drift and the trio of objectives increases the risks of the multiple objectives trap.

After multiple, multi-million rand grants and service delivery contracts from the MDoE and private capital investment in EDTech Pty.; there is real potential for the technology to become imbued in the tensions highlighted in figure 4. These tensions could be expressed through a conflict between funding their creative arts programmes; adequately resourcing the development and implementation of the EDTech platform within schools; and ensuring that the EDTech platform achieves improved education results which reflect the social and financial investments made in it.

It is important recognise the multiple, competing institutional logics of EDTech/IMA and the complex relationship management required for success; given the increased complexity in managing a hybrid organisation with two independent value streams (Santos et al., 2015). This requires perspectives from within both fields in order to strive for such dualistic organisational objectives.

Given the intention for EDTech to become a sustainable source of income for IMA; and the competing objectives of delivering effective digital education in government schools (and doing so profitably) while using this funding to deliver drop-in after school music education; as a hybrid organisation; EDTech/IMA run the serious risks associated with such complexity.

Now faced with almost wholesale avoidance at worst and limited use at best, EDTech/IMA arguably is struggling to reconcile such complexity and are waiting for both a financial and social return on the investments made into the digital learning platform. The risk of mission drift away from the original founders' mission to provide effective, free music education towards a complex mix of social and financial objectives, accountabilities, funders, and stakeholders is potentially only being realised now. Such a mission drift is a result of being overambitious with the organisational competencies and as such being caught in the multiple objectives trap (Garrette & Karnani, 2010; Wach, 2012).

4.1.1 Moving from Informal Music Education to Government School Education

To understand the transition from a focus on informal music education to developing a multi-million rand blended learning platform; it is important to view such a journey through time as captured in annual reports from IMA.

The original mission of EDTech from its inception “was intended to deliver music content to our members in our Hubs. The initial focus was to develop Music Theory, Guitar and Recorder.” (IMA Annual Report of 2013). IMA music hubs are informal music education programmes that were situated in existing organisations, mainly within townships and acted as spaces to provide access to music education in an after school youth club setting. Over time, however, the mission developed “to enable IMA to provide a better service to its members including the delivery of educational content which is lacking within their schools, such as mathematics and science.” (IMA Annual Report of 2012). This is rooted in the perspective that “music supports education outcomes and is good for the spirit” (IMA Annual Report of 2014) and a recognition that learners may not have access to learning resources in the communities where IMA operates hubs when compared with fee-paying schools.

When this is read in conjunction with the previous interview extract of E-CEO, the IMA annual report of 2013 explains:

“We are confident... that [EDTech] has the potential to raise significant funding for IMA through sponsorship (marketing budgets) and social investment budgets from organisations who are keen to improve education standards in South Africa.”

(IMA Annual Report of 2013)

In facing this market pull (where the market is conceived as revenue streams for IMA) at the expense of mission stick (Rangan, 2004); IMA subsequently focussed significant resources in the development of EDTech, with evidence of this at the expense of valuable resources available – both in terms of demands staff (management and operations employees) but additionally financial resources.

“In 2014, IMA continued to deliver its music program through its existing hub structures [drop-in music centres within township communities]. EDTech, our management and training program, consumed many of our resources in 2014.”

(IMA Annual Report of 2014)

As the ideas of lucrative funding became increasingly real; IMA signed a contract with the Mpumalanga Department of Education (MDoE) to develop content for 10 of the most taught subjects within the province. A combination of governmental grants; national lottery funding; private sector tax deductible donations; and private investor loans were gained in order that IMA may develop a solution for schools to address shortfalls in South Africa's government school system.

This, another example of both market pull (funding opportunities) and further redefinition of the organisational mission can be thought of as the point at which EDTech as a project of IMA, started to become a semi-independent organisation on its own. This is an early indication of potential mission drift as IMA's desire to become a self-sustaining NPO saw them embark on a long and tumultuous journey; combining the technology start-up institutional logic with a music education logic; and an education development logic.

As part of the social enterprise set-up, IMA is a majority shareholder (60%+) of EDTech. In return for IMA's ownership, profits gained through successful growth and development of EDTech would be invested into the music education programme because "the arts are incredibly difficult to fund. This is an opportunity for us to gain alternative income streams" (Informal conversation with E-CEO).

In signing the contract with the MDoE to deliver such a massive project, EDTech/IMA management envisaged the platform becoming "an important educational tool in the province of Mpumalanga... we plan to expand the reach of EDTech to the whole country." (IMA Annual Report of 2014). The mission of EDTech Pty. Ltd. (although a private company) became imbued in a political project to "become leaders in blended learning and developing a pathway to flipping the African classroom" (IMA Annual Report of 2014).

While hybrid learning or blended learning is generally regarded internationally by protagonists of education technology and its innate, deterministic outcomes; such assertions are generally based upon rhetoric as opposed to reality (Selwyn, 2010, p. 66). There are many dangers in assuming that "the African classroom" is in need of flipping. This includes, but is not limited to: the view that all African schools are the same; that centuries of oppression and colonisation, and decades of Apartheid can be addressed by digital technology (Mercer et al., 2003); and that "improving teacher productivity" (IMA Annual Report of 2014) is necessarily fulfilled through technology subverting

the role of teachers from “professionals” to “day labourers” (Hodas, 1993, p. 5). The latter, of viewing teachers solely as vectors of measurable units of knowledge, creates the inevitable outcome that economic views of efficiency posit teachers as “the weakest link in the chain” (Hodas, 1993, p. 8). This partly explains why videos, as the main mediums of instruction through EDTech’s ideal enactment, were so emphasised as a headline feature and benefit of the platform.

4.1.2 Design and Development of the EDTech Platform

Initially, the content and functions provided by EDTech (the technology) were focussed on managing hubs – IMAs after school music education programs situated in peri-urban townships and one in a boutique shopping centre just outside White River. The management of hubs relates to tracking attendance; delivering learning content and assessments (initially for music only); and managing events – the latter being a previously sought after source of self-generated income for IMA (indicated in many of the IMA annual reports).

4.1.2.1 Developing and Curating Non-Music Content for EDTech

Development of the platform (mainly in terms of broadening available content), helped push the project towards the project of a free, ‘cloud-based classroom’ for all South Africans. This took place between 2013 and 2015 in two phases:

1. Providing content for Mathematics, English (First Additional Language), and Physical Science (2013)
 - a. Using twelve employed teachers to curate existing content and where necessary develop in-house content
2. Providing content for thirteen ‘Major Enrolment Subjects’ such as Accounting, Economics, Mathematical Literacy, Life Sciences, etc. (2014/15)
 - a. Using fifteen employed teachers to curate existing content and where necessary develop in-house content

In conversations with a board member of IMA, it emerged that the specific financial remuneration structure for employed teachers did not foster a comprehensive approach to the curation of content.

“[The curators] would pick the ‘low-hanging fruit’ tasks and avoid the more time consuming tasks. There were issues with quality assurance [QA] of the resources. Because of how they were getting paid, some modules for a specific grade and subject lacked the quality, depth and appropriacy for use within [the schools we operate in]. They [the curators], were paid before QA

issues emerged. So they had no motivation to revise content issues as they had already been paid.”

(Informal conversation with E-BM1, 2017)

As teachers were employed on a module by module basis, payments were made for the completion of modules, rather than whole grades or subjects. In each subject and grade there may be four or five modules, separated into weeks, as indicated in the relevant Curriculum Assessment Policy Statements (CAPS)¹ documents. While E-BM1 hadn't visited the schools involved within this study; they were acutely aware of some of the content deficiencies identified. However, the implications of inadequately developed content provided by EDTech are only truly appreciated when considered in relation to the experience of EDTech within RCSs.

4.1.2.2 Re-Designing the EDTech Interface

After the initial development of the EDTech platform, and the incremental addition of CAPS aligned subject material for Grades 7-12, focus began to shift to usability and interface design.

“It looked boring. [EDTech] was too complicated by then. It didn't have the face that you're seeing now... Then we could see that kids were struggling to log-in, find what they were looking for... So then we decided to have a management side and a learners' side, then things became easy.”

(Interview 1 with E-DBA, 2017)

E-DBA explained that there were fundamental changes made in terms of interface design based upon user feedback and experience from the IMA music hubs. Examples of the early interface is shown in figures 8 and 9, below.

It is clear from speaking with E-DBA, who has worked for IMA and EDTech as a dual function employee for over 5 years, that there were concerns that utilisation was hampered by the relatively poor usability of the earlier versions of the platform interface.

¹ CAPS is the current South African Curriculum structure and CAPS documents/statements outline all examinable learning outcomes. For resources to be curriculum aligned they must account for each of these examinable learning outcomes.

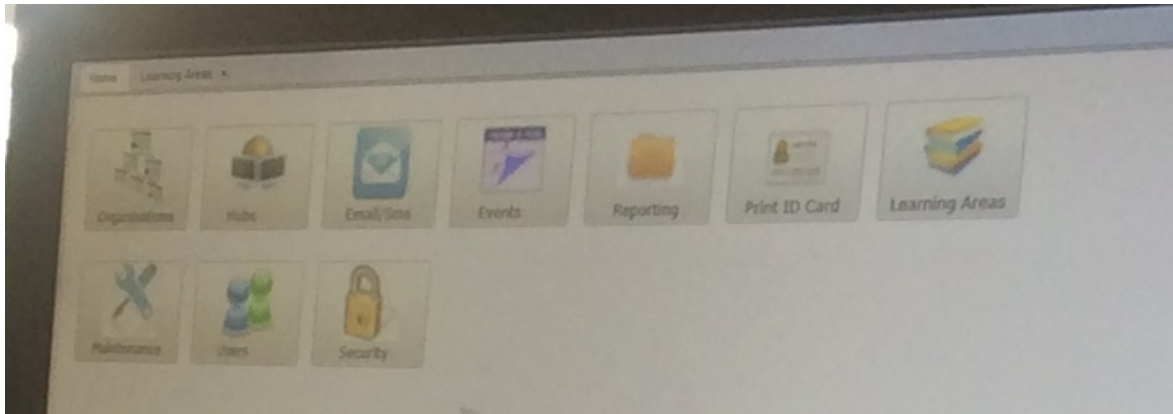


Figure 8 - Old Interface view (image 1) – Researcher’s Photograph

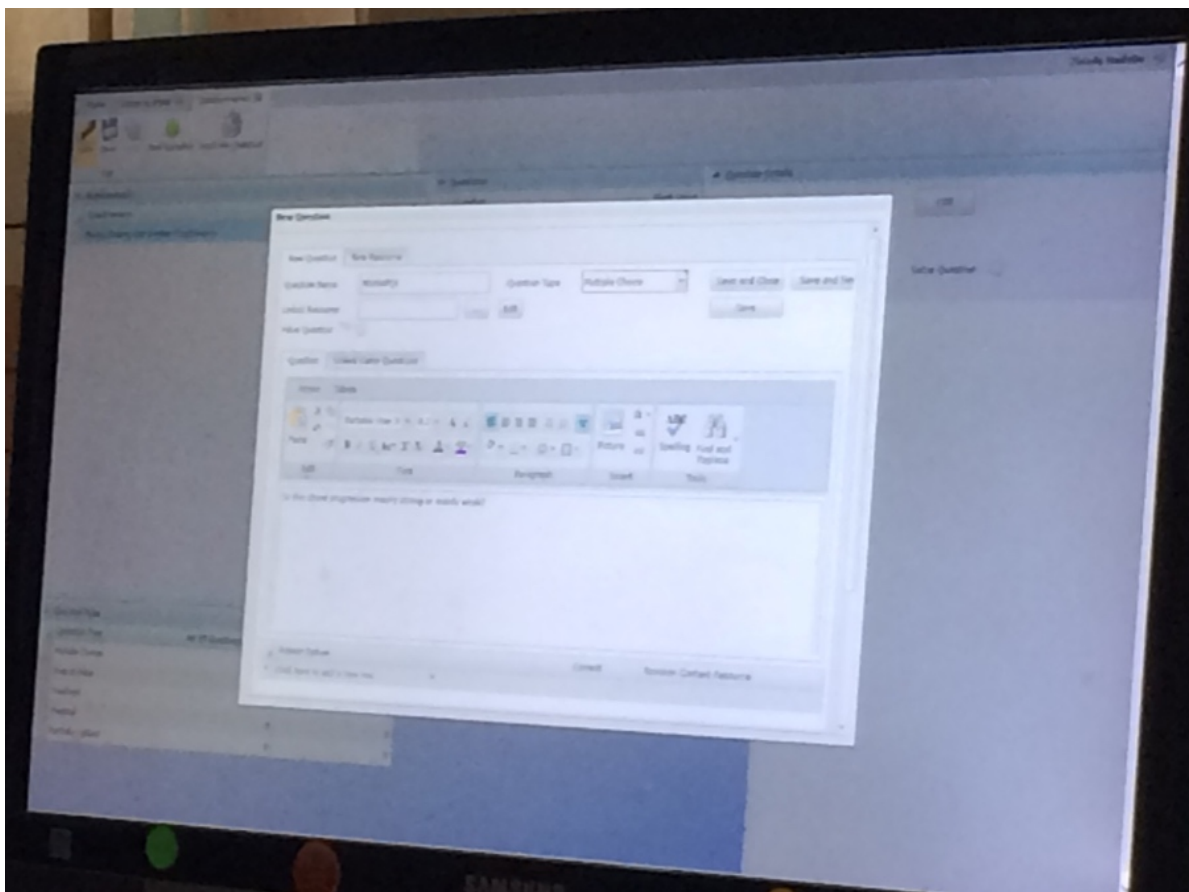


Figure 9 - Old Interface view (Image 2) - Researcher's Photograph

As figures 8 and 9 show, there wasn’t engaging or intuitive. Furthermore, the ‘database feel’ of EDTech’s early iteration shown more clearly in figure 9, provides many options within the one screen such as multiple windows, options, and access to different tables within the complex database structure. Therefore, for users commanding low digital literacies, such as learners and teachers in the resource constrained community hubs; it could be intimidating.

From this point, a new interface was designed, which mimicked the ‘tile’ interface typical of the previous Windows Mobile and recent Windows PC Operating Systems (OSs). This can be seen in figure 10² (below).

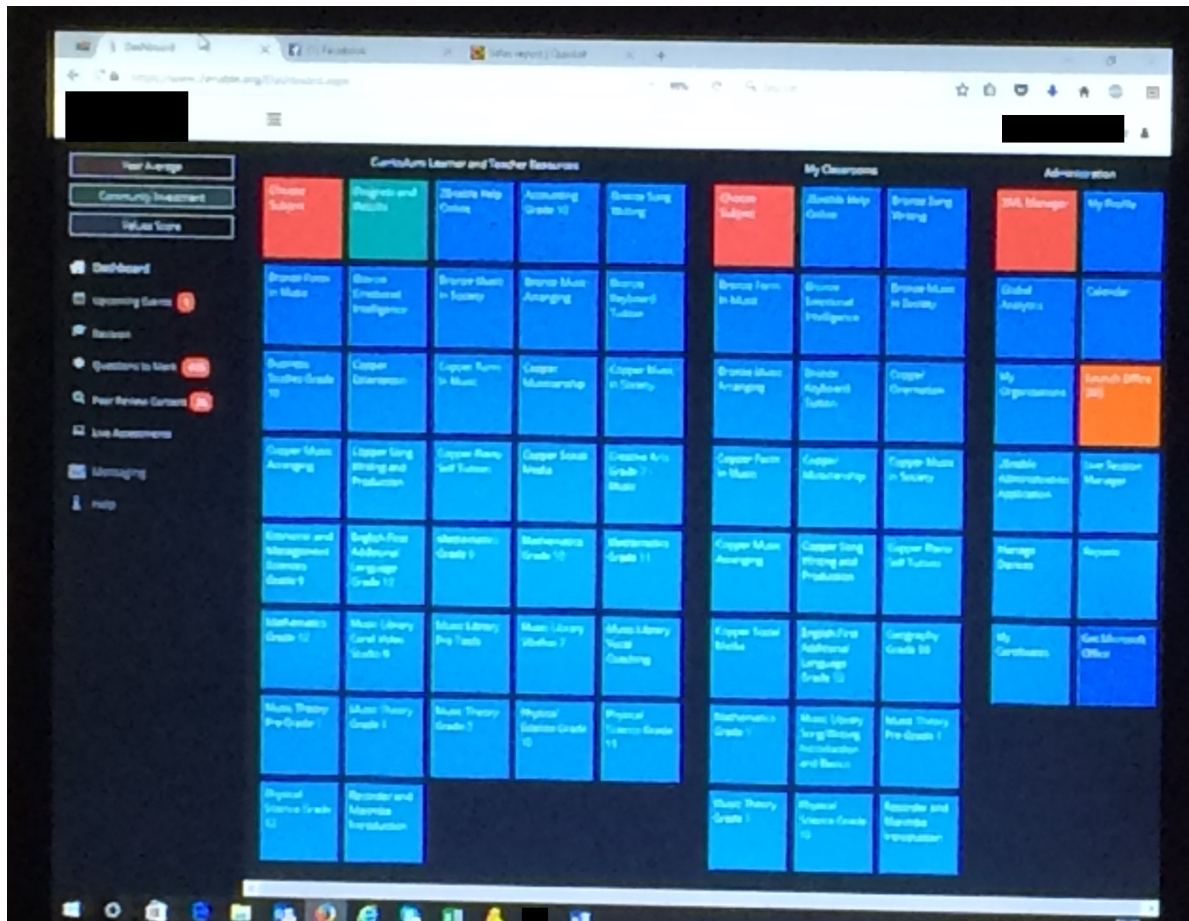


Figure 10 - New User View of ‘Dashboard’ - Researcher’s Photograph

It is important to note that this design iteration requires an internet connection and must be operated through a web browser in order to access resources, videos, instructional documents, assessments, etc. This, currently operational, version of the online software is referred to as ‘EDTech Enterprise’.

This version was developed specifically for IMA hubs in order to realise a hybrid learning environment for music tuition within the context of the series of centrally managed, but geographically spread hubs. Software modules, including online assessments and real-time user analytics, were designed to ensure consistency of tuition and identify areas where learners in

² Black boxes have been used to cover information which could reveal the logo and name of EDEdTech and the informant who was logged in at the time.

specific hubs may lack the necessary support to effectively learn and pass assessments. This has resulted in a relatively complex virtual learning environment (VLE) being developed for a specific use case – IMA drop-in music hubs.

4.1.2.3 Involvement of (Some) User Experience Feedback in EDTech Re-Design

Due to the connectedness of the drop-in music hubs using EDTech (they all fell under the management and authority of IMA), there was regular feedback and observation throughout the early development stages of the platform. This meant that as development took place, the context specific requirements of IMA music hubs were taken into account and ‘on the spot’ feedback could be gained. It is vital to recognise that teaching methods between the RCSs and IMA hubs are inherently different and the implications of retrofitting such rigid teaching practices from IMA into resource constrained may not be easy.

This feeds into other streams within existing literature as EDTech/IMA responses to failure (the limited/non-use of EDTech in RCSs) and the technologically deterministic view of technology on behalf of EDTech managers. This view of technology is exacerbated through little interest in understanding the existing nuances, routines and structures that make up the education context. This privileges the rationalisation that technology (EDTech, in this instance) can achieve certain outcomes “if used in a correct manner” (Selwyn, 2010, p. 68).

IMA was developing proprietary software in a new and growing organization; without a complex, hierarchical management structure or established/institutionalised work practices. The EDTech platform was developed alongside IMA’s practice/culture. By having the two so tightly intertwined; EDTech products and IMA’s pedagogy and learning culture were conceptualised, designed and developed with relative freedom and flexibility. This specific design context for IMA hubs did not translate to formally assessed, academically accredited, fiscally frugal, and systematically underinvested in no-fee schools typical of townships and particularly in former Bantustans. Such structural differences are partly as a result of the legacy of separate development policies during Apartheid and the issue of the fiscal inequality due to the dualistic no-fee/fee paying schools where governmental subsidies to no-fee schools fail to resemble fee income from fee-paying schools.

There was a higher degree of flexibility in terms of technical design and organization work patterns during initial development. This echoes the co-constitutive nature of technology within organizations. Although, this is more acute due to the infancy of both IMA and EDTech

technologies and how integral the technology had to be in teaching and learning within the IMA music hubs. E-CEO explains his motivation to deliver music theory education through wholly digital means:

“I don’t have enough resources even with the funding I’ve been given. I’ve got to employ a full-time teacher to lecture students as you do in a classroom setting? So I’ve had to make the conscious decision that we are using a digital platform to deliver education and that’s where it begins.”

(Interview 1 with E-CEO)

There are many spin off implications of this approach to ‘going digital’, which were revealed through the broader engagements with E-CEO during the research process. The simplicity with which he views the integration of technology in teaching and learning as a “decision at management level” (Interview 1 with E-CEO) may be acceptable when the technology is developed in-house, in a new and growing organisation. However, as the software was developed for very specific applications, in specific education contexts with non-accredited curricula; the extent to which this ‘top-down’ approach to implementation can be administered in a government school is uncertain.

This is one critical oversight made by EDTech/IMA: The direct transferability of the platform intricately designed for (mainly peri-urban) drop-in, after school music programmes to no-fee, government schools in former Bantustans.

E-CEO has a background in satellite communications and worked for years overseas, partly in the UK before returning to South Africa. As such, E-CEO is technically astute and intricately understands satellite connectivity and its practical applications. However, the remaining board members are either professional musicians who play more of an ambassador role within IMA; local business owners; one former education professional; and an accountant.

E-CEO considers all of the areas where EDTech/IMA operated to be ‘rural’; apart from the office (with a hub attached) in a boutique shopping centre. The hubs are actually operating in peri-urban townships (on the outskirts of towns and cities) within 35Km by road of the office. The RCSs are based in the rural countryside roughly 80-90Km by road from the office. This is an important differentiation to make as the infrastructure of towns and cities is more proximate to peri-urban areas than in rural areas and the proximity of the music hubs, relative to the schools studied in this

research means EDTech management and staff must travel twice the distance to observe limited/non-use.

The implications of this are broad, but are felt by EDTech/IMA in terms of the increased costs (travel time, fuel, etc.) of visiting schools involved within the trial. Additionally, E-CEO's and EDTech/IMA's homogenising view of townships through many examples in interviews, informal conversations, and in annual reports can be questioned. This is not only because of the significantly different contextual factors between peri-urban townships and former self-governing territories; but additionally, the limited experience, knowledge, and appreciation for the context of rurality and education in resource constrained settings were lacking both on the board of IMA.

As the White Paper on Local Government outlines: "the definition of "urban" and "rural" is hotly debated" (Department of Constitutional Development, 1998, p. 19) and elsewhere in the white paper it explains the importance of understanding the impact of historical processes in the wide variety of areas classified as 'rural' and their distinct, highly variable context. 'Rural' formed such a broad generalisation of areas perceived to be a mixture of non-urban, poor, townships, inhabited primarily by black people but was also particularly problematic in relation to E-CEO's labelling of black learners at IMA as 'rural'.

The conflation of rurality with township, poverty, social deprivation, a lower socio-economic status naming individuals as 'rural' is problematic, and insensitive to the nuance of black lived experiences. In one of the researcher's first interactions at IMA; E-CEO randomly selected a male, black learner as we were discussing the work IMA does with individuals from disadvantaged backgrounds and from what he described as rural areas. "As we were leaving the stage to go back to the office, someone walks past and E-CEO asks: 'Hey, are both your parents dead?'" (extract from researcher's diary). The learner was shocked, said no, and continued to walk past. But this quote emphasises the conflation E-CEO makes, primarily highlighting a lack of sensitivity for the circumstances learners within IMA come from and subsequently reducing the analytical purchase of rurality; and.

As Figure 11 (below) (Statistics South Africa, 2003, p. 3) shows, there is great complexity in evaluating an area based upon proximity to urban centres. Based upon the evidence of conflation of rurality with a myriad of other socio-economic, spatial, and historic processes; rural very quickly becomes a worthless descriptor.

EA Type	Urban/Semi-Urban/Rural	Urban/Non-urban
11 Urban: formal 12 Urban: informal 13 Urban: hostels 14 Urban: institutions	Urban	Urban
21 Semi-urban: formal 22 Semi-urban: informal 23 Semi-urban: hostels 24 Semi-urban: institutions	Semi-urban	Non-urban
31 Rural: formal 32 Rural: formal/semi-formal 33 Rural: tribal villages 34 Rural: informal 35 Rural: hostels 36 Rural: institutions 37 Rural: farms 38 Rural: tribal exc. villages	Rural	

Figure 11 - 2001 Census Area Classifications between Urban-Rural (Statistics South Africa, 2003, p.3)

When discussing issues related to rurality, E-CEO highlighted “we were able to deliver a digital education solution into rural townships” (Interview 1 with E-CEO) and additionally the annual report of 2013 read “the application can be used by rural schools to deliver meaningful educational content to any user regardless of internet availability and regardless of the physical location of the school”.

While there is most certainly a difference in the lived experience of those living townships and informal settlements (such as Langa around Cape Town) within cities and those in less urbanised areas (such as Pienaar around Mbombela, Mpumalanga) – township (one categorisation of formal settlement) is as variable a concept as rurality. Given the unique circumstances and historical processes through which each individual settlement was created or developed; differing access to services are available. Some rural townships on the periphery of commercial farms, forestry businesses, mines, etc. were created specifically to serve the needs of these white owned businesses; and were (and to some degree still are) inherently labour reserves. This is the importance of understanding the implications of historical processes on the spatial inequalities faced and a detractor of motivation for some learners’ future careers.

This explicit assumption that peri-urban townships in Mbombela Municipality and resource constrained communities in Bushbuckridge Municipality face the same challenges is a source of under appreciation of the contexts of individual communities. As such, the difficulties schools face between these two different contexts and the implications of uneven development and spatial inequality between former self-governing territories and townships is stark in many cases. Such a view, combined with the difference in institutional function (hubs as drop-in music centres and

RCSs as government, schools following an accredited curriculum); goes some way in ‘setting the stage’ for non-use within RCSs.

Because drop-in music centres in peri-urban townships were involved in EDTech’s technology design and development process; the potential for under-appreciation of the institutional context of RCSs and the centrality of the teacher in government school classrooms becomes evident.

4.1.3 Developing Digital Libraries (hubs)

EDTech, recognising the lack of internet connectivity in most resource constrained schools, developed what is called a Digital Library (also interchangeable within EDTech with the word hub).

When digital libraries are distributed by EDTech, they are branded with the EDTech logo and are pre-loaded with the full curriculum of resources (or those which have been curated) from Grade 7-Grade 12. However, instead of accessing the learning resources using the Intel firmware; EDTech developed a series of mobile and PC apps with which users must use to interact with the digital library. This was a strategic decision made by EDTech developers and management based upon the role the digital library was envisaged playing within resource constrained schools and was intended to simplify the interface for ease of use.

Due to the limited internet connectivity expected within resource constrained settings, the Digital Library operates only as a resource retrieval system. No assessments/tests are available without access to the Internet. Users can only navigate their way through learning resources structured by *Subject*, *Grade*, then *Week* to find the video and text based resources required (see figure 12 and 13 below). Critically, without Internet connectivity: no usage data is collected and either stored or transmitted to EDTech’s servers. There is no data held by EDTech of whether or how a particular device is being used, unless it is connected to the internet *and* online assessments are carried out.

When the Digital Library is connected to the Internet (either through an Ethernet or SIM card connection) this allows the hub to communicate with the EDTech ‘cloud servers’. If this networked set-up is opted for, the Digital Library works to minimise the bandwidth and data use by only downloading and uploading minimal bandwidth content such as assessment questions/answers – in theory.

It can therefore be summarised that, the Digital Library presents an opportunity for locations without internet connectivity to have access to all of the content curated by EDTech on the one device, but unless there is internet connectivity, all other features of EDTech (assessments, updates, class analytics, etc.) are not possible. However, even in the small number of cases where content is updated or fixed, in locations using the Digital Library without internet access; these updates will not happen as there is no connection to the servers where updates are held.

4.1.4 Developing Mobile and PC Apps

EDTech developed Mobile (Android, iOS, and Windows Mobile) and PC (Windows 8 and 10) Apps which offer users the opportunity to use EDTech on the devices of their choice. These were made public on the relevant App Stores in 2015.

Both the Mobile and PC Apps share a similar interface which is different to the enterprise version (with tiles – figure 10) – see figure 12 (below) for the mobile interface and figure 13 (below) for the PC interface.



Figure 12 - Mobile App Interface and Basic Navigation - (EDTech, 2016)

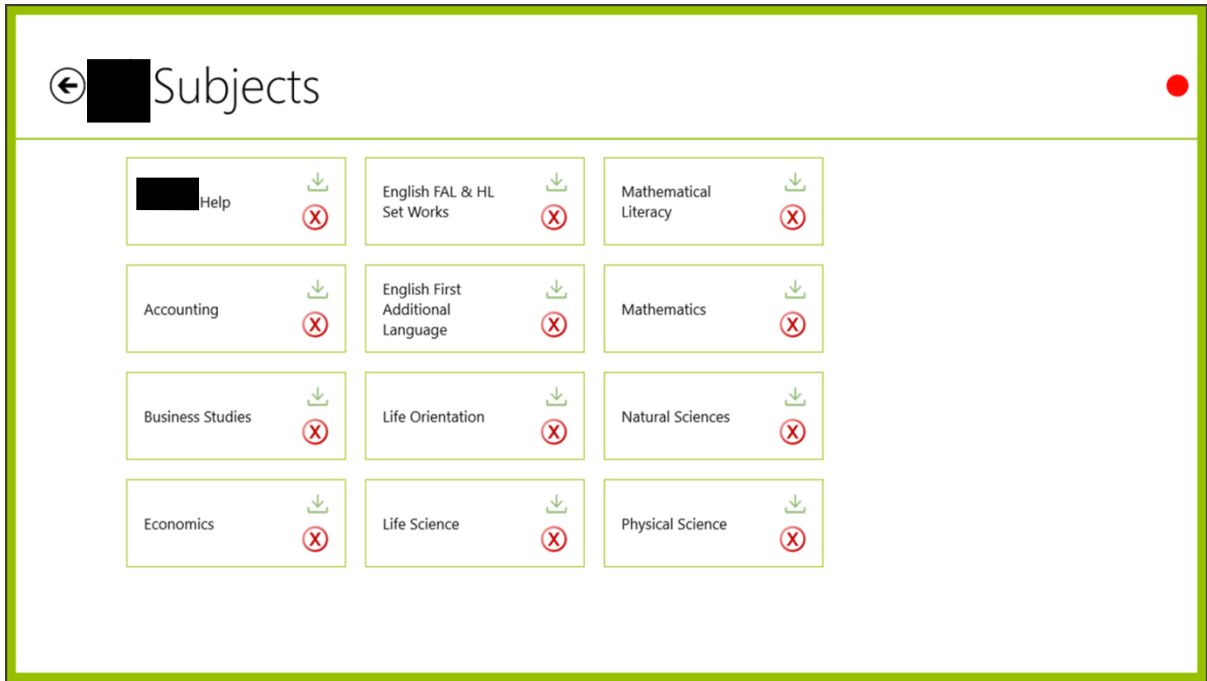


Figure 13 - PC App Interface - (EDTech, 2016)

In the App, at the top right corner there is a connection indicator and there are 4 possible “states of connectivity” (see figure 14 below).

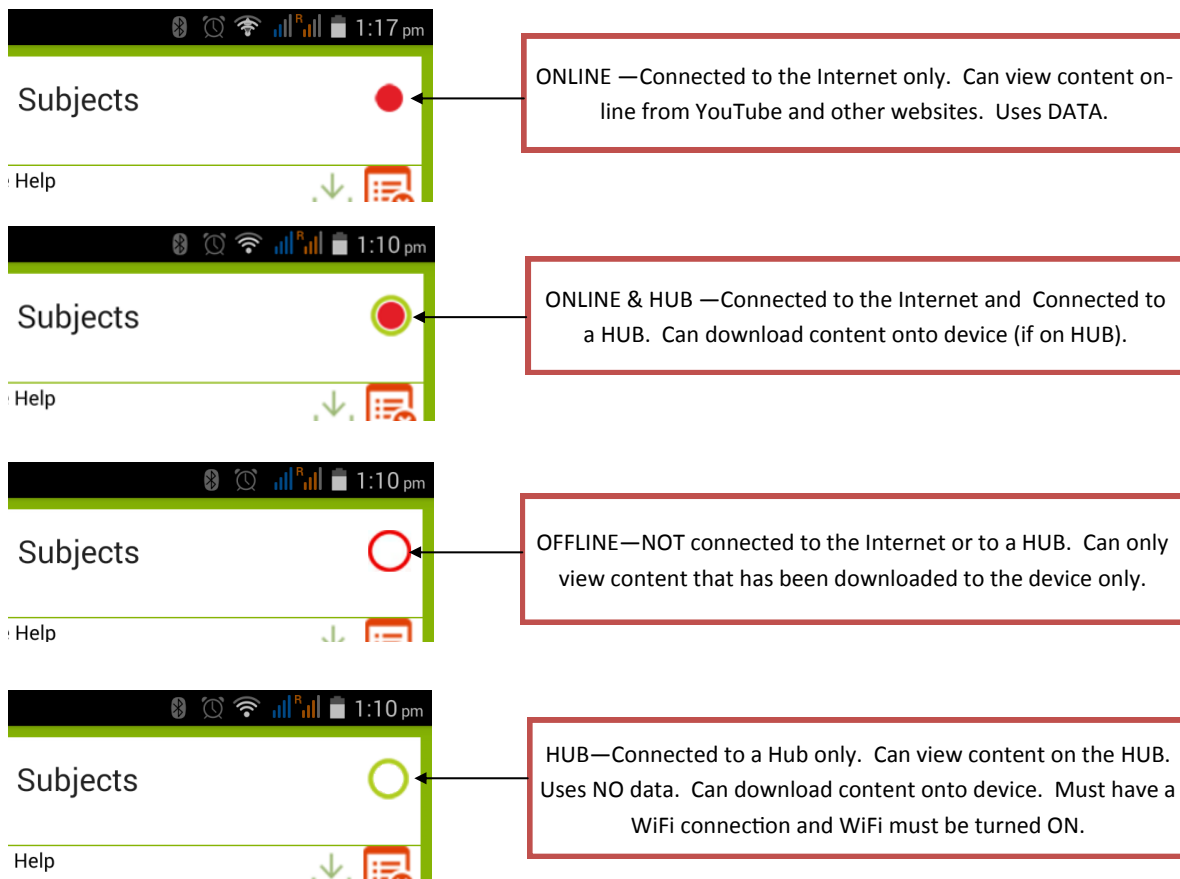


Figure 14 - States of Connectivity - (EDTech, 2016)

If a user is connected to a digital library, they can browse and stream content from the hub or alternatively can download content to their device. This allows them to access learning content in places where they have no internet connection. If a user is connected to the internet (either via a WiFi connection or a mobile data connection in the case of SIM card devices) they can stream or download content to their device like with the hub, but additionally, they will have access to online assessments.

If a mobile connection is used, this depletes a user's data bundle or airtime and because it is rich multi-media content, this has the potential to deplete the average South African learner's mobile data within seconds – assuming she has any to begin with.

There are settings which can be used to stop the use of mobile data, but these are within settings menus which might not be easily accessible of their location on the user interface. There are increased levels of complexity if the digital library is hosted within an existing W/LAN as certain network settings within the App need to be changed. The following example showcases the inappropriateness of EDETech's products requiring internet access within resource constrained contexts.

4.1.4.1 Other Experiences of EDTech as an Internet Requiring Solution

In 2015 EDTech carried out a separate trial with live-streamed lessons through *Skype Broadcast* where viewers could watch a teacher give a lesson (in Maths, Physical Science, and Life Science grades 10-12) in real time and additionally communicate with the teacher through an instant message service. There was an expectation from EDTech management that there would be an average of 1,000 viewers per lesson. The average viewership was less than 2 per lesson. The private company who funded this project as a tax deductible donation from a Corporate Social Responsibility fund received a report where the analysis section began:

“The premise for this project was that there is a demand for education; the country, the economy and business need a well-educated population, which translates in the minds of many to a “demand for education”. This premise is false.

The number of online viewers is staggeringly low and the uptake so poor that it can simply be said that there is not a demand for education. [sic][emphasis in original]”

EDTech Funders Report (2017)

Co-authored by E-CEO, this report provides valuable insight into the ways in which EDTech, as an organisation, lack empathy for the lived experience of the average South African and particularly those who live in communities around former Bantustans and attend no-fee schools. The rationale behind such an unfounded assertion that there is “not a demand for education [in South Africa] [emphasis in original]” is that because Facebook marketing and engagement through likes was high; the only conceivable explanation for low viewership and click through rates was that all learners in South Africa lack any motivation for education.

Additionally, the report and informal conversations with E-CEO projected the idea of apathy on behalf of teachers too; providing further conjecture that if teachers lack materials, hypothetically, they should jump at any opportunity to access resources. Apathy was projected onto teachers and principals by E-CEO in their assertion that every school in South Africa received a daily email with links to the broadcasts and a description of the lessons.

This reveals ignorance on behalf of EDTech, its management, and the authors of the report and lack of appreciation for the complex context of EDTech’s target user market. Given the prohibitively high costs of mobile data (and internet enabled devices) in South Africa (Africa Research ICT, 2018) and across emerging economies (and the global south) (Chetty, Banks, Brush,

Donner, & Grinter, 2011; Donner, 2015; Donner & Gitau, 2009; Kreutzer, 2009); and the high inequality that South Africa faces in terms of socio-economic security, education (between no-fee and fee paying government schools), access to wired broadband internet access, etc.; it is unsurprising that viewership was so low.

In the context of high social media engagement, users on many mobile networks in South Africa are given free access to Facebook and Twitter, explaining the high engagement on these platforms and the low click through rate, when required to pay for access outside these platforms. Furthermore, as learners generally are provided with after school lessons regularly and schools have uneven and metered (capped) access to the Internet. Such access is typically through satellite connections with a 10Gb per month usage cap – for a whole school.

In informal conversations with E-CEO, the researcher found that in spite of being aware of the challenges in accessing the Internet in such contexts; E-CEO's response was to assume that "if learners wanted to access it, they could do so at school" or "they could go somewhere that offered free WiFi" (informal conversations with E-CEO). Such a belief that learners can seek out connectivity is at odds with pragmatic reality as learners will either already be engaged in extra lessons after school conducted by teachers in schools (at the same time as live broadcasts). Additionally, schools frequently found their 10Gb data allowance depleted within a few weeks of each month. The issue of rurality means there is significant cost (financial *and* time costs) of transport and the number of individual taxis required to get to areas offering free WiFi; and not to mention the implications of travelling at evening on the safety of learners, particularly girls.

This example, while dense in description, reveals several key misunderstandings, assumptions, and worldviews which are not in keeping with the reality experienced by learners targeted by EDTech, particularly within resource constrained settings, where additional study materials would supposedly be most impactful.

4.1.5 EDTech/IMA Organisational Perspectives of a 'Failed Trial'

Much of the conversation with E-CEO, when discussing the failure of the trial of EDTech in RCSs placed culpability squarely in the hands of an "incompetent" provincial Department of Education (interviews 1 and 2 with E-CEO). In fact, the term "incompetent" appeared 19 times over two interviews lasting a total of 2 and a half hours, referring specifically to the department as an organisation and its constituent employees and representatives. E-CEO rationalises the failure in the following way:

“the failure of the project is not going to be due to [EDTech], it's going to be due to the fact that no training has been provided and part of the installation was that the schools had functional internet... It's been an epic failure by the department to provide the training, and to follow-up on the training and to make sure the infrastructure needed is there and is being used [sic].”

(Interview 1 with E-CEO)

Here, E-CEO views the provision of training as a major downfall of the EDTech trial in RCSs coupled with the perceived lack of internet within RCSs involved within the schools. E-CEO explained the contract EDTech had with the Mpumalanga Department of Education (MDoE) (agreed and signed in 2014) that EDTech provided training to roughly 15 trainers who operate on a cascade model also referred to as ‘training the trainer’. However, in reading the contract, it is explicitly stated that EDTech/IMA was responsible for providing training to “*Teachers, facilitators, and users to optimise their effective use of the platform*” (EDTech/IMA service delivery agreement with MDoE, 2014).

It turned out that after the contract was signed, E-CEO was requested to train MDoE staff to subsequently train teachers. This renegotiation of the contract was not necessarily formally agreed through a contractual amendment, leading to what could be understood as diffusion of responsibility, where the MDoE may not have fully appreciated the extent of training required for teachers to use EDTech effectively and lead to a fuller utility of the platform.

“I'm sure they will view [EDTech] as a failure in the future. It's not a failure because [EDTech] is a failure. We can demonstrate that it works in a functional space. It will be a failure because the people in the Department of Education are simply incompetent and should not be employed [sic].”

(Interview 2 with E-CEO)

In relinquishing responsibility for the failure, along with the perception that “it works in a functional space”, E-CEO implies that EDTech is perfectly positioned to realise the national Department of Basic Education’s directive for “e-Education” (Department of Education, 2004). The empirical base for E-CEO to assert EDTech as the ideal tool for realising such a directive, however, is based upon the experience of EDTech in IMA Hubs and with no substantial effort to explore areas of limited or wholesale avoidance of EDTech, beyond conjecture. Additionally, what

separates EDTech from other technological possibilities is questionable at best and the data from RCSs reveals divergence in routines developed by teachers with technology in the classroom.

From a critical perspective, the vacuum of education professionals involved within the development of the platform; the lack of any black or coloured representation and but a few women on the board of IMA (and exclusively white males as directors in EDTech Pty.) could offer an alternative conception as to the antecedents of failure of the EDTech trial. As Doherty, Haugh, and Lyon (2014) outline while discussing the increased responsibility of social enterprise boards in accounting to a broader range of stakeholders than for-profit organisations; “[this] leads to tensions in securing the appropriate board representation of commercial and stakeholder engagement expertise” (ibid, p. 429).

As there are no individuals representative of black lived experiences within the board of IMA; nor the experience of teachers with professional, practice based, expertise in RCSs; the extent to which decisions made are inclusive or representative of the interests of the schools involved within the trial is concerning. Understanding the potential for teachers and learners from resource constrained schools to be considered as “antagonistic assets” (Hockerts, 2015) and the transformative promise they have to become part of EDTech’s competitive advantage; it is worthwhile in acknowledging the limited input teachers and learners from such schools played in developing EDTech.

Given the dual organisational structure of EDTech/IMA; the board of IMA seeks primarily to serve the interests of the drop-in music centres. This suggests there is little oversight of the social mission of EDTech. As EDTech Pty. Ltd. is a private company, even though it is part owned by IMA, the significant degrees of autonomy and lack of participation of “target groups” (Mair et al., 2015).

This highlights a significant degree of complexity in the organisational structure of EDTech/IMA as a hybrid organisation. Furthermore, the balancing of two different social impact logics (of music education in resource constrained communities and education technology development in RCSs) with the commercial logic of the technology start-up is problematic. There is no board whose principal role is to ensure inclusiveness, relevance, and effectiveness of the EDTech platform.

Mission drift is evident given the multiple (re)developments made to IMA’s mission with regards to EDTech. Such revisions to mission from initially providing after schools support holistic development of learners in their drop-in music centre; to developing an ambitious, ubiquitous solution to address teaching and learning resources in resource constrained schools highlights a

drift from the original mission. Language in the IMA annual reports is highlighted the EDTech project as a drain on resources and as E-CEO puts it: “*Out of every 100 company ideas that start – one might work. So people burn a lot of money in trying to make things happen.*” (Interview 2 with E-CEO). What was originally viewed, however optimistically or naïvely, as a cash cow – very quickly became a costly, time consuming, stressful, and resentful project detracting from E-CEO’s and the founding board member’s aim of developing the next generation of South African musicians.

EDTech/IMA have separate clients (resource constrained schools and funders) and beneficiaries (IMA learners of music). In the Santos et al., (2015, p. 45) categorisation of hybrid organisation value chains: they live up to the dual assertion that the risk of mission drift is high and achieving financial sustainability is difficult.

4.1.6 Summary of EDTech Pty., IMA, and EDTech Technologies

IMA is the parent organization of EDTech in such that EDTech Pty. exists to, ideally, create significant revenue streams for IMA. Both IMA and EDTech Pty. are linked within the same Social Enterprise structure.

Through a co-constitutive development process, both IMA and EDTech’s product offering were developed to suit the specific needs of IMA and its music hubs operating in resource constrained communities, while the technological capabilities of EDTech equally informed the way IMA would operate. As outlined through the classifications of hybrid organisations programmes and organisational design by Santos, et al., (2015); EDTech/IMA can be considered a coupling hybrid with significant risks of mission drift (prioritising one element of the organisational logics at the expense of another); and the significant difficulty in achieving financial self-sustainability.

EDTech/IMA management classify IMA music hubs as “rural” (as outlined in reports, interviews and informal conversations); while the researcher disagrees with this assertion and considers the IMA hubs as peri-urban due to their relative proximity to urban centres. The extent to which EDTech’s Digital Library product is directly transferrable and usable within resource constrained, no-fee government schools situated in rural areas (or significantly ‘more rural’ than the IMA hubs) is explored in the next section of this chapter.

Critically, however, the specific configuration of the EDTech/IMA social enterprise structure is problematic as what started as a project to provide maths and science education in IMA music hubs,

has run down a rabbit hole, drifted from the mission of delivering effective music and arts education in resource constrained communities. In turn, EDTech has arguably become too complex a project in it's focus on schools across Mpumalanga and South Africa to be managed and administered within the context of a relatively small and locally focussed social enterprise. The result, from viewing the social enterprise data: a draining of resources from IMA through shared management and frontline staff, offices, and competing operational priorities; social missions; and complex multi-million rand grants, investments, and donations. As such, the limited/non-use of EDTech could be subject to aiming to tackle too much given this niche focus on music education and have been caught by the multiple objectives trap (Garrette & Karnani, 2010).

4.2 Results from Resource Constrained Schools (RCSs)

The data from the resource constrained schools (RCSs) are presented following the structure of the model developed based upon the practice lens, and the structurational modalities it outlines. While analyses are presented as discreet categories and sub-categories; to read these as such, without regarding the 'intra-connectedness' of each component, misses the depth of nuance and idiosyncrasies involved in teachers deciding whether or not to use technology in general. Supposing they do; selecting which technologies and the 'hows', 'whens', and 'whys' of the integration of technology in the classroom are also subject to nuanced negotiations.

Figure 15 (below) shows the model developed based upon the data collected throughout the research process, focussing on teachers' negotiations with technology within RCSs. There is an emphasis on idiosyncrasy; heterogeneity; the individual; and their journey. Each constituent component outlined in the model is not mutually exclusive: they are presented as such for analytic purposes, and the structure of results reflects this.

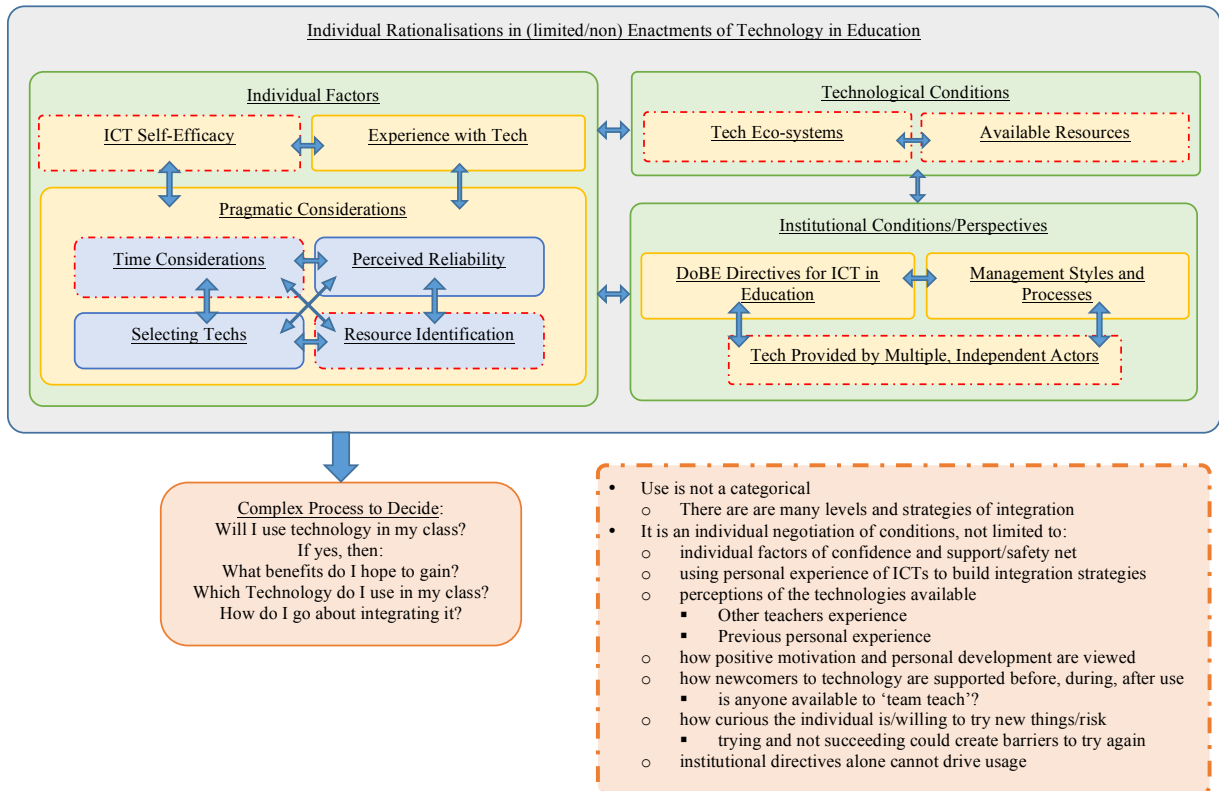


Figure 15 - Negotiations of Education Technology in Context Model

There is a significant level of iteration between concepts due to the co-constitutive nature of structural modalities. This particular order is used to map the technological conditions teacher operate within to set the scope for discussing normative conditions and interpretive schemes (Halperin & Backhouse, 2007, p. 6). Overlaps between concepts are signposted in the text. The model aims to highlight the relative complexity beyond the deterministic, linear way which E-CEO sees the process of achieving digital education within RCSs in South Africa.

4.2.1 Technological Conditions – The Modality of Facility

The mere presence of technology in RCSs does not automatically encourage systemic integration of technology into classroom practice. Often times technologies remained locked within safes, cupboards and offices. While for some teachers a lack of available technology is a barrier; for others the outcome of deciding not to use technology is impacted by broader issues. In each of the RCS field sites, there were broadly similar technologies present. These were connected and stored in different ways and places. Subsequently, the degree to which they were implemented or even brought out of the safe/secure storage varied greatly between field sites.

Figure 16 (below) shows a secure storage and charging unit for tablets which was not used. Instead a cast-iron iron safe of similar size in the principal’s office was used but without the charging

facility. This was due to security concerns. Figure 17 (below) shows storage solutions in RCS-B. A wooden cabinet (right) is used for storing things like speakers, old keyboards, etc. and two storage units similar to that shown in figure 16 house tablets and laptops. For additional security, these secure storage units are encased in a locking steel frame which is bolted to the cement floor.



Figure 16 - RCS-C Integrated Tablet Storage and Charging Cabinet



Figure 17 - Two Device Storage Options in RCS-B and Half Bricked Windows (for security)

The following categories of technological conditions provide evidence primarily of heterogeneity in technology; its technical and perceived levels of interconnectedness; and sets the backdrop for understanding the levels of appropriacy of institutional and individual perspectives of technology-in-practice. The rich ethnographic data presented, shows the pragmatic approaches of teachers to navigate new technologies, spaces, developing and modifying new routines.

Heterogeneity is evident in individual use of technology within different classrooms and is practically rationalised by users depending on the technological conditions present within a school. However, prescriptions for technology use in the classroom are mandated at various institutional levels (nationally, provincially, municipally, by district, by circuit, by individual principals, and by non-governmental actors within the space). Therefore, the extent to which policy, protocols, and technologies are pragmatically realised in teaching and learning is broad. This is impacted by the specific assemblages of technology available. This includes the coalescence of these technologies within education spaces and the context specific concerns (e.g. security); infrastructure available (electricity supply and internet access), diverse supply and qualities of user devices; and the educational resources available to teachers and learners to exploit.

4.2.1.1 Technology Ecosystems – a Category of Technological Conditions

Technology Eco-Systems relates to various technologies which are available within schools. Tech Eco-Systems can be broken down into various categories and based upon the field sites considered, the categories are Technology Capacity; Facilities; and Device Supply Chains.

Technology Capacity – A subcategory of Technology Ecosystems

In each school there were varying degrees of access to the Internet. RCS-A at one point had a connection to the Internet through VSAT (Very-Small-Aperture-Terminal [satellite based internet connectivity]). However, it was rendered unusable due to a lightening storm and was therefore not providing any connectivity. The only access to the Internet was provided through a sim card which was used purely for administrative purposes. This significantly limited the opportunities of staff to use online materials.

Some teachers, however, through their own catalogue of resources stored on their personal devices were able to continue their use of technology in the classroom. RAT1 only occasionally used EDTech to browse the available content to find resources which he believed could be useful to supplement resources he curated over years of teaching. The full functionality of the EDTech hub (online assessments and class progress reporting/analytics) could not be realised. In RCS-A, only a small part of the platform was used meaning the majority of effort to code and develop EDTech Hub/App remained wasted in RCS-A.

RCS-B was the most advanced user of EDTech, and in fact, the only regular user of EDTech. However, the quality of the internet connection presented significant issues in its effective use. In RCS-B, the EDTech hub uses a sim card to connect to the internet when using EDTech for online assessments. The researcher sat in the dedicated ICT centre were RBF, the technology facilitator, hosted cohorts of students to deliver digital education.

“RBF connects to the "EDTechHubVodacom" Wi-Fi network; accesses the device system menu; allows internet access for connected devices; and borrows my cell phone to check the balance of the data on the SIM card inside the hub.

RBF: Ok, we have 800Mb

Researcher: Is that enough?

RBF: I don't know, we can see. Maybe we'll only bring around 10 learners”

(Observations in Research Diary)

Learners are brought into the ICT centre in groups of 15 (half of a class) due to its small size, but the mobile data available means that only 5 learners can complete online assessments out of a class of 30. There may have been intervening issues that depleted the school's available mobile data such as the tablets learners were using conducting automatic updates – though other causes are also possible. This highlights significant issues in the intricacies of setting up internet connections through the EDTech hub and critically, how these are managed.

To further problematize this scenario, online assessments when conducted through the app are designed to be streamlined. However, when using the EDTech app when connected to a hub there are two possible ways to enact online assessments (the data intensive in-app browser or through the streamlined assessment interface). The former was the default option presented to some users. This is another potential cause of depleted data, but the specific cause was not investigated by RBF – it appeared this was not unusual.

While this specific case represents an enactment of EDTech; it highlights why, for the next two weeks, there was no use of the EDTech online assessment facility and explains subsequent non-use of the technology. Here, EDTech operates as part of an eco-system of technologies. This raises issues in terms of the distributed nature of role players within RCSs to be discussed in more detail later in this chapter, particularly the 'Technology Provided by Multiple, Independent Actors' section.

Facilities – A Subcategory of Technology Ecosystems

Facilities comprise of the physical spaces present within RCSs. Facilities and strategies to manage them are different in each of the field sites. RCS-A had no dedicated space for the use of technology in teaching and learning.

In RCS-A, there were two projectors. RAT1 explains how one of these is distributed within the school.

“[F]ortunately last year, someone donated a laptop, a new projector and a new screen. So because I was using this... mainly it was only me. Then the principal said, these things that have come, I'm putting them in your hands. You are in charge.”

(Interview with RAT1)

While some other teachers implemented technology within the classrooms in RCS-A, this was very limited. Very few teachers in RCS-A, if any other than RAT1 used technology for presenting alternative multi-media, and the enactment of EDTech in particular was significantly limited. Observation data shows teachers in RCS-A tended to project PDF documents rather than rich multi-media content.

RCS-A had a smart board fixed within the science lab which dual functioned as RAT1's classroom. This was never used as more than a projector screen during the research encounter, meaning that while RCS-A had access to interactive technology, it was never implicated in practice. Additionally, the presence of the smart board had implications on the ease with which he could teach using two small blackboards at either side of the smart board (see figure 18 which shows this).



Figure 18 - RCS-A Science Class: Smart and Chalk Board Positioning (Researcher's Photograph)

RCS-B had an ICT centre with an interactive white board rendered non-functional due to theft of an essential cable. When a whole class was present in the class, it was very crowded. The need to

divide classes in two increased the pressure on the ICT centre's capacity and scheduling. As a result, use of the ICT centre was timetabled and restricted to certain subjects reducing the utilisation of the majority of the EDTech content. Only grades 9-11 used the ICT centre and only for two subjects.

In RCS-C, there was a dedicated classroom with an interactive white board and enough seats to accommodate a whole class. Teachers could request the use of the ICT classroom and then use it as it suited them. Teachers using the ICT classroom were asked by RCP to sign a register when they used the ICT classroom and explain briefly how they used it; which technologies they used; and how they described the experience.

For RCS-B and RCS-C; theft was a major problem. Both, in recent months, had experienced robberies, where expensive devices such as laptops, LCD TVs, and specialist cables were stolen. As a result, RCS-B had bricked up the majority of the windows in the class and now only use the secure storage unit for storing devices. However, after the research encounter, the researcher was informed of significant theft of devices from RCS-B (almost everything) in spite of the additional security measures present in RCS-B.

Device Supply Chains – A Subcategory of Technology Eco-systems

While devices are present within schools, there are many examples of where devices used in teaching and learning are the personal property of teachers and learners. The benefits of having individuals using their own devices are multiple such as the case of RAT1 having built up a personal bank of resources over their years of teaching in different schools, in different provinces (both government and private). This includes a science experiment simulator to circumvent the lack of fully equipped science labs.

The benefits to EDTech of teachers and learners using personal devices with an EDTech Hub, is the option to download content to the device and take it home to prepare for classes with no internet connection or mobile data required. This is a theoretical benefit that was rarely enacted by learners but is discussed by E-CEO in saying that:

“The students can't make use of the resources as they're not able to bring their devices to school. So that's a non-starter. You would think the first thing is just open up the digital space and say, children bring whatever device you have, download it, and take it away.”

(Interview 1 with E-CEO)

E-CEO isn't 100% accurate in this assertion. In both RCS-A and RCS-B; learners were permitted to bring their own devices under the conditions that they are stored in the school office during school time with prior written consent from a teacher. However, the limited learner access to EDTech on their own devices, is rather a more complex mix of issues to be explored in the discussion chapter drawing upon data presented throughout this chapter.

While a Bring-Your-Own-Device (BYOD) approach may overcome some issues in the availability of devices or financial resources of institutions to procure them (Selwyn et al., 2017); there are a number of drawbacks in this approach. It is an ineffective strategy to increase use of EDTech in practice. In many cases, the devices that found themselves in the hands of teachers and learners were not fit for purpose beyond personal entertainment and communication.

RAL1 expressed an interest in using EDTech as part of their revision, but within seconds it was apparent that the laptop wasn't compatible with EDTech as the OS was Windows 7, and therefore incompatible with the EDTech Hub. The device was a 'hand-me-down' from RAL1's older sister. Through a soft hack, RAL1 could circumnavigate the restrictive requirement of the App and transfer files through a proxy device – their friend's android cell phone. However, this increased the workload for RAL1 to access the content before having the chance to decide whether it was useful or not.

RAT2 explained that their son had recently got a new laptop and gave them this one. RAT2, had a laptop with Windows 8, but many of the keys on the keyboard were not working. This meant using the laptop in any meaningful way for teaching and learning was limited by the time-consuming task of using the on-screen-keyboard (OSK). While this provided a workaround, the cost of replacing the keyboard and even identifying where to get the keyboard replaced given the location of the school may prove an expensive, time consuming ordeal. Figure 19 (below) shows the impact of the OSK on the available, and valuable screen real-estate.

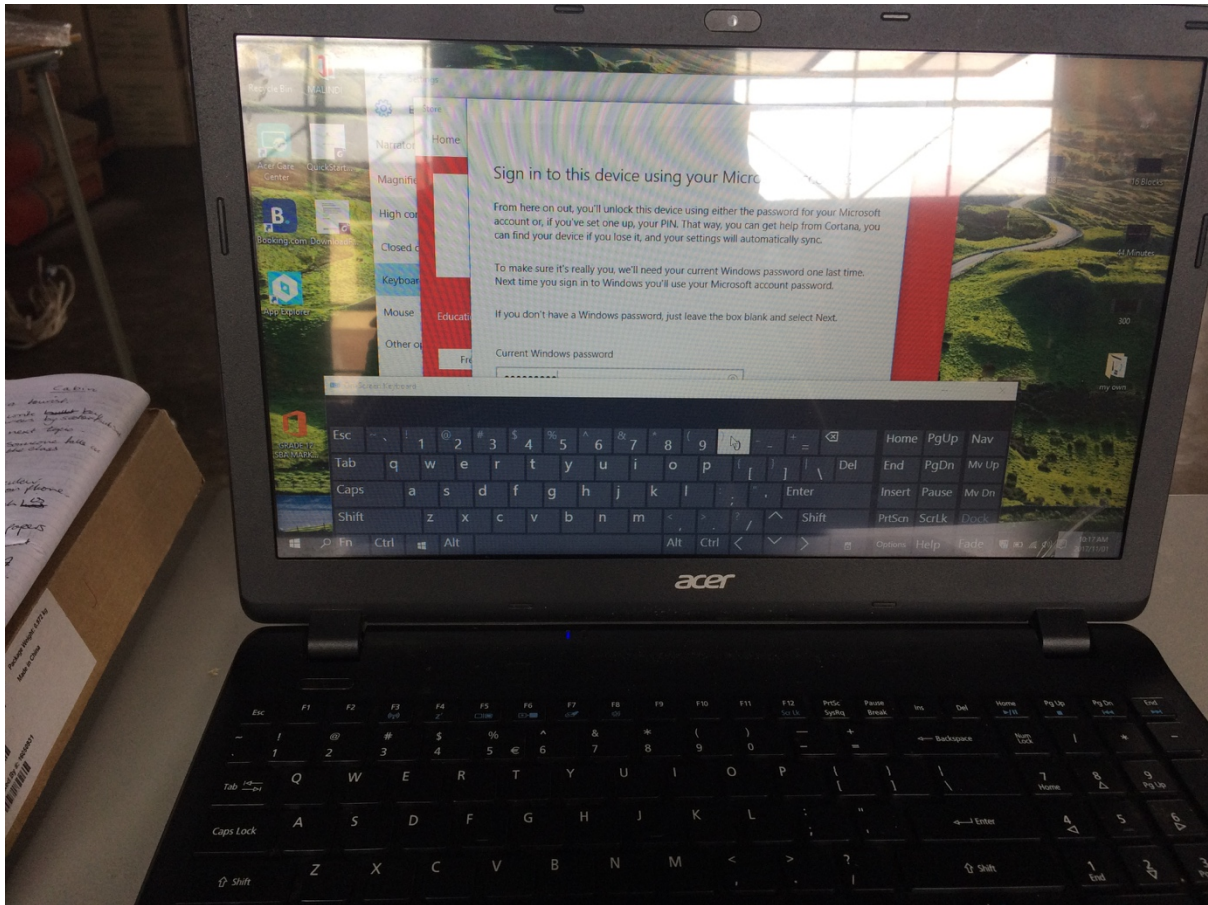


Figure 19 - On-Screen Keyboard on RAT2's Laptop

In the case of RAL2, even new devices purportedly compatible with EDTech highlighted further issues. RAT2 had a budget Android OS phablet (SIM enabled tablet) which was technically compatible with EDTech. However, when working with the learner, during the EDTech app installation process, the phablet crashed. It took about 45 minutes to remedy the issue as the App required the overwhelming majority of the processors capacity – so much so, that it was impossible to find enough processing power to turn the device off.

The app itself eventually worked, but even once operational, the storage capacity was so low, very little could be downloaded. This highlights further issues of enacting EDTech on the devices which typically find themselves in the hands of users in RCSs and alludes to inadequate user market research on behalf of EDTech. Combined with the recommended screen size of 7 inches or higher (advice on the app store system requirements), it becomes problematic to assert that a BYOD policy is desirable when smartphones are the devices that are generally available to bring. Limited device access means learners must accept less as a result of the inequalities they face.

4.2.1.2 Available Resources – a Category of Technological Conditions

The availability of resources is a major aspect of a user’s decision whether or not to use technology within their teaching and learning. This emerged as a critical factor specifically for EDTech in spite of the thousands of video resources available due to multifaceted issue of quality; subjects being omitted; videos not following the curriculum effectively enough; and the EDTech App’s sometimes disappointing user experience.

Above and beyond the individual resources available with an education technology; issues along the lines of ease of set-up and use (dependant on users’ literacies and experience at an individual level); how they balance the perceived benefit over traditional pedagogies; and how perceptions of a technology are informed by previous experience also impact how available/accessible technologies are perceived to be.

The issue of resource quality is consistently raised as a reason not to use EDTech (at all or more regularly) and this is related to the content curation process adopted by EDTech/IMA. This includes the original source of videos which are held within EDTech. As many of the videos come from an organisation called Khan Academy, the resources present on EDTech are often in an accent foreign to South Africa. These videos are designed for proficient (if not native) speakers of English and, mostly being developed in North America, the pace of speech can be fast. RBL1 explains “*Some of them, they go too fast. We are still thinking, like calculating and then you end up not understanding it.*” (Group Interview in RCS-B). Therefore, E-CEO’s vision of digital, independent, learner driven learning through EDTech is not likely to be realised.

Almost every individual across all field sites who had used EDTech at least once identified content as a major barrier to use. However, upon further reflections on the data, other issues emerged throughout the research process and the issues with EDTech can be generally summarised in table 5 (below).

Table 5 - EDTech Issues as Available Resource

Problem Area	Symptom
Content	Aspect Ratio (black ‘boxes’ around video)
	Colour Contrast (black background and coloured text on videos)
	Accent/pace of speech of video narrator difficult to hear
	Some videos not made by school teachers or for school classrooms
	Inadequate content available (subjects/modules covered)

App Design	Time navigator on the in-App Multimedia Player not functional
	Full screen mode on iOS app doesn't work effectively
	Limited App OS Compatibility
	Mobile Data/PPB Internet consumption of online features is significant in RCCs
	App installs and runs one day and doesn't work the next day
Hub Design	Confusing Set-up Process
Hub/App interoperability	No files appear on first use (without internet)
	Inefficient system architecture for low-cost/low-performance devices
	Mobile data/internet required to move between G7-9 and G10-12 resources
Maintenance Process	App is not maintainable as EDTech prioritising communicating 'soft fixes' not app fixes and couldn't be adapted for RCS environments

Each of these symptoms (or problem areas) have various cases, impacts, and potential remedies. Issues related to content generally stem from the content curation/development process employed by EDTech. This can be remedied going forward through the development of a content protocol or checklist. When coupled with the feelings of E-BM1, highlight the content curation process was poorly conceived. However, given that much (if not most) of the video content has been aggregated from external organisations (e.g. Khan Academy) issues relating to the colour contrast and aspect ratio are not easily addressed as 3rd party content is developed outside of the realm of EDTech controls.

Even content developed in-house experienced issues with the aspect ratio of videos, but due to the way in which the content was recorded (screen capture from a live lesson); this would require the teacher who recorded the video to re-design the PowerPoint slides used and re-record a whole 50-minute lesson – the funding for such an endeavour, already spent.

Issues related to app and hub design and their interoperability will require redesign of these technologies. For example, issues in the in-built media player, presumably could be fixed by implementing a different pre-programmed media player module within the code design; while addressing the technical aspects of the efficiency of the App on low-cost/low-performance devices may require significant and fundamental re-design of the App and Hub environments. However, this will be essential should a BYOD strategy be pursued.

This is a problematic strategy in and of itself given the uneven access to variable quality devices within user groups in resource constrained communities. This holds serious potential to exacerbate existing inequalities and deepen the disadvantage faced by learners already in difficult domestic contexts as also found in the OLPC programme by Warschauer and Ames (2010).

4.2.2 Institutional Conditions/Perspectives – The Modality of Norms

At many institutional levels of education in South Africa; technology integration is promoted as a key driver of education development. Each individual school involved within this study operates in nuanced conditions with access to varying sources of technology; facilities and available technologies; degrees of dedicated integration expertise; and school management cultures. Therefore, each school creates a unique environment though which teachers are more or less empowered to integrate technology within teaching and learning.

Such heterogeneity in the specific visions of technology in education across institutional remits may therefore require higher degrees of collaboration between actors including government departments of education; individual schools and their leaders; and the independent suppliers of technologies and training. EDTech, as one of many independent actors did not recognise this and arguably standardised their product offering too early and in a vacuum of empathy for such complexity. The results within this section showcase a need to develop cases of different practices and responses to technology to interpret and action policy through context specific means.

4.2.2.1 DOBE Directives for ICT in Education

The Department of Basic Education (national) have provided directives and plans to ensure that South African schools increasingly use technology within classrooms and for school administration.

These directives take different forms such as the guidelines for ICT integration which presents a ‘teacher development framework’ which positions differing levels of ICT use in the classroom as a pyramid, shown in figure 20 (below) (Department of Basic Education, 2007, p. 7). This framework is an important consideration in terms of institutional conditions/perspectives as it sets the agenda of national and provincial governments for assessing schools’ integration of ICT into teaching and learning; and accounts for expectations of newly trained teachers leaving their formal education.

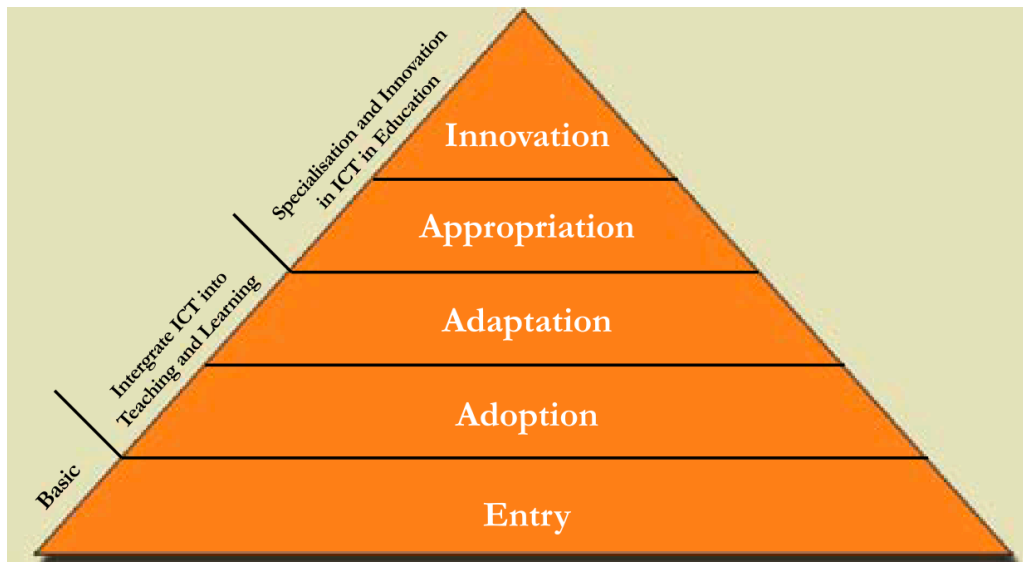


Figure 20 - Teacher Development Framework (from DoBE, 2007, p. 7)

This document (*ibid*) is an important marker in central government policy for directing positive change within digital education in government schools in South Africa and builds upon the ground work provided in the white paper for e-education (Department of Education, 2004). Above the entry level, teachers should be confident enough to implement ICTs in the classroom which also involves the confidence to teach learners how to use ICT. While for some teachers, like RAT1, this is straightforward; for others it becomes more complicated as it requires the will to implement technology in their classes. RBF explained they often faced difficulty in encouraging staff to turn up to training sessions. However, RBF also performs one of the core roles which teachers are expected to carry out above the entry level. RBF works with learners in semi-structured technology training with learners and teachers. This eases the burden on teachers.

Within RCS-C, at least two teachers were engaged in courses with University of the Free State known as ‘Advanced Certificates of Education/Teaching’ (ACE/T). These appeared to be greatly appreciated by the teachers studying for these qualifications as RCT1 explained:

“It’s a bursary from the government. They cover the cost of studying, maybe we have to take a week, they organise a place for us, they organise the catering, the accommodation. We only pay the transport. So it really helps you develop as a teacher... it’s difficult because some of the subjects they have introduced to us in the field. We are not quite skilled for these subjects. So this course; it is developing us so we can have enough knowledge and skills to assist learners in the classrooms.”

(Interview with RCT1)

RCT1 touches on a few issues pertinent to the institutional conditions teachers operate within such as: their individual professional development; opportunities to travel and stay in hotels (which can be a big deal for overworked and underpaid teachers); and ways for them to stay abreast of curriculum and teaching developments since they left teacher training colleges. Furthermore, these accredited courses also aid teachers in their career progression should they wish to seek promotion or move from practice to policy.

RCT1 and RCT2 were in possession of laptops which were provided to them/the school as part of an initiative to encourage the broader use of technology within their practice. These two teachers were keen users of the ICT centre within RCS-C and regularly conducted extra classes within the ICT centre; enabled by the provision of devices to them. Additionally, the ACE/T provides teachers with assignments that require the use of technology, developing their experience with ICTs and subsequently their ICT self-efficacy. In the various interactions with RCT1 and RCT2, both approached the researcher at different times to ask for assistance in achieving some tasks. On one occasion, RCT1 asked for advice about creating tables which involved merging cells. After 20 minutes of repeating the process to build the complex table structure in MS Word, RCT1 expressed some pride in the new skill.

Other teachers such as RAT1 mentioned the value of these courses for teachers and in their opinion, the disappointingly low uptake among colleagues. This can be perceived as a negative factor relating to teacher motivation. However, it can also be conceived as a way to encourage passionate teachers to continually develop their professional practice. This prioritises resources to teachers with a vocational approach to their work; a life-long learning perspective; and desires for career progression.

4.2.2.2 Management Styles and Processes

In the schools studied, each management style was slightly different. This related to various approaches to delegation of responsibility of technology (i.e. a science teacher in RCS-A); monitoring performance (RCS-C had a register used indirectly in performance appraisals); and strategies to develop use (RCS-B had a technology facilitator to provide training and support; RCP would sometimes take the lead in coordinating training; and in RCS-A, individual teachers are informally providing assistance and support).

However, operationally, leadership within schools generally took the form of leading by example and engraining a culture of 'teamwork' or 'unity' within Senior Management Teams (SMTs) and

the school as a whole. The emphasis of positive motivation techniques, prioritising the motivation of teachers based on guest speakers; occasionally holding meetings in a hotel in a nearby town; and principals assisting teachers in the delivery of digital education all work together to form unity within the school.

RBP was very clear throughout the interview in terms of their positive, constructive approach to delivering great results with teachers who might be underperforming.

“[I]t should be positive and constructive at all times. It’s not a talk that will be negative. Negativity will never bring good results. You have to be positive to the situation. Try to understand what makes them not to perform and talk to them in a positive way and in a supporting way, so that they come back on board and they start working hard.”

(Interview with RBP)

Beyond leadership, to manage the facility and ensure that access to the ICT centre was equitable, RCS-B developed a policy to only use the ICT centre and EDTech for English First Additional Language (FAL) and Maths. These were the classes where there were teachers keen to use technology as part of their teaching. This had the benefit of allowing specific teachers to develop routines in implementing technology, and based upon the school timetable, greatly reduced the possibility of clashing. The ICT centre in RCS-B was managed through a timetable of which days and periods the ICT centre was used.

RCS-C differed in that the ICT centre was open to any teacher willing to use it. Here, there was a register which teachers were expected to sign every time they brought a class into the ICT centre. The register, as part of RCP’s own ICT in teaching strategy, is explained it as such:

“So now I’m starting to give more pressure. Now I’m monitoring, indirectly... When I want them to sign, and when we have a meeting I can say that ‘[this and that teacher] are the only teachers who are using the ICT, what about you? What about the others?’ ... [then they realise] ‘the principal is reading there who is going to the ICT centre... next time it’s me.’ I’m winning them like that. I’m not fighting them; I just thank them...”

(Interview with RCP)

RCS-B and RCS-C, with their dedicated ICT facilities, were able to develop their own strategies to manage the utility of the ICT centre in ways which suited them. Conversely, in RCS-A with the

space limitations (all rooms primarily functioning as classrooms); rather than the learners being mobile throughout spaces; the technology itself was mobile throughout spaces. Further compounded by the lack of internet connectivity at the time of the research; this reduced the ability of teachers to leverage more substantial benefits of networked technologies within their school. RCS-A and RCS-B appeared to have less emphasis placed on as many teachers as possible using technology and rather focussed on maximising specific teachers' enactments of technology: those who had the skills, experience, and passion.

On the issue of vocational passion and the context of school management driving use, RCT3 felt that the principal of RCS-C was authoritarian as RCP wasn't listening to the teachers or taking their perspectives into account in decision making. Therefore, in RCT3's opinion, the lack of institutional support in terms of job security affected their buy-in to management's vision and directions. Arguably, this impacted on RCT3's motivation to invest personal time into their role and limited RCT3's feelings of being an integral part of RCS-C as an organisation and a team.

Therefore, aside from the management of technology, resources, and school vision; the specific issue of employment contracts, contributed to an experience of flux as they may be 're-deployed' and have to re-adapt to a new working environment. Evidently some, like RCT3 react to this scenario by limiting their use of technology, while others like RAT1, in previous temporary roles in other provinces, used this opportunity to collect a broad range of resources from various individuals. Approaches to management and institutional directives may be undermined by more conventional employment politics. This highlights the heterogeneous responses to education and technology use in light of transient deployments in conjunction with their personal rationalisations of work, working, and *going above and beyond*.

4.2.2.3 Technology Provided by Multiple, Independent Actors

There are various sources of technology within the RCSs studied. Generally, these providers operate relatively independently and little after installation support is given. For example, only 3 months of post-install support is required of MNOs legal obligations under ICASA regulations in school connection programmes (documentation received from MDoE). For EDTech, however, there is no formal follow-up policy and a serious bone of contention held by EDTech/IMA management is the lack of training implementation through the DoE in Mpumalanga.

The implications of having multiple disaggregated actors within the area of education technology in schools is directly related to the subcategory 'Technology Eco-Systems' as the limited/non-use

of EDTech can be attributed to a variety of factors. As a core theme in the research question of this study is providing alternative accounts of the perceived failure of the EDTech trial; divergent viewpoints of the antecedents of the failure now gradually emerge.

As non-school-based actors within the education technology space operate more or less in distributed pockets of activity; the unsystematic, superficial integration of technology into teaching and learning is a relatively predictable outcome. Vodacom (and other MNOs), local business outreach programmes, EDTech and the various levels of the Departments of Education work towards similar goals of realising digital education. Though this presents a dilemma when each actor's relative independence creates a scenario where there isn't a unified front in developing a systemic approach to digitising education in government schools, and RCSs in particular.

As many teachers may lack the confidence to integrate ICTs into their classes, providing basic training on the EDTech platform itself may not go far enough to account for the challenges expressed by teachers of EDTech, nor take account of the reality of teachers' ICT self-efficacy and digital literacies more generally.

The distributed and disconnected responsibilities (some contracted and others not) show potential for different actors to duplicate work by other actors. Simultaneously, some responsibilities may be overlooked based on the assumption, other actor(s) will fulfil these needs. The case of training provision for EDTech is a specific example of such.

This is considered within the Institutional Conditions/Perspectives modality due to the often disconnected nature of these interventions. Though there is some inter-organisational cooperation in initiatives provided, for instance RCS-B has a technology facilitator employed by an UK based NPO (focussed on improving literacy through the provision of content pre-loaded e-readers) in collaboration with EDTech's initiative; this is more an exception, than a general reality.

Having multiple sources of technology can result in uneven provision of technology across different schools. Some such as RCS-C found themselves in possession of at least 4 learning technologies (other than EDTech) and due to proximity to a game reserve benefited from their CSI/R initiatives.

The implications of having technologies distributed across different devices include increased effort required to search these devices for relevant material. For instance, a teacher would have to

go the ‘Vodacom Laptop’ to browse for the content they might be able to use, then use a separate laptop provided by the department of education to take home without software/content installed on the ‘Vodacom Laptop’.

In RCS-C, there was some very useful software which increased the benefits of the smart board by allowing teachers to draw on the screen (through a touch sensitive interface) over what is presented from the laptop. This has its own implications in terms of increasing the complexity of use. However, the point in this aspect of the Institutional Conditions/Perspectives modality is to highlight the uneven distribution of technology within and across schools, districts, and provinces. This is further compounded by a lack of research into what technologies are used and the extent to which it improves educational outcomes. Such a lack of research results in weak understandings of best practice and data driven decision making in the education technology industry

Evidently, a more cooperative, integrated approach to digital education initiatives may provide more clarity in terms of specific responsibilities, contractual obligations and ensure the efficient use of resources is targeted by various stakeholders operating within this space. Therefore, while *some* training may be provided to *some* teachers, a more concerted effort to consolidate multi-organisational competencies could be one aspect of developing teachers practice from an institutional or normative perspective.

4.2.3 Individual Factors – The Modality of Interpretive Schemes

Central to the development of the model are the negotiations teachers make in relation to their immediate role as teachers. The significantly different operational conditions (technological and institutional) teachers in the three schools faced impacted the specific routines individual teachers were able to enact.

The following section highlights the centrality of teachers’ time considerations within schools as the relatively poor user experience offered by EDTech through its content and technical structure increase the effort required to consult it for appropriate applications within teaching and learning. However, time concerns were also apparent through cases of technology (other than EDTech) being used. The broad distribution of software and resources across devices supplied by different actors increased the time investment teachers had to make to find the best resources for their particular needs.

What emerges through this section is the delicate and highly nuanced implications of heterogeneous distribution of technology, skills, facilities, infrastructure (such as internet connectivity) and increase the importance of how teachers approach the sense making of technology within their practice.

4.2.3.1 ICT Self-Efficacy

In the model presented (figure 15), some elements which are found in the Technology Acceptance model (TAM) are reflected in this model; namely, ICT Self-Efficacy. This is a salient term used within user acceptance modelling and refers to the confidence in one's ability to use ICT (I. T. J. Brown, 2002), as opposed to an objective measurement of their skills.

This sub-category of individual factors tends to speak for itself, although through the empirical work gathered for this study, it includes perceptions about *out-of-the-box* (OOTB) ease of use. In other words, is a technology intuitive enough to 'pick up and go'?

In the case of EDTech, this presented itself as a barrier due to the particular interfacing technologies (Wi-Fi) and digital literacies required to use the Hub. Related in a sense to a teacher's experience with technology, the Hub requires a knowledge of how to connect to WiFi (and understanding that WiFi provided by the Hub, doesn't necessarily mean a connection to the internet); how to use the app and ensure they are connected/configured appropriately.

In the cases of RCS-A and RCS-C, the EDTech Hub was rarely used. The time taken to (and uncertainty involved in) setting it up; and the lack of user support, *in situ*, complicated use. However, RCS-B had RBF. This eased the burdens on teachers. Given the limited accessibility of the ICT centre due to the decision to limit access to a timetable and for particular subjects; the facilitators role here was more reducing time pressures on teachers than providing technical support.

Because the teachers using the ICT centre in RCS-B were already relatively highly digitally literate; the role of the facilitator as a trainer was reduced to set-up and breakdown of the technology required by teachers. This is not to diminish the important role RBF played in digital education within RCS-B. Conversely, the lack of support and/or adequate provision of training to users limited the confidence of teachers to implement EDTech within RCS-A and RCS-C.

Additionally, given the concerns over content with EDTech; this increases the need for teachers to interrogate the resources they intend to use. The author argues that a lack of trust in the content and its unsuitability for spontaneous use means teachers must proactively plan their use of the EDTech Hub: additional to the expectations of teachers' to prepare and work outside of school time.

4.2.3.2 *Experience with Technology*

A user's experience with technology is an important consideration which is intricately linked to ICT self-efficacy in that where one has increasing experience of technology, it is generally understandable that one will develop more confidence over time as tasks and activities become routine (Hong & Tam, 2002).

Experience with technology is dependant on access to devices in order to develop the digital literacies required to use them. RCT1 explains how important experience with technology was for developing their ICT self-efficacy and driving teaching practice to 'the next level' as such: "*I have to practice teaching nearly every day with technology. I would gain more confidence and that would make me to be at the next level.*" (Interview with RCT1). 'The next level' represents an intuitive understanding of the teacher development framework presented in figure 20 and RCT1 represents a teaching professional recognizing the value technology could bring to teaching and learning, and the untapped potential they may still realize through engaging in further personal and professional experience with technology.

Experience with laptops or computers generally would involve users being able to use productivity programmes such as word processors, even at a basic level. In RCS-B, RBT1 used Microsoft Word to explain shapes and how to work out their areas, etc. by using the 'insert shape' function. However, in this example, due to multiple pop-ups and closable menus being open, the shape only occupied about a third of the screen it could have (see figure 21 below). Additionally, the thickness of the line may have made the shape difficult to see at the back of the room, flooded by natural light – in spite of the windows being mostly bricked up.

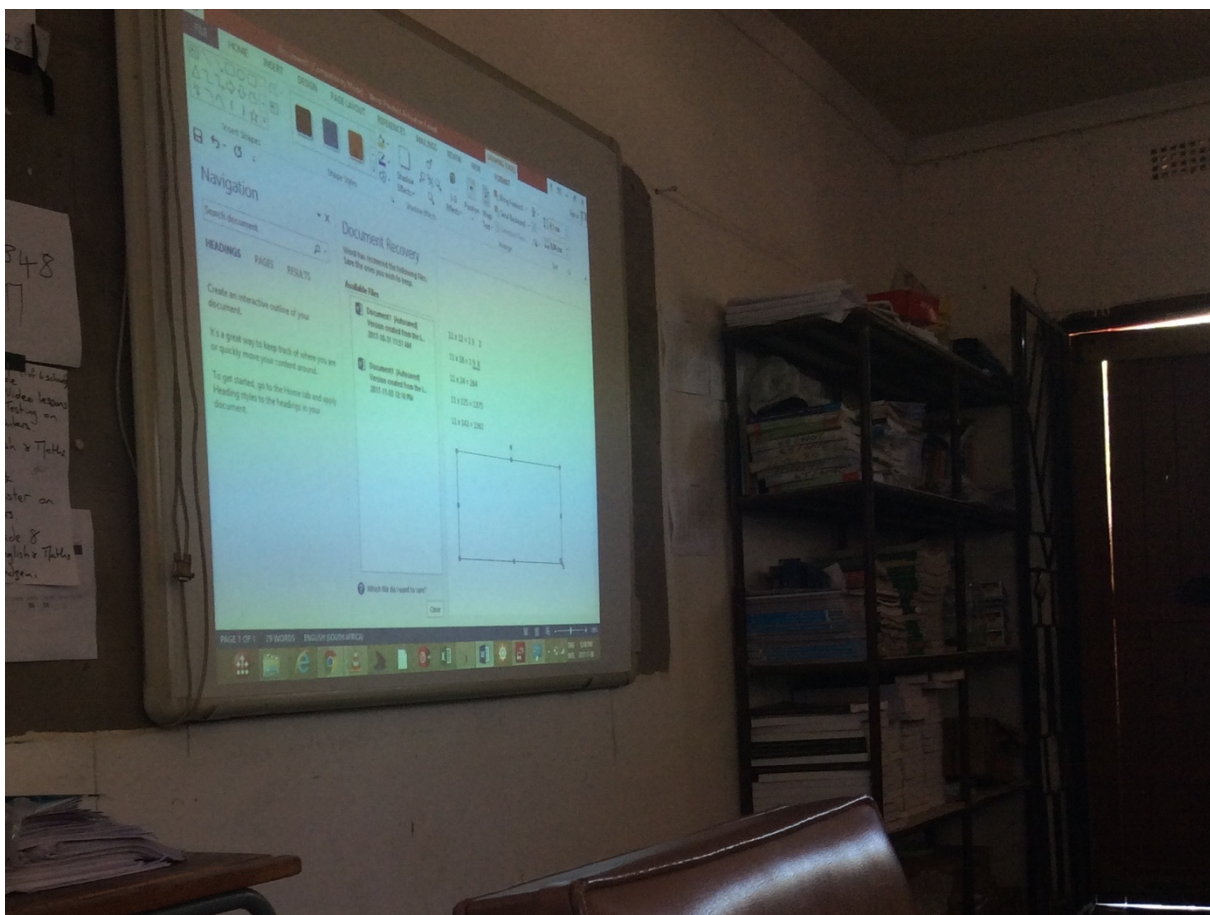


Figure 21 - Use of Microsoft Word in RCS-B (Researcher's Photo)

While RBT1 was a proficient user of technology, their ability to utilise technology ‘off-the-cuff’ was a good example of simple ways technology can be incorporated into classes. After explaining the basic principle of working out areas of shapes, RBT1 loaded EDTech on the computer; identified the video which was pre-selected for use in this class; and uses the video as a tool to explain the process of working out the areas and volumes of various shapes. By playing, pausing, explaining and playing the video again, RBT1 incorporated EDTech into the lesson with relative ease. RBT1 supplemented the explanation provided in the video through drills of questions; looking for the class to repeat the key learning outcomes (LOs) the video is related to in the curriculum.

RBT1 gained experience through the teacher training college they attended and drew on personal experience of using computers and the Internet. As one of the teachers sanctioned to use the ICT centre in RCS-B; RBT1 operates within the institutional guidelines developed within the school. By selecting EDTech as an available technology and utilising some of its features to supplement his own explanations; he capitalises on the attraction/excitement of technology by learners to enhance teaching and learning and maintain the class’s attention. This is really the only significant benefit of using EDTech in this instance as the time required to move learners to and from the ICT

centre and open Microsoft Word seem far longer than the action of simply drawing a rectangle on a chalk board.

While in this case, RBT1 presents high ICT self-efficacy and experience with technology – throughout the research process – other internal mediating factors influence an individual’s choice to use technology: EDTech in particular. The perceptions of other factors are important in framing both the intention to (not) use; the extent of use; which technologies to implement; and how.

4.2.3.3 Pragmatic Considerations

Pragmatic considerations can be thought of as the individual negotiation factors teachers make based upon the technologies available (and the benefits and barriers they can manifest); the institutional conditions (how their role as teacher within a given school context is rationalised); and a combination of self-assessment of skills; recognising the primary metric of education is for students to pass exams, but on tight curriculum schedules.

Time considerations – A Subcategory of Pragmatic Conditions

There are various issues teachers experience in relation to time pressures on integrating technology into their classes. Principally, the time pressure associated with delivering the curriculum on time was often cited as a reason for not incorporating technology within the class. An individual teacher may rationalise similar time pressures; within broadly similar institutional conditions; with access to the same technology; in very different and occasionally contradictory ways. This is reflected in the work done on technological frames by Orlikowski and Gash (1994). They argue individuals have and develop their own interpretations (frames) of technology (*ibid*). These are rooted in the individual; their prior experience of technologies; and to some degree, can be shared or congruent to other individuals within the organisation (*ibid*).

Time, depending on the individual, was perceived as a dually constraining and motivating factor in the use of technology within the classroom. Such a duality highlights both the nuance involved in perceiving the benefits of technology while rationalising this with the time pressures with curriculum/prescribed resource changes; the latter, a common occurrence in the past two decades in SA education policy.

Technology is mostly viewed as an additional tool which teachers could use to supplement the delivery of concepts in the class, usually delivered outside of official school times. RCT1 explains:

“With[in] the lesson itself, there is no time for that technology. But like myself, during my extra lessons, I take them and show them what we were talking about in the classroom, is what we are going to see now. Then they watch and they start watching and laughing saying, yes, there it is, there it is.”

(Interview with RCT1)

Having recently started a trial of new curriculum implementation resources (National Education Collaboration Trust [NECT] curriculum planner and tracker); RCT1 explained how the institutional obligation to utilise these resources impacts on their teaching style. The trial of the NECT resources prescribes text which must be copied to the chalk board for teachers to explain core learning outcomes. RCT1 and other teachers mentioned how this was difficult due to the volume of copying they have to do.

RCT1 provides vivid examples of how technology can assist in adding value to teaching and learning and explains over the course of the interview how technology comes to play a role in their practice both to be efficient in terms of time to develop comprehension of the LOs, but additionally for clarity in concept revision.

“When you check the lesson topic or the lesson title, you can see that this topic, it needs technology to help me teach. It will make learners understand better than myself teaching. I’m busy teaching about the earth moving around the sun. Mina [read: myself], I can tell them it moves like this, when it spins it rotates on it’s own axis and it revolves around the sun, but if I let them watch the video... they’re going to see this thing is real and how it spins and how does it revolve. It makes it easier than showing them with hands and pictures. [sic]”

(Interview with RCT1)

RCT1 may not have the time to deliver education through technology within sanctioned class times. However, they recognise the value in saving time that technology brings when explaining abstract theories such as planets moving through the solar system. RCT3 was teaching a very similar topic and when observing them teach the lesson without any technology, the volume of writing required by the NECT resources and restricts the style of teaching possible (towards a traditional rote learning pedagogy).

“RCT3 writes word for word what appears in the [NECT] book as a series of bullet points on the left hand board. This seems to slow the pace of the lesson. The English comes from the book, and

in xiTsonga, [they] explain what these phrases mean. As RCT3 is talking about the sun as a ball of gas which can burn your skin, they point to me [the researcher] to highlight how my white skin has turned a little pink.”

(Observation from Research Diary)

Later, RCT3 explained; *"unless I go and find that information myself, I can't use it, there aren't resources for my class."* (informal conversation with RCT3). The implication here is the time and effort required to find resources to aid in the delivery of LOs was a barrier to using technology in the classroom, as this would be expected to be prepared in teachers' personal time.

Here, both RCT1 and RCT3 operate within the same school, teaching very similar classes; but both have divergent responses to and enactments of technology. RCT1 is roughly 15 years older than RCT3; RCT3 uses their personal laptop extensively outside of school and downloads movies after school using the WiFi. These two contrapuntal examples of individual rationalisations of the value technology can add to teaching and learning allude to the impact different individual technological frames have on the decision to use technology.

This highlights the intricacy of navigating individual motivations based upon the context of institutional conditions as well as the new requirements of teachers to use NECT resources with tight time demands, thus forcing teachers to use technology as an add-on outside of official, paid teaching time.

Selecting Technologies - A Subcategory of Pragmatic Conditions

In the schools, there are a variety of different technologies available to choose from. EDTech represents only one of these within the 'technology eco-system'. This factor refers to the strategies of selecting which technologies to implement, based upon the individual teacher's goal or desired outcome of using a particular technology within the classroom.

Teachers considering to use technology within the class will have to weigh up the benefits and challenges that a technology can bring with the outcomes they want to achieve through incorporating this into their practice. Drawing on the available technology resources; how technology is managed within a school; the confidence of a teacher to implement a technology with relative predictability (i.e. has the teacher developed a routine with a particular technology); and the time available to teachers – they will select different technologies and enact them in different ways.

Taking RCS-B initially, given that technology is used almost exclusively within the ICT centre; is rigidly scheduled and prioritised for certain teachers; use is supported through RBF; and teachers have immediate access to EDTech: EDTech resources have become routinized in use.

For RCS-A and RCS-C, however, EDTech tended to be used much less – if at all in RCS-C. In RCS-C, RCT1 tended to be most comfortable using YouTube to identify resources and using the smart board to present this to the class. However, at no point in any of the observations was the smart board enacted to its fullest potential (beyond a projector screen): the touch sensitive component of the board was never plugged in via USB. However, in spite of this, the projector with projector screen was still referred to as a smart board.

RCT1 explained her selection of the smart board as their preferred technologies over using the tablets as such:

“It’s good when you use a smart board, because the eye-contact with the learners, you can see whether these learners are concentrating on the lesson or not. So I think the projector, smart board and laptop is the one... it’s better in my opinion. Tablets are for them to google information, but when I’m teaching, I prefer those things [smart board, laptop, and projector]; because that way I can see the centre of their attention.”

(Interview with RCT1)

RCT1’s view of effective teaching and learning was based on catering for different learning styles providing information through text, speech, video and images, and ‘practicals’. The traditional power relations within the classroom were seen as desirable. As such, technology can produce work practice changes where routines are developed or modified during and after the introduction of technology (Orlikowski, 2000). Therefore, teachers incorporating technology into lessons by using smart boards develops existing routines and power relations of chalk boards as standard school technologies.

On at least one of the laptops containing digital education resources in RCS-C, there was a software tool which allowed the teachers to control the learners’ tablets. This control allows the teacher to stop learners’ tablets from working temporarily; ‘casting’ an individual tablet’s screen to the projector e.g. to showcase learners work; and potentially projecting the teachers screen to the the tablet. At no point was this ever enacted by teachers and the researcher believes teachers were not

aware of this tool, in spite of learners' tablet management being outlined as an issue in use by RCT1.

In RCS-A, RAT1 had a choice of multiple resources curated over his years of transient teaching positions around the country. Having relatively extensive experience in implementing technology within teaching and learning meant that RAT1 knew which resources and technologies to strategically apply to add the most value. While time, in terms of curriculum pressures, was a concern for RAT1 (they regularly conducted weekend classes); due to their experience with technology, it was relatively easy to compliment core teaching and learning with technology and to select technologies with an intricate knowledge of their outcome when combined with skilled, strategic enactment. However, given the lack of devices for learners in RCS-A and the lack of any internet connection for teaching and learning, RAT1 was restricted significantly to using their laptop and the school projector.

In each of the different schools, given the varying access, assemblages of similar technologies, skills, backgrounds, management contexts, and individual perspectives; different combinations of technologies and resources are used.

Resource Identification - A Subcategory of Pragmatic Conditions

Teachers find resources in different ways, from different sources, with varying degrees of success, and at not always in advance of classes using technology.

Finding resources has implications on the time considerations as in some cases finding the right resources ahead of class can be an issue, in spite of others identifying this as important to effective teaching and learning. Examples are RCP explaining the expectation that teachers adequately prepare for lessons using ICT and RCT1 explaining that lessons with technology require preparation. In the case of googling, effective search strategies, are important. RCT2 would search for resources to use by using Bing search engine in the ICT centre, in front of the class. This meant occasional pauses in class of a minute or two as the teacher iterated through various search terms and results.

“RCT2 searches Bing for ‘Transformation’ then ‘Transformation Mathematics’ – RCT2 then loads resources from ‘ca.IXL.com’ [content designed for the Canadian curriculum]. After a minute or two the screen saver comes on and the projector screen goes blue. As the teacher’s phone rings, I am asked to search ‘reduction’ to find appropriate resources. After several

iterations of the search, modifying the specific search terms each time, I decide to search google images instead. We are struggling to find the best images. Trying to find appropriate information on the spot, live is difficult, especially when I am not aware of the key learning outcomes to be addressed and at what level of complexity.”

(Participant Observations in Research Diary)

Here, the researcher assisted in the curation of resources with the teacher live, in the class, and to dubious degrees of success. The way this occurred left the researcher feeling this was a common tactic employed by RCT2. That a search engine was the go-to resource identification tool, suggests that more systematic sources of digital content were not used or that the significant resources provided by external organisations within RCS-C, were not consulted. Owing to the distributed nature of resources as explained in the section ‘Technology Provided by Multiple, Independent Actors’; the time required to search across 4 devices for appropriate content, the disconnected technologies present a time consuming, and potentially fruitless endeavour. Avoidance becomes an understandable response.

The individualistic processes of employing available resources involve teachers’ assessing the speed at which available resources can be consulted; their appropriacy based on teachers’ desired outcomes; and the confidence with which teachers feel their skills suit those resources all contribute towards the development and maintenance of routines when using technology in class.

Learners have their own distinct views on the digital resources that are introduced into the classroom and it isn’t all positive. RAL3 explained “*Sometimes those videos can be confusing because the video says one thing and the teacher says another thing...*” (Group Interview 1 with learners, RCS-A). So while digital resources have the potential to enhance teaching and learning, there is the potential for these resources to confuse learners. As the curriculum has changed many times in recent decades, the impacts on teacher’s subject knowledge and specific elements of the curriculum may have been updated since a particular teacher graduated. Technology poses the simultaneous potential to contradict and compliment teachers’ explanations; depending on the individual.

Resource identification involves an internal heuristic to negotiate between advantages over traditional pedagogies (including time and effort); technologies available within the school; and ICT Self-efficacy. The teachers’ experience has implications on the kinds of resources they wish to implement (e.g. some teachers looked for images, others for videos, others looked for PDFs) and

experience in using technology can lead to teachers creating their own collections of resources as is the case with RAT1. It can be seen that there is great divergence in strategies to identify resources and this leads to very different enactments of technology within schools leading to teachers achieving their goals for technology in the classroom to varying degrees.

Perceived Reliability - A Subcategory of Pragmatic Conditions

Depending on experience with technology and ICT self-efficacy, teachers may perceive the reliability of technology (specific or more generally) in different ways. From the data there are many aspects and examples of perceived (un)reliability which include relatively new technologies (e.g. Bluetooth speakers in RCS-C); ease of set-up (e.g. connecting the various components of a smart board); confidence to fix errors presented (e.g. when smart boards don't function as expected); issues related to internet connectivity (e.g. how stable and fast is the internet connection and how much data is available); and other, more idiosyncratic issues (e.g. difficulty in providing user support in Windows 8+ due to the Microsoft Store's restrictive log-in requirements).

The perceived reliability of a technology (or an ensemble of technology) is founded upon a negotiation of prior experiences (positive and negative); hearing others experiences and issues; the ICT self-efficacy of a user; the support available to them; and this list cannot be exhaustive.

RCS-C was in the months prior to research taking place gifted a brand new smart board, but was not the same brand or technology as the smart boards present in RCS-A or RCS-B. Both RCS-A and RCS-B had Promethean branded boards while RCS-C had their smart-board provided through Edu-Board. Prior to an ad-hoc in-service training day conducted by the researcher, no teachers were aware how to use it. In RCS-B, the smart board was rendered useless beyond an expensive projector screen. During a theft in the months leading up to research: the cable to connect the board to a computer was stolen. In RCS-A, the smart board was never connected and only used as a projector screen – which then forced the teacher to rely on the two small blackboards with which to write on (figure 18).

While technically, all schools could claim to have smart boards, none of them were successfully implicated in practice during the research encounters unless the researcher, in the case of the ad-hoc in-service training, set it up to do so. This required the researcher to come prepared with a screwdriver to adjust the laser positions inside the touch sensitive unit above the board. This was aided though *simple* instructions provided by Edu-Board technical staff over the phone. However, the researcher's relatively high ICT self-efficacy and experience with technology facilitated this

process, with relative ease. With a trial and error approach it ended up taking about 30-45 minutes to fix. Something which, based upon the digital literacies and ICT self-efficacy of the teaching staff, may have been immeasurably more challenging, if not simply a waste of time in their eyes.

This is linked to the device supply chain issues mentioned in ‘Technology Provided by Multiple, Independent Actors’ section. Through the example of the smart board in RCS-C (and to some extent in RCS-A given the non-use); reliability and teachers possessing the skills and knowledge to actively engage in setting-up and managing the technology effectively, are of vital importance if these donated technologies are to live up to the impact/reach purported. For as long as these devices and technologies remain unused, the investment in the technology is arguably redundant and from a critical perspective, ineffective use of the financial and social resources by the 3rd party organisations, regardless of intentions. In other words, could the provision of ‘food parcels’ to the least economically stable learners be a more valuable, impactful investment; though less seductive to donors with funding power?

4.2.4 Summary of Negotiations of Education Technology in Context Model

Heterogeneity appears frequently throughout the results and in all of the different categories of the model. This is manifested in the various technologies available and the ways in which these are connected and implemented. However, above and beyond the multiple technologies available within the schools studied; the individual teacher and the expectations, protocols and management styles within these schools also impact on the specific ways technologies are implemented.

As there are various suppliers of education technology within schools, each school will find itself with varying technological options open to them depending on where they are; how connected their school is; and how available structured/formal support is. In terms of EDTech, the Hub represents one of five options in RCS-C (if the internet is included as a technological resource). Therefore, for EDTech use to be increased; a more concerted effort to provide training and support to teachers in ICT must include sufficient rhetorical work to ‘sell’ the features and benefits of technologies; gain important user based feedback on barriers towards implementation (while effectively addressing these); as well as developing the core competencies of those teachers who wish to use technology in teaching and learning.

Additional to the number of teaching and learning devices available; in instances where a BYOD culture has emerged (where teachers and learners use their personal devices); there are specific issues highlighted from the data such as the appropriacy of low-cost/low-performance devices and

the issues of 2nd hand devices. These can have issues such as broken keyboards or older OSs (issues RAL1 and RAT2 faced).

E-CEO was explicit in viewing a BYOD policy as a positive behaviour. However, in the context of RCSs – there are numerous other unintended consequences of such an approach. This includes the potential to perpetuate existing inequalities; but also in the experience of RAT2 and RAT1; devices which are older and relatively low performance struggle to use the EDTech App. Furthermore, while EDTech recommend devices with screens of 7 inches or above on the App Stores; E-CEO's complacency in believing a small screen is better than no screen is not unproblematic.

Several issues specific to EDTech (the Hub and the App) emerged throughout the research process. These tend to be symptoms of deeper issues particularly evident in the experience of users. This is in terms of the content quality (colour contrast and aspect ratio); pace of speech and accent; and the lack of content for many subjects and grades. While these are not all issues directly stemming from EDTech's realm of control, they ultimately affect the user experience and go some way towards exploring the less than expected utilisation. More fundamental issues with the technical structure of the Hub and the App, while affecting the user experience significantly, point towards the development process followed and the implications of development time being donated and measured in terms of hours of development time.

Within schools there are various approaches to ICT facilities management. Depending on the spaces available to use technology in teaching and learning, either the technology moved between class rooms or the learners moved from traditional classrooms to dedicated ICT centres. However, the specific approach to managing who uses technology in their teaching and learning varied between schools and depended on how the principal delegated management of space, technology, and practice. Regardless of how technology was managed within schools, teachers who used technology in their practice had the motivation to use technology. The researcher only observed teachers who wanted to teach in these spaces, rather than teachers being forced to.

The supply of devices in RCSs led to a high degree of variability in access to specific technologies and resources. Leading from disconnected education technology interventions; while it is positive to see so many devices with pre-installed resources, there is a distinct increase in the demands on teachers to consult each of these devices separately. Furthermore, with each device operating as a silo, many of these devices and resources are underutilised. With a disconnected stream of actors

providing resources within schools, the RCSs studied didn't necessarily suffer from poor access to resources; but rather the strategies to consult each of these devices and understand how each supplied device can add value in different ways. As EDTech is one of these disconnected providers of technology, it is not surprising that poor user experiences lead to teachers not implementing EDTech systematically, if at all.

Teachers develop their own routines in using technology over time, through experience, and in tandem with their colleagues. Furthermore, when EDTech is perceived by technology using teachers as inadequate (in RCS-A and RCS-C); this generally is perceived by other teachers. Therefore, it is unsurprising that in RCS-C, teachers opted for the simplest vector of educational content – search engines – and tended to ignore the other resources provided within the school. Therefore, OOTB usability is key for any education technology endeavour. How this OOTB usability is developed is a matter to be discussed in the proceeding chapter. Additionally, for EDTech, teachers identified the importance of content operating as standalone, trustworthy resources giving them the confidence to utilise it during their class with minimal use of their personal time to 'vet' content.

5 Discussion

This chapter discusses the implications of EDTech/IMA as a hybrid organisation aiming to effect positive improvements within the South African education landscape. Having presented the results, this dissertation now discusses the implications of these findings to the research questions; compares existing literature with these implications; and frames these within the limitations of this study and future directions for research.

5.1 Summary of Results in Relation to the Research Questions

This study seeks to uncover factors which led to limited/non-use of EDTech within resource constrained schools in Bushbuckridge Municipality, Mpumalanga. The secondary research question seeks learning opportunities from the EDTech/IMA approach to integrating technology in no-fee government schools in Bushbuckridge Municipality, Mpumalanga.

The results show various factors internal to the social enterprise, which have contributed to this result. While not an exercise in placing blame; three major factors have been discovered. Mission drift of the organisational focus; ambitious and arduous strategies for growth; and ineffective product design and development processes for no-fee school contexts all contributed to limited/non-use of EDTech.

This chapter now breaks each of these three factors down into a series of tensions which frame the discussion.

5.1.1 Mission Drift as a Contributing Factor to Limited/Non-Use of EDTech

Mission drift is when “the social objectives of the social enterprise are sacrificed to achieve financial sustainability” (Doherty et al., 2014, p. 423). However, through reading the results, in the case of EDTech/IMA this definition may not be as straight forward or cater for the nuance of the context of the organisations. As such, three tensions are highlighted to explore mission drift in the context of EDTech/IMA.

5.1.1.1 *Mission Re-Definition Vs. Mission Drift*

One tension which became apparent to the researcher throughout the data analysis process was the tension and grey area between redefining an organisational mission to more fully satisfy client/beneficiary needs and when such redefinition of the mission becomes mission drift.

Revising the mission of IMA to include the provision of non-music education resources to improve the holistic development of IMA learners may not be defined as mission drift. Rather, the author would consider this scaling in or deepening impact with existing service users. However, the point at which significant resources and management time were redirected towards developing a digital solution for the Mpumalanga Department of Education – this is considered mission drift.

As Rangan’s (2004, p. 114) work would suggest, IMA were “pulled by market forces” (ideas of easier revenue streams beyond regular funding applications) away from the organisations core competencies of music tuition. This impacted the organisation’s ability to balance multiple stakeholder expectations which is typically difficult, stressful, and time consuming of its own accord. Due to the three organisational objectives and complex, disintegrated value streams of EDTech/IMA; they are caught in the multiple objectives trap; where organisational focus is pulled in different, oppositional directions (Garrette & Karnani, 2010; Wach, 2012) further compounding the impact of such mission drift.

The confidence of IMA to use EDTech as a significant and sustainable revenue stream led to an overzealous distribution of resources to the project. EDTech utilised many resources in ineffective ways. The waste of limited financial resources reduced the impact the organisation could have on

its core social mission (Ebrahim et al., 2014). This underscores the lack of critical project leadership in allocating resources to the design and development of EDTech.

To further exemplify the pull of the market, the promise of significant funding to develop the EDTech concept into a market based product (partly through interest from the provincial Department of Education) contributed to the prioritisation of speculative financial gain. This highlights a departure from what has been considered a development of the organisational mission.

Mission drift is a key aspect of the failure of the EDTech trial in terms of limited/non-use. Simply put, developing EDTech for government school settings was an incredibly large project to undertake for a relatively small and niche organisation with specialist competencies in music tuition. Particularly in terms of micro-finance, mission drift is often discussed as prioritising profit making as a trade off (Cull, Demirgüç-Kunt, & Morduch, 2007), implying success at raising self-generated income at the expense of social outreach. However, for IMA; venturing into an unrelated field resulted in failure to generate sustainable revenue streams. This failure to develop a sustainable revenue stream is further compounded by the complexity of the multiple objectives trap. Together they both constrain the potential to achieve multiple social objectives in a financially sustainable manner. Danone recognised the impact of the multiple objectives trap and focussed their mission. EDTech did not and continued their efforts.

5.1.1.2 Board and Management: When Being Inclusive Can Deepen Understanding

The emergent and complicated organisational structure made realising the multiple organisational objectives between EDTech and IMA more difficult. Key issues surfaced through the data including a lack of oversight of EDTech by IMA and the board of EDTech was not inclusive of target groups (instead it was three white, relatively wealthy men). Furthermore, the complex, mixed funding streams for the EDTech project from E-CEO individually; from the MDoE; from the National Lottery fund; private sector social development funds; etc. contributed to the complexity of planning, developing, and implementing the project successfully while satisfying various donor/partner expectations and prerogatives.

Given the limited contact with teachers, principals, learners, and schools involved within the trial; there is promise in viewing teaching professionals as antagonistic assets. EDTech may be able to utilise target groups such as teachers' and principals' knowledge, experience, and wisdom into developing a competitive advantage (Hockerts, 2015). Teachers and principals from resource

constrained school settings have an acute understanding of the conditions within which teaching and learning takes place as well as the specific challenges that are faced within such schools.

EDTech only involved teachers in the content curation process and with little focus on consulting their skills and experience. The involvement of teachers within the board or as implementation managers could act as target group representatives. Furthermore, with experience of curriculum integration, these teachers could provide valuable insight into assumptions and strategies that don't compliment the operational realities of no-fee government schools developing an enabling environment within schools where EDETech is introduced.

From the perspective of the sociomaterial studies of technology – because technology is not an independent variable (Leonardi, 2012) – success in one particular school requires a holistic understanding of the operational context through which it is applied. Even though EDETech may 'function' as intended within the IMA hubs, the successful application in the complex environment of no-fee schools is dependant on a variety of individual teacher's needs, constraints, and knowledge; the finer details of ICT resource availability and management; and even what education practitioners' definitions of a 'successful' might be.

Had EDETech included target groups within the board, design, or decision making/governance structures of the organisation; teachers would have been able to utilise their vast experience and expertise contributing meaningfully towards EDETech's education development logic. As such, without involvement of those within the organisation with education experience/logic; there was great difficulty in developing an organisational identity which complimented the technology business logic (E-CEO's background) (Battilana & Dorado, 2010).

While E-DBA understood EDETech and felt themselves an integral part of it (given their dual roles within IMA and EDETech) E-DBA as a resource could not be utilised over the long-term of the trial to manage integration and provide on-going support and training. E-DBA's role within integration generally remained as an initial trainer and informal technical support provider via WhatsApp. Had EDETech hired a part-time administrator for IMA (to relieve E-DBA of their duties); or hired an integration manager – the limited/non-use situation may have been reduced and the contractual responsibilities for integration support addressed.

5.1.1.3 Dual Value Chain Development Skewing Resource Allocation

The intense resource requirements of the EDTech project detracted from the core focus of IMA, as highlighted through the annual report of 2014. What was imagined from its inception as a cash cow, a sustainable revenue stream for IMA to reduce reliance on donor funding paradoxically became a significant resource consumer. Given that E-CEO had invested personal savings into the project; this may have clouded judgement in recognising sunk costs and reassessing the prospects of EDTech Pty. Ltd. becoming a successful venture; an aversion to losing what is available at the expense of developing something new and more useful (Liedtka, 2015, p. 931). While this may have resulted in a decision to terminate the EDTech project, such a decision would have reduced investment into a product that would ultimately yield poor results anyway.

The point at which EDTech ceased to be a project of IMA; and instead became a for-profit company; IMA departed from being a “blending hybrid” (where clients and beneficiaries are the same but value creation requires “regular support”) to being a “coupling hybrid” (where clients and beneficiaries are distinct groups and two value chains require management) (Santos et al., 2015, p. 45). As Santos, et al., (2015, pp. 49–50) explain “social impact is also dependent on additional interventions that are not included in the provision of their core commercial activity.” IMA had to scale back their events programme in 2014 because of heavy resource allocation to EDTech.

Opposing the literature of prioritising customers over beneficiaries (Battilana et al., 2015; Ebrahim et al., 2014), EDTech/IMA as a social enterprise neglected their customers (assuming schools are considered proxy customers of the MDoE). While in the long term, EDTech became a massive resource consumer for EDTech/IMA; in the short term IMA may have financially benefited from such large flows of capital from various sources. The specific flows of investment destined for the EDTech project are technically donated first to IMA from donors and subsequently contracted to EDTech Pty. Ltd. with a fee deducted for IMA acting as a third party.

In spite of short term income gained through the process of subcontracting EDTech development funds to EDTech Pty. Ltd., there could have been a more effective utilisation of resources and importantly, a more realistic understanding of the requirements of the EDTech project prior to developing the technology for government schools. Given the time consuming and resource intensive nature of managing a technology start-up in general (Ries, 2011); more realistic projections of the true costs of redeveloping EDTech for use in RCSs may have allowed EDTech to realise the difficulty, expense and risks to IMA: the organisations primary social project. Subsequently, this may have allowed a more rational, objective decision of the commercial viability

of the business venture or dramatically altered the linear design, development, implementation process.

The significant time, personal financial investment made by E-CEO (as well as by other individuals and donor agencies) could have been used to develop alternative revenue streams. Had IMA considered the key knowledge, organisational competencies, and networks of social capital within IMA; such revenue streams more closely aligned with core or complimentary to existing programmes could have been prioritised. This could be a vehicle to create a financially self-sustainable organisation avoiding the implications of two disintegrated value chains.

5.1.1.4 Summary of Mission Drift

EDTech/IMA incrementally redefined their mission to a point at which management, resources and the broader organisational focus were prioritised on developing EDETech as a potential revenue stream. As Ebrahim, Battilana, and Mair (2014, p. 84) mission drift can cause differentiated hybrids “to invest more resources into their commercial activities than in their social ones”.

EDTech prioritised resources towards future financial gain at the expense of the IMA social mission. While there may have been a superficial mission towards improving the South African education landscape, EDETech was primarily financially driven.

There was no representation of EDETech’s target groups (teachers and principals) on the board or within the organisation’s work force. As such, there were key assumptions of EDETech which went unchallenged and valuable insight from practicing education professionals untapped. While there is an inherent social mission within EDETech (to improve access to multimedia education resources within schools); this was undermined by the financially driven focus of EDETech Pty. Ltd. Given that E-CEO had invested personal finances towards the project; this may have created a bias towards driving developments to recoup part or all of this investment. Such a scenario would limit objective assessments of the viability of the project and perhaps compel them to continue diverting money and resources at EDETech with the same speculation and cognitive biases that defined previous design and development practices, and resource allocation tactics.

The dualistic value chain impacted not only the delivery of core social projects of IMA due to resources being diverted to EDETech; but increased demands on management to oversee the delivery of three organisational objectives of music and arts education in resource constrained communities;

improving the quality of South African education; and developing a mass-market education technology product.

Such a trio of institutional logics is akin to the experience of Danone trying to achieve adequate profitability of their fortified yogurt product (Wach, 2012). However, an important distinction to be made here is the difference in the degree of convergence between customers and beneficiaries. For Danone, paying customers would automatically receive social value through the nutritional value of their product and subsequently local environments not be harmed after the packaging was produced. For EDTech/IMA on the other hand, given the divergence between customers and beneficiaries; the impact of having dual value chains accentuates the complexity. Not only do EDTech face the difficulty of managing the two, distinct value chains (Santos et al., 2015), the inclusion of a third logic further increases complexity.

The difficulty of managing these three organisational objectives is shown through management's expectations to grow rapidly and the design and development process through which EDTech was created. Both will be discussed sequentially now.

5.1.2 Strategy for Growth as a Factor Contributing to Limited/Non-Use of EDTech

As development actors and traditional non-profits are being pulled towards market based, capitalist legal forms and philosophical ideals (Curtis, 2008; Evans et al., 2005); there is an increasing disposition of third sector organisations showing promise with evidence of impact to grow and scale their impact (Doherty et al., 2014). However, scholars often find tension in scaling up for growth by targeting increasing numbers of beneficiaries reached as the essence of the social mission is build on relationships, social ties, and the development of organisational culture – which scalability would seek to standardise through mass-market-like products and services (Hockerts, 2015). Without knowing what value schools, principals, teachers, and learners were looking for; standardisation of EDTech was premature.

The following sections related to growth and scaling strategies reveal primarily, the incorrect evaluation that EDTech had achieved product-market fit and the implications this had on the failure of EDTech to realise ambitious growth.

5.1.2.1 *Products Must Have Viable Value Proposition Before They Can Scale*

In the lean start-up, Ries (2011) outlines the importance of achieving product-market fit prior to exploiting opportunities for growth. Product-market fit is when the value derived for the product satisfies users needs and wants at a price which is acceptable and is sustainably scalable.

That the best performing school, RCS-B, is only “half functioning” (Interview 2 with E-CEO) indicates that the product isn’t wholly suited to resource constrained school settings with limited space to utilise technology more regularly. Additionally, the extent to which technology use was facilitated by RBF in RCS-C – a resource most schools do not have – indicates that schools with no dedicated internal support staff may struggle enact EDTech within the classroom. This, based upon the model in figure 15, will create negative experiences for teachers trying to use EDTech and failing to do so with sufficient ease. This subsequently reduces their confidence in the technology leading to EDTech being resigned to gather dust in cupboards, cabinets, and safes.

Even with RBF, the structure of resource constraints (only capacity for cohorts of 15 learners in the ICT centre and inadequate internet connection) provides more evidence of EDTech being unfit for purpose. Without effective internet access EDTech can only be used as a content retrieval system as opposed to its fuller VLE capabilities with class analytics. There must be a fundamental re-think of the technical structure of the EDTech hub/digital library to account for and work within this constraint. Furthermore, critically evaluating whether the learning analytics component of the software delivers value to teachers or solves problems they *actually* have.

The principles of the lean startup and design thinking emphasise on starting with a small number of users; generating value early within the development process; a focus on agile, iterative development practices; and building solutions incrementally with an emphasis on organisational learning (Blank, 2013; T. Brown, 2008; Kelley & Kelley, 2012). The approach of IMA did not foster these core principles.

Only upon realising product-market fit, managers are in a position to drive growth through scaling efforts to gain new customers and crucially, retain them (Ries, 2011). The growth strategy was myopic in the sense that growth was imagined organically through sales of EDTech to provincial governments. This would rely on a strong product offering which aligns the value proposition with the needs of users and an evidence base of successful implementation and results – a large element of product market fit. This requirement of product market fit prior to growth is reflected in the conceptual model in figure 4.

Teachers' approaches to utilising technology in the classroom and resource identification heuristics are individualistic and draw on a wide range of sources. As such, there is a value deficit within the current design iteration of EDTech given the content concerns highlighted. This limits the possibility of sustainable growth by pushing for a standardised product prior to understanding the diverse routines, styles, technology availability, etc. within schools facing different immediate challenges.

5.1.2.2 *Unchallenged Assumptions Impact Product Value and Growth Potential*

Growth was prioritised as EDTech/IMA had assumed EDTech had reached product-market fit based upon the experience of implementing EDTech within IMAs drop-in hubs. The perceived transferability of the EDTech product from IMA hubs to resource constrained government schools is founded upon a few assumptions which highlight the lack of end user involvement in product development.

It can be loosely argued that design thinking principles were followed to some degree and users were involved in the incremental early phase developments of EDTech. However, such involvement was narrowly focussed on the specific context of IMA drop-in hubs. Utilising the technology-in-practice framework would have decentred such a techno-centric perspective to consider varying users' practices and institutional contexts through which they teach. The replication growth strategy (from IMA hubs to no-fee schools) was not realistically going to be successful as it requires willingness to adapt "to new contexts via co-generation of knowledge" (Moore et al., 2015, p. 77). This idea of co-generation of knowledge was not fostered given the projections of need from EDTech; a lack of empathy building; and having no openness towards adaptation to the new context of no-fee government schools beyond adding significantly more learning content. In reference to the conceptual model in figure 4, systematic context based problem definitions are required when designing and developing technologies to ensure that they deliver clear value to users.

Through a lean start-up gaze, EDTech/IMA would have recognised that limited/non-use of EDTech in trials were a sign of failure to reach sufficient product-market fit as opposed to the gloomier rationalisation that "there is not a demand for education" [*emphasis in original*] (EDTech Funders Report, 2017).

One assumption which undermined the possibility for EDTech to build a realistic contextual appreciation for operating within no-fee schools in non-urban locations was the disposition of E-

CEO and annual reports to overuse “rural” as a defining characteristic of the communities they operated in.

Such a broad categorisation of all areas IMA operates in as rural not only detracts from the rich, complex, multi-faceted sub-categorisations of rurality. It also reveals a lack of appreciation for the specific and highly variable circumstances of individual villages, tribal authorities, townships and former homelands. The lack of any systematic and empathetic involvement of teachers, learners, principals and school governing bodies within the redevelopment of EDTech for resource constrained schools underpins why so many assumptions went unchecked; leading to EDTech not being wholly fit for purpose in the context of resource constrained schools.

The benefits of EDTech, in the opinion of E-CEO is in its ability to provide targeted revision topics for teachers based upon the analysis of class assessment data but a digital sticking plaster on the systemic oppression of such communities will not suffice (Mercer et al., 2003). Because whole class assessments are rarely conducted; the quality of data available for teachers to target and prioritise their teaching based upon EDTech class analysis is poor. The causes of low numbers of assessments vary between schools. The element of the product believed (but never empirically proven by EDTech) to deliver the most value was never fully realised.

From a practice lens perspective, such elements cannot be considered as part of the technology-in-practice: even though they are part of the 1s and 0s which make up the software. As such this represents an over engineered solution for a misunderstood problem; or as Orlikowski (2000, p. 416) writes: “simply a solution in search of a problem”.

This element of the product, in current usage, represents a wasted investment of development time, finances, and organisational focus. Thusly, both the data and the conceptual model in figure 4 rather than pursuing scale; efforts should have been made to make EDTech a plausible solution within the trial schools, requiring, initially, a significant degree of integration support in tandem with adaptive maintenance so that over time standardisation and streamlining of the new install process can be achieved.

5.1.2.3 Scaling Impact Requires Evidence of Impact

The trial of EDTech in 11 schools in Mpumalanga was largely viewed by E-CEO as an easy proof of concept. If successful, this would be testament to the transformational power of EDTech to ‘fix’ South Africa’s education system.

In developing a track record of success, costs in the early stages of start-ups usually overshadow earnings thus making a breakeven point an aspiration at this point of business development (Blank, 2013). As such, developing case studies of success and being able to prove a product is impactful is necessary to gain the trust of new users beyond passionate early adopters and ensuring use is recurring. The failure of EDTech management to intervene during the early stages of the trial were described as being due to resource constraints within IMA. This highlights the short term costs of iterative development in the aftermath of an expensive development process involving very few users. However, in the long run this increases the probability a valuable, scalable product can be developed to generate revenue.

The diffusion of responsibility experienced though operating in an eco-system of multiple, independent actors combined with poor contract negotiation with the Mpumalanga Department of Education contributed to a lack of support being provided within schools. E-CEO's assertion that the informal contract renegotiation of training responsibility from EDTech to the MDoE was the cause of a lack of integration support. From the perspective of a teacher keen to increase their use of technology within the classroom; the lack of provision of training and support was the issue; not the provider. This is reflected in the rich picture diagram which forms part of the praxis model in appendix E. It gives a visual representation of different stakeholders, their perspectives and their relationships.

Such a perspective does not foster an enabling environment within the trial schools; limited EDTech's ability to learn if, how, when, why, and why not schools use the technology; and continue the development process of the technology to a point at which adoption of the product happens as user retention increases. This is representative of the build, measure, learn cycle in the lean start up (Ries, 2011); which typically happens prior to product-market fit being achieved, but should continue through ongoing development.

In spite of E-CEO's emotions when discussing the MDoE requesting responsibility for training (referring to the MDoE and its employees as incompetent); according to lean principles, EDTech management should have maintained regular contact with trial schools with learning (or "structured sense making" (Liedtka, 2015, p. 934)) as an organisational priority. This should have involved visits to understand why digital libraries were mostly resigned to cupboards and safes. These visits didn't happen and thusly, user based accounts of non-use only emerged through the research process for this dissertation. The researcher was the first representative of EDTech to visit RCS-A

and RCS-C for more than a half day since initial training was provided. This experience of expecting scale through “rapid saturation” without an evidence base of success was similarly experienced by OLPC (Warschauer & Ames, 2010, p. 36). As the conceptual model in figure 4 shows, the lack of target group representation and linear development processes hinder the development of effective and scalable technology based solutions in the complex ecosystems presented in the rich picture in appendix E.

5.1.2.4 Summary of Strategy for Growth

The ambitious growth strategy of EDTech caused management to overlook key factors which directly contributed to the failure of the project. These include the assumption that product-market fit had been achieved and exponential growth was inevitable; ignorance towards the contexts of resource constrained schools in marginalised settings and no-fee government schools more generally; and the diffusion of responsibility for training.

Evidently, the perception that EDTech was a finished product played a major role in shaping the expectations of E-CEO for the trial in terms of the value he perceived teachers to realise based upon their limited appreciation of the context. Subsequently, this perception of having a finished product saw E-CEO move from a perspective of design and re-development for a new context to focussing purely on diffusing the product. Furthermore, the lack of systematic training as a result of contractual disagreements, led ultimately to one of the more straightforward explanations for a lack of use: a lack of integration support and learning about users.

Without adequate training and support to use the technology; effective use will be difficult to realise and without evidence of effective use; attempts at scaling are unwise or futile tasks (André & Pache, 2016). If a product is scaled when there are usability/integration issues; this correspondingly scales the costs and effort for the organisation to remedy these issues. The higher short term costs in iterative design and development will be recouped at a point at which a context relevant product with scalable implementation practices will be recouped in the longer term growth.

Determined attempts to scale at this stage will cause a great deal of frustration and demands for support as users perceive they have been over-sold the benefits of a technology (Warschauer & Ames, 2010).

5.1.3 Product Development as a Contributing Factor to Limited/Non-Use of EDTech

From a design thinking perspective, building empathy is central to the development of a technology product where managers, designers, and developers do not represent the lived experiences of end-users. “Time and again, initiatives falter because they are not based on the client’s or customer’s needs and have never been prototyped to solicit feedback.” (T. Brown & Wyatt, 2010, p. 32).

The next section of the discussion deconstructs the design and development process for EDTech to be used in resource constrained government schools.

5.1.3.1 Underestimating the Impact of Context on a Product’s Appropriateness

Development time was donated to EDTech from a for-profit software development company based in South Africa, from their social development fund. This was measured by a number of development hours and thusly may have limited the extent to which an agile development process such as lean or design thinking could be used. As there was no direct financial incentive for the developers to invest the effort required to redevelop the system for use beyond IMA hubs; this is another indicator that resources had not been adequately planned and allocated to allow for re-design for the specific context of no-fee government schools.

Biases towards EDTech (in its current form) as an appropriate solution, inhibited rational user based expressions of the sticking points and stressors within the school system; issues Liedtka (2015, p. 930) would specifically describe as “egocentric empathy gap” where E-CEO selectively chooses which information to believe based upon his world view and his subjective personal (financial and emotional) connection to the solution.

“Understanding the broader context might have enabled the development of something much more powerful, and something that would actually be adopted.” (Beckman & Barry, 2007, p. 33). Empathy building develops from observations of, and constructive conversations with users to get to the fine details of the problems the face or needs they have (Beckman & Barry, 2007). Furthermore, while potential users themselves don’t always know what they they want, a design thinking approach helps to mitigate this through rapid prototyping, and quick and dirty experiments (Liedtka, 2015).

Prior to the trial, this feedback was not systematically collected by EDTech. When combined with the organisation’s bias towards the product’s completeness and no donated development time remaining; systematic approaches towards product adaptations were not taken. As such, the prototype phase of EDTech’s development in no-fee schools was skipped over. The impacts of

missing this crucial stage of (education) technology development resulted in a very rigid, obtuse tool which is inflexible to suit the varying needs, wants, and stress points of teachers' work.

5.1.3.2 *EDTech and Determinisms: Users (and Their Routines) are the Weakest Link*

EDTech had imagined the technology would encourage schools within the trail to perform a massive shift in pedagogy from teacher directed, rote learning towards a more learner driven independent learning environment characterised by group work and independent research. Such a pedagogical revolution shares many of the core philosophies of the previously failed move to an Outcomes Based Education (OBE) policy after the transition from the Apartheid Bantu Education policy (South African Council for Educators, 2011; Thwala, 2010).

For many reasons, the OBE policy in South Africa did not last and some of the most potent reasons were due to insufficient resource availability within many South African schools and a lack of support to teachers to facilitate such a change. As such, “far-reaching restructurings tend to be driven through much too quickly, ignoring the long time it takes to establish new cultures, procedures, and skills, let alone new patterns of trust” (Mulgan, 2006, p. 157). EDETech attempting to introduce a completely new style of teaching and learning shows a lack of understanding for the historic policy context of education in South Africa and the well document experiences of why OBE failed.

E-CEO only visits RCS-B. As the best functioning school, this only served to reinforce their perception that it works when used correctly – a logical conclusion with a technologically deterministic perspective (Oliver, 2011; Selwyn, 2010). Therefore, in visiting RCS-B, E-CEO “may enter with preconceived notions of what the needs and solutions are” (T. Brown & Wyatt, 2010, p. 32). In this sense, EDETech is imbued in power politics (it works when used correctly) and is prescriptive of new teaching and learning cultures (where existing school cultures aren't considered “functional spaces” (Interview 2 with E-CEO)).

As Hodas (1993) explains the most likely technologies to experience success within schools are ones which mimic existing power dynamics and routines of teachers – explaining why projectors (smart boards) were used in each school. This was seen in earlier decades by the overhead projector (Hodas, 1993, p. 10). However, when the technology appears to subvert the role and routines of teachers or are said to provide a ‘more efficient’ way of completing tasks; teachers generally meet the technologies with scepticism and limited use (*ibid*).

The lack of cooperative design and development to understand *how* EDTech could reasonably be implemented was a major design issue led to an ineffective solution. Furthermore, the ambitious, out of touch, and previously failed visions of technology-facilitated pedagogies show neglect for an empathetic, experience-based implementation plan.

5.1.3.3 *Content: Quantity and Haste Vs. Quality*

The lack of a systematic approach to curating content for EDTech and limited foresight to understand the ease with which these resources can be confidently used is a primary barrier to effective teaching and learning with EDTech.

As a starting point, teachers who would eventually become end-users were not consulted in terms of what kinds of resources would be most appropriate. Instead, it was assumed that videos would add most value to lessons using EDTech. Many teachers found and used videos using their own resource identification strategies to compliment their teaching and specific issues emerged in terms of the quality of videos available within EDTech. Teachers mentioned they couldn't trust the videos to explain the key learning outcomes effectively and the researcher noted the lighting conditions within classrooms using technology were difficult to see given the colour contrast of videos.

Here there is tension in the value perception of EDTech between management and users. EDTech management perceived issues in the education system being partly to do with teachers not being adequately resourced (in subject knowledge and teaching support resources). This developed the predisposition towards replacing teachers primarily through providing videos. EDTech didn't trust teachers to explain learning outcomes effectively. While RCT1 outlined subject specific knowledge as a challenge; this, in their opinion, is addressed through ACE/T courses aimed at refreshing and updating teacher knowledge. RCT1 used videos to compliment teaching of more abstract theories which would supplement rather than replace their role as teacher. This subtle difference suggests that EDTech, in the content curation process, viewed teacher's subject knowledge issues as justification to subvert their role by replacing them with videos – confirming their biased hypothesis of the value of videos (Liedtka, 2015).

The teachers responsible for content curation were seen as contracted suppliers of digital resources as opposed to utilising their wealth of collective experience to benefit the project at a deeper strategy and decision making level. There was a lack of a coherent quality assurance process. Content was aggregated from existing sources (Khan Academy, YouTube, etc.) and rarely

developed in-house. Such diverse sources of content lacked the consistency, appropriateness, quality, and depth. These factors were sacrificed for developing a finished looking product quickly.

While attempts to crowd source the quality assurance of videos were made; such a system relied on users having an active internet connection to rate videos; the benevolence of users to actively engage in rating videos; and teachers submitting more appropriate content. The latter required a team of teachers (which in reality didn't exist) to vet the videos uploaded by teachers. Given the lack of users engaging with the platform and with the internet connection issues highlighted, this isn't a realistic solution to addressing the weakness of content within the system.

Given the significant financial resources invested in the content curation phase and the incredibly low use of it in practice – a lean approach to product development (which includes content as a critical component) would lead management, designers, and developers towards a very different approach to content curation. EDTech and the MDoE agreed mass aggregation of already available content for the 10 major enrolment subjects for all high school grades, However, a lean approach could have allowed EDTech to enter trial schools asking what specific subjects and grades would be most aided by additional resources and developing content in smaller batches. Here iterative build, measure, learn feedback loops would have allowed for detailed feedback on each batch of video content released and allowed EDTech to cooperatively design consistently good quality resources over time.

5.1.3.4 Technical Structure of EDTech at Odds with Practical Realities

There are specific findings, corroborated across field sites and data sources which indicate clear issues in content available within EDTech leading to limited use; the applicability of EDTech in its current design iteration; and device requirements for resource constrained school settings.

Specific issues such as the full screen button not working on iOS devices, and the time navigation bar not working effectively across all operating systems meant teachers could quickly get frustrated with the user experience. This makes users increasingly reluctant to use it again. As EDTech was unable (or unwilling) to fix these issues; bugs within the system remain and detract from a teacher's perception of a seamless, trustworthy, quality technology. As is generally accepted, ease of use positively contributes to perceived usefulness, thus increasing use more generally (Hong & Tam, 2002).

While in the early stages of IMA developing a digital solution to provide consistent, efficient music education there was significant involvement with users; this design philosophy did not translate into the integration of EDTech into schools. For example, learners were automatically directed to the data intensive in-app browser rather than the streamlined assessment facility.

As was the case in the OLPC programme; the idea that deep rooted, complex, and emergent social issues can be remedied through a digital solution which requires intensive teacher training and significant infrastructure development leads the programme towards failure (Bass, 2009; Warschauer & Ames, 2010).

The only way for EDTech to monitor utilisation, other than direct observation of use, is through data provided through online assessments. Given that even the best performing school faced serious issues with internet connectivity regularly; much of the online assessment content remained completely unused and thusly no utilisation monitoring was possible. Had there been an empathy building approach during the design and development phases of the product; different approaches to assessment design may have been identified to address the lack of assessment data and usage monitoring data more generally. The praxis model (appendix A) suggests addressing this through a redesign of the app and presents an alternative new business model which bundles internet services within a monthly fee with an HTML based interface for users connecting to the EDTech Digital Library.

5.1.3.5 Integration Strategy: Limited Understanding of Context and Owning the Problem

Assumptions made about existing teaching and learning practices taking place within these schools went untested due to the limited engagement of teachers. EDTech management couldn't develop an integration strategy and support programme to develop utilisation within the schools without understanding the broader context and other structures at play. While initially, this would consume more resources than it would produce; the opportunity was missed for organisational learning about how teachers want to, already do, and could use a technology like EDTech. Schools and teachers were 'left to their own devices' – metaphorically and literally – as was found by Selwyn, et al., (2017) in their paper titled as such.

EDTech management had perceived that teachers and learners would bring their own devices to school to use EDTech. While in many cases this did happen, given the specific context of resource constrained communities: access to devices and the quality of these devices is highly variable. Literature on BYOD policies tends to emphasise the very variable impact of one device per learner

policies have – and these studies tend to focus on countries like Australia (Selwyn et al., 2017). However, given the complex inequalities facing South Africa, the data reveals uneven access to technology suitable for a BYOD policy to reflect the redress and equity goals of South African education (Roberts, Spencer-Smith, Vänskä, & Eskelinen, 2015).

While some teachers and learners within the schools involved in this research had access to devices, some had partially functioning devices (RAT2's broken keyboard) or low-cost/low-performance mobile handsets. The latter lacked the necessary processing power to effectively use EDTech, not to mention the extremely limited mobile data balances users had to fully utilise the online only content. Not all android devices are equal and on the lower-performance end of the spectrum; EDTech is simply not fit for purpose given these limitations. Smartphone penetration may be increasing (Kreutzer, 2009); but the differences in processing power; screen quality; battery life; and product durability vary significantly between high-end and budget devices.

For more developed nations and more equitable societies BYOD policies may be appropriate. However, given the complexity of technological, socio-economic, and spatial inequalities facing South Africans in resource constrained families and communities – BYOD expectations are not appropriate, nor inclusive, and can perpetuate existing inequalities.

5.1.3.6 Summary of Product Design and Re-Development

From a product design and development perspective, there are several critical oversights made by EDTech. These stem from the perspective that the product was market-ready and 'worked', requiring no adaptive maintenance to the context of no-fee schools. This resulted in the EDTech management believing that in order for the technology to be integrated into classrooms; teaching styles and work practices needed to be adapted to suit EDTech, rather than EDTech being adapted to suit or subtly develop existing routines and work practices.

This approach undermined the realistic chances of success. Adopting the practice lens to view organisational change with technology; the application of a specific technology can be very different depending on the users (interpretive schemes); the organisational cultures (norms); and importantly the existing structures through which technology use is situated (Orlikowski, 2000).

While a co-creative design thinking approach was adopted for the early product iterations for IMA hubs; such a mindset didn't continue through to implementation in schools. This is reflected in the process of content curation which didn't account for the needs and feelings of teachers, nor the

ways in which they could realistically implement EDTech within a classroom setting. The relegation of integration strategy planning to the remit of individual schools coupled with the lack of support is akin to the belief “that the transformative power resides in the box itself rather than in the uses to which it is put” (Hodas, 1993, p. 7).

5.2 Limitations

This dissertation employed a qualitative methodology using purposive sampling. As such, the findings are not necessarily statistically representative of every no-fee government school in Mpumalanga, or South Africa.

In order to avoid researcher bias, three separate methods of data collection were employed to contribute towards a triangulation of sources, as mentioned in the methodology chapter. By utilising a mixture of observations and informal conversations, semi-structured interviews, and document collection and analysis; a number of perspectives were gathered within each encounter.

Research took place within a small geographical area where each school was within 5Km of the others. Each school operated within the same circuit (a geographical area under with the same manager). Therefore, the particular circuit manager responsible for each of these schools may have had a more or less hands-on approach with regards to technology use within their schools. This gives a rich picture of the similarities and differences between schools operating within relatively similar communities.

Qualitative research of this nature is heralded for the process of discovery (Gioia et al., 2012). The experiences of the specific schools involved within this study provide rich accounts of their experience with technology; much of which may be transferrable across schools in different areas experiencing similar resource constraints. Each school appeared to be a relatively high achiever; as such there is potential for differences in the enactments of technology within lower achieving schools. This highlights that even on the lower extremes of resource constrained schools; there are barriers in the integration of technology into teaching and learning.

With regards to the authors use of resource constraints as a term; in reality, each school experienced resource constraints in slightly different ways. Resource constraints may be an appropriate term to describe the general experience of operating within restrictive budgets. However, the specific mix and severity of resource constraints are unique to each school and affect teaching and learning in different ways.

The researcher's constraints in terms of funding, time, and transport limited the length of the research encounter within each school. Had the researcher been able to remain within these schools over a period of longer than one week each; the relationships between informant and researcher may have developed further and richer understanding of the operational conditions of teaching and learning within the schools, identified. However, given the studies explicit focus on a particular technology, observations of use, and the alternatives to EDTech give a broad frame for limited/non-use of EDTech.

5.3 Summary of Discussion

Principally, this research suggests that EDTech experience limited/non-use as a direct result of working on a project that was too resource intensive and beyond the professional capabilities of IMA, the board, and management. Resultantly, the prioritisation of EDTech/IMA's commercial logic over the music/arts development logic is reflected particularly well in uneven resource allocation (financial resources and funding applications and management time/focus) towards the development of EDTech as an organisation and as a packaged technology over IMA.

When the strategic decision of IMA to monetise the software developed for after-school music and arts education; mission redefinition became substantial mission drift. IMA hoped EDTech would become a mass-market oriented product aimed at sales to all government schools within South Africa. The high complexity of managing two completely different value streams with different beneficiaries (learners in IMA's drop-in hubs; and teachers and learners in government schools) and paying customers (provincial departments of education) proved too big a project to be realistically administered by a local arts education social enterprise.

With more integrated, complimentary value streams; EDTech may have limited their experience of the multiple objectives trap through a more manageable and realistic duo (rather than trio) of objectives (Garrette & Karnani, 2010); and developed sustainable revenue streams where commercial success and social performance are more integrated, even complimentary (Ebrahim et al., 2014; Santos et al., 2015). As such, the Praxis Model in appendix A suggests that EDTech/IMA would benefit from splitting and EDTech forming a social enterprise for itself and to have a simplified and integrated value stream.

There is a broad acceptance in recent years for agile approaches to software development such as lean principles (Ries, 2011). With the lean startup approach, the point of a technology product

delivering sufficient value for the cost of buying it; product-market fit is an important stage in the start-up organisation. A foundational error of EDTech management was to assume that based upon the relatively successful implementation within IMA; that this had been achieved.

However, the failure for any school to implement EDTech as expected and to make us of the full technological potential that it is believed to have, indicates product-market fit had not been achieved. Based upon the experiences of EDTech to facilitate independent learning within IMA; EDTech had been standardised for this specific context and the independent learning culture developed within the drop-in hubs.

The unchallenged assumptions of need within no-fee government schools could have been mitigated to some degree through target group inclusion in decision making and strategy setting. EDTech over-estimated the product's transferability. As such, no resources were allocated to the re-development for this specific context. Reflective through the determinism of E-CEO and through annual reports and reports to funders of EDTech highlight the rejection of responsibility for failure. This was further compounded by an over-reliance on limited assessment data requiring internet access within schools and a lack of observation of EDTech in practice.

Without observation data, EDTech management were unable to challenge their biases. Unfounded assumptions remained. Such a projection of need and a lack of empathy building for the project is imbued in power politics. This sense of 'we know what they need and how they need it' is, in the authors opinion, made more acute due to the racial composition of the board which leads of oversimplifications and biases towards black (South) African lived experiences (Mercer et al., 2003). Such oversimplifications are evident in the misunderstanding of the systemic impact of historical processes on development of former non-white areas of South Africa. Furthermore, the over-use and homogenisation of definitions of rurality, townships, poverty, and an under appreciation of the impact socio-economic inequalities reduced the ability to recognise contextual nuance.

While the idea of facilitating multi-media learning content through an offline server in resource constrained schools in South Africa is a good idea:

“An idea does not by itself solve a problem, but needs to be combined with time to develop it, skilled work to provide evidence for it, rhetorical work to make it plausible to others, and the support to put all of those in place” (Sismondo, 2004, p. 70)

Over the 5 or 6 years EDTech has been developed, there is still a lot of work to be done to realise a sustainable revenue stream. In terms of EDTech as a mass market product there is a need to ensure that content provided through the EDTech platform is consistent, reliable, trustworthy, and intuitive to be used out-of-the-box. Furthermore, in terms of the technical design of the system there is work to be done to repurpose the solution for the context of schools with limited access to reliable internet connections, not to mention for use on second hand and low-cost/low-performance devices.

However, this can only be achieved by fundamentally re-evaluating the core philosophy driving the development of the product. As such, a user-centred approach to design through adopting design thinking and lean startup principals is essential. Such an approach, given the track record of EDTech/IMA in delivering mass market education support through internet enabled technology, will require the inclusion of target groups such as teachers in setting strategy; scoping the needs of teachers and learners effectively; and innovating within the contexts of and constraints of the problems – as Prahalad’s (2006) innovation sandbox suggests.

Through an iterative design, development, implementation, and testing process; early value delivery should be a priority. To claim transformative potential within South Africa’s education landscape, there must be an evidence base of success. Resources must be applied within a framework of delivering the most value early on in such a process, critically; knowing when to stop development of one area and start on another. It requires a keen eye for agile software development where product managers are passionate about solving problems through cooperative design with users, and not prescriptive routines for beneficiaries.

6 Conclusion and Recommendations

Forward from the discussion chapter, there are three principal findings which underscore why there was limited/non-use of EDTech within resource constrained, no-fee government schools in Bushbuckridge Municipality, Mpumalanga.

However, with no experience of working with, managing, or implementing technology within resource constrained schools; this was a difficult task. Given the primary focus of EDTech Pty. Ltd. was financially motivated; resources were diverted from the core programme of social value creation. This can be considered mission drift (Ebrahim et al., 2014).

What makes the case of EDTech somewhat unique is the triple focus of the organisation. However, the example provided to explain the multiple objectives trap through the Danone fortified yoghurt is different in that the value spillovers associated with product were automatic (simply by consuming the product, not contingent on a change in teacher and learner behaviours (Santos et al., 2015). The implications of the multiple objectives trap may be more acute in coupling hybrids.

In the broader literatures on hybrid organisations seeking a dual logic of profitability and social impact; difficulty in managing these are highlighted as one of the core challenges facing managers of hybrid organisations. However, for EDTech to try and achieve this with the added logic of enhancing education in government schools; this seems to highlight an extremely difficult triad of objectives. Mission drift presents itself as the primary reason for failure within the EDTech trial.

While the focus of this dissertation is on explaining limited/non-use of EDTech within no-fee government schools; had EDTech not naïvely invested so much time, financial resources, management focus, and energy into the project; there would have been no technology (within the context of resource constrained schools) to have critiqued limited/non-use.

Specific issues which contributed to the failure of EDTech in practice are far reaching. Principally, failure emerges through the strategy of management to scale very quickly with a product that had no evidence of effecting improvements within the resource constrained contexts of schools.

Because EDTech management believed so passionately in the appropriateness and completeness of the product; this led management to believe, deterministically, that failure was not due to unsuitability for the context. Rather, from this perspective it was a failure because those responsible for the implementation (schools and the MDoE); didn't act.

Critical issues in the content are revealed through the data which resulted in a wealth of videos (over 15,000) which lacked depth, consistency, relevance for the specific contexts of schools; and neglected how these could be implemented within schools. The technical architecture of the product was not fit for purpose and this highlights the lack of effort on behalf of EDTech to understand the context they were trying to innovate within. Rather, an extremely expensive and time consuming product was developed to be relegated to the cupboards, cabinets, and safes of schools. Even when it was, as in RCS-B to marginal success, use was at the absolute most 15-20% of all content curated (only 2 out of 10 subjects were using EDTech in RCS-B and only in two or three grades).

Given this lack of appreciation for the context they were trying to innovate within; it is clear that EDTech did not foster contemporary design practices, principles and philosophies which now receive increasing credibility within social innovation theory (Kelley & Kelley, 2012).

The following section builds upon these shortcomings and makes various suggestions as to the development of a sustainable revenue stream for IMA; and optional recommendations to salvage what progress has been made to date with the EDTech technology.

6.1 Recommendations Based Upon Principal Findings

The recommendations are developed in tandem with the Praxis Model (appendix A) which details a potential business model and opportunities for EDTech/IMA to recover from their experience of the failure of the EDTech trial.

As such three options are presented, which account for the broader context through which EDTech/IMA operate in.

6.1.1 Recommendation Option One: End EDTech Pty. Ltd. focus in Government Schools

This recommendation is based upon a reflection of the competencies of management; commercial viability of the project; and realistic resources available within EDTech/IMA. This option has implications on how EDTech management and the board of IMA reconcile their experience of developing EDTech. Admitting failure to achieve the mission is a difficult process. However, considering the requirements of EDTech to continue pursuing commercial success; recognising EDTech's developments for government schools as a sunk cost would remove distractions and realign the organisation with the founding vision of IMA.

Because IMA and their constituent drop-in hubs utilise the technology, this is not a wholly wasted investment. However, continuing to prioritise resources and gain funding to pursue this as a revenue stream for IMA requires extensive work to ensure fitness for purpose for the context of resource constrained schools.

The effort and resource intensiveness of continued adherence to the commercial and social mission of EDTech, in EDTech/IMA's current form are unlikely to succeed. The author asserts this based upon the track record of the organisation particularly within the worldview through which the EDTech project has been led.

Furthermore, the lack of initiative of the board and management to ensure inclusion of target groups within decision making and strategy formation indicates a lack of appreciation for the needs of resource constrained schools. However, this is potentially because those who participate on the board of IMA as a non-profit; are members primarily to facilitate music education within disadvantaged communities. Therefore, given the extent to which finances, focus, creativity, time, and energy were diverted from IMA's core social mission; the continued commitment to EDTech beyond use in IMA's hubs will continue to restrict the fulfilment of music development of young South Africans.

Instead of IMA investing in the speculative revenue stream of EDTech; resources would be more reasonably be spent on developing revenue streams which are more integrated with the core social mission of IMA. This may involve prioritising the development of performance spaces and recording studios for IMA learners to use; which could be 'rented' to others for a fee when not in use by EDTech. However, it is not unreasonable to suggest that IMA return to a traditional charity model; operate within the established funding mechanisms for non-profits; and operate with a pure social impact logic.

6.1.2 Recommendation Option Two: Separate EDTech Pty. Ltd. and IMA

Given the multiple objectives trap and the disintegration of the social and commercial missions; complexity is inherent and managing of the competing resource demands social objectives difficult. The continued investment of money, energy, time, creativity and management of the project will continue to affect the ability of IMA to achieve its social mission. With EDTech as its own social enterprise; there would be a dedicated board to ensure the appropriate design, development and strategy of the organisation and technology. This would allow the inclusion of teaching professionals to ensure teachers are viewed as 'antagonistic assets' systematically throughout the organisation.

Such an approach would require redesign and redevelopment of the platform, in line with what is suggested in recommendation option three, below.

6.1.3 Recommendation Option Three: Fundamentally Re-Design and Re-Develop EDTech

Based upon the research within resource constrained schools; there are specific recommendations to EDTech to increase the likelihood of EDTech achieving its multiple objectives.

The following key recommendations are based upon the praxis model presented in appendix A. The following is a summary of what is contained in these documents.

Firstly, EDTech require a critical reflection on the recent trial which wielded significant levels of non-use. Current organisational perspectives (including blaming the MDoE) are inadequate. These neglect the internal issues identified with EDTech. Such critical reflection should prioritise interrogating the motivation of the board, staff and management to continue with the EDTech project.

Secondly, an empathy driven user consultation must happen. While this dissertation has uncovered the complex process of integrating technology into resource constrained schools; EDTech management must create organisational governance policies which prioritise communication, co-creation, and iterative re-development processes. This could allow a process for EDTech to begin to learn from failures, and work constructively to address them.

Such a consultation process must push EDTech to convert perceptions of failure and blame into contextual learning opportunities. Given the complexities technology start-ups face, someone with design thinking experience should be brought into the organisation. The specific competencies of the experienced design thinker in this consultation process must seek to build shared understanding of the context between EDTech management, and the schools involved within the trial.

Thirdly, after this consultation period, based upon the lessons learned and specific assumptions used to build the current iteration of EDTech digital libraries; a process of fundamental redesign will be required. Such redesign should address the specific issues of EDTech experienced by schools particularly in the unsuitability for older operating systems and low-cost/low-performance devices, and the inadequacies of the current content catalogue, for instance. There are a significant number of constraints within schools as identified through the model in figure 15 and the contributing data, which highlight variable access to and the limitations of internet connectivity within schools.

Fourthly, following the lean startup principles during this process and throughout to the incremental development process where value is created early for users and; the development of technology cannot be carried out in a vacuum – as happened during the trial. Product development must follow a lean approach which is flexible enough to respond to feedback from users. As such the number

of schools involved within such a process must be significantly smaller even limited to two or three schools. There should not be a focus on standardisation in the early stages.

Fifthly, key partnerships must be developed with organisations who already specialise in digital education content and remove this responsibility from EDTech. These partners are required to free EDTech to focus on the development of technology for serving content in low connectivity environments. As such there should be a focus on integrating solutions within the trial schools to reduce the effort and complexity for teachers to plan, use, and evaluate their technology use. As such, this will require strong stakeholder management competencies, which EDTech may need to hire other external staff.

Lastly, the specific revenue streams open to EDTech may have to be fundamentally re-evaluated. Currently, sustainable monetisation of the product only comes through repeated purchases of digital libraries as the product begins to fail. Current predictions of the digital library life span are three years. Consideration of EDTech as a service could prove a more valuable revenue stream mechanism as this forces EDTech to ensure value is delivered throughout the whole experience and provides a key metric of the value proposition delivering enough value to schools for monthly, quarterly, or annual subscriptions. This could involve bundling mobile data through 4G sim connectivity already possible with the existing digital library hardware.

In summary, the third recommended option presents significant resource requirements due in part to the need to recruit experienced technology industry professionals. However, as is the case with technology focussed start-ups; it is rare to find such companies are profitable as soon as the first product iterations are launched. This requires recognition of the significant resources required for EDTech to reach product-market fit (prior to scaling).

Fundamentally, there should be an understanding that technology products are never truly 'finished'. Continued success is based upon incremental re-design and development. Had Facebook, for example, not innovated beyond its early product iterations; there would be no Facebook today. Facebook, Google, IBM, etc. recognise maintaining and enhancing competitive advantage relies upon continuous innovation and iterative development.

6.2 Areas for Future Research

There were numerous possible directions for this research. However, the author decided to focus on emerging theory within the area of mission drift and the implications of EDTech/IMA's

approach to product implementation within resource constrained schools in Mpumalanga. Other possible areas of enquiry adding to this body of research would be to have a deeper enquiry into the composition of the board and explore how the demographics of board members affects decision making, strategy, and inclusivity of those who are sometimes referred to in South Africa as previously disadvantaged individuals.

Additionally, given the tension in terms of the contract between EDTech/IMA and the MDoE; future research could explore more cases of the tendering process of education resource tendering as well as how contractual responsibilities and expectations are formed. Such exploration would encourage an understanding of how public-private partnerships are administered within the context of education in Mpumalanga, South Africa.

Such research to understand contract negotiations would help to explore some aspects of why training was not delivered to an adequate standard within the schools involved within this study and as such compliment this research's analysis of some antecedents of failure within the trial.

Further research to understand how these independent stakeholders may be brought into a unified project structure could facilitate a more productive use of resources between them and maximise each organisation's core competencies. Such research could work towards developing an evidence based, integrated strategy to increase the effectiveness of technology within schools; create enabling environments for teachers who wish to increase their use of technology; and build upon the work of the national Department of Education's e-Education policies (Department of Basic Education, 2007; Department of Education, 2004).

6.3 Summary

“The rabbit-hole went straight on like a tunnel for some way, and then dipped suddenly down, so suddenly that Alice had not a moment to think about stopping herself before she found herself falling down a very deep well... She had plenty of time to look about her, and to wonder what was going to happen next.”

(Carroll, 1984, p. 3)

In the opening chapter of Alice's Adventures in Wonderland, Carroll tells the reader briefly of the circumstances surrounding her decision to follow the white rabbit and quickly finding herself in a dark tunnel with no idea of what lay ahead. This is an appropriate metaphor through which to

describe EDTech/IMA's tumultuous journey; chasing after money; and ultimately trying to do business in a completely new, unknown context.

The metaphor of Alice following the white rabbit down the hole is akin to EDTech's experience of mission drift. At countless stages there were opportunities to evaluate progress; to understand where they were heading; until it was too late. The vast resources utilised in the process clouded objective judgements of the likelihood of the EDTech's commercial and social missions being achieved. EDTech/IMA followed the white rabbit only to find themselves in a place they could not recognise, nor relate to.

The critical difference between EDTech/IMA's experience of what happened next was that Alice was curious, developed empathy for her counterparts, and forged an adventure of learning about new realities – EDTech/IMA did not.

EDTech made two principal errors. First and foremost; to chase speculative future gains only to be caught in the multiple objectives trap where resources were spread too thin caused the failure of the project to realise commercial success and to positively benefit the South African education landscape. Secondly; deterministically assuming that because a technology works (within acceptable bounds) in a specific context; it's transferability is all encompassing; ultimately led to critical oversights. Thusly, the solution developed didn't address the needs of users and thusly a white elephant was developed. This secondary error is built upon emotional connections to a solution at the expense of gaining evidence based, empathetic understanding of what needs *actually* are and innovating solutions within these constraints, routines, practices, and shared visions.

7 References

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Appendices

Appendix A – Praxis Model Report

EDTech Pty. Ltd. Praxis Model

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Purpose:

To critically assess the current business model and strategy of EDTech based upon the trial in 11 schools in Mpumalanga and present an alternative. This is used to show areas of organisational learning to develop a ‘road-map’ for EDTech’s future development and implementations as well as presenting the business case for a revised business model.

Audience:

Senior management within EDTech, for examination as part of MPhil. Inclusive Innovation degree of the author.

Structure:

- A. Reflection on project to date
- B. ‘Road map’ to success
- C. A new business model
- D. The business case moving forward

Appendices Referenced:

- User Critiques of EDTech
- Comparisons Across Field Sites
- CATWOE and Root Definition
- Rich Picture Diagram
- Current Business Model Canvas
- New Business Model Canvas
- Interim Research Report (provided to EDTech by researcher)

Reflection on Project to Date

The annual reports of EDTech/IMA reveal key issues in EDTech's utilisation and the observation data contained within the dissertation show a mismatch between expectations and reality. An interim report produced by the researcher and provided to EDTech presents a summary of many of the main issues identified throughout the research process.

Process of Prototype Development

The approach to the project was to have a finished product as soon as possible. The fast pace of re-development for no-fee schools shifted focus from addressing user needs, to packaging a *vague idea* of what *might* be useful. This is a costly approach as what was developed is significantly underused.

Money was prioritised to be spent up-front for platform and content development prior to systematic engagement with teachers and learners to understand what content was required. The rush to develop a 'finished' app and Hub reduced the possibility of testing/maintenance as well as iterative design. This increased the costs of errors/misjudgements as it scaled through the trial. Early attempts to standardise without experience in diverse no-fee school contexts meant EDTech was not appropriate as a one-size fits all product. Scaling for increased penetration was therefore premature (as outline in the dissertation).

Issues in Hub, App, and Content Design

The extent to which internet access was available was overestimated and the reliance on an internet connection for seamless user experience limited the Hubs usability and offline use of EDTech often presented error messages. The App/Hub interoperability software architecture is processor intensive and not suitable to user devices typically found in the trial schools involved.

Content lacked in several key areas. This was in the quality of content available but also how useful and relevant it was in depth and accessibility. Issues relating to content, app design, Hub design, and the interoperability of hardware and software are shown in the document labelled 'User Critiques of EDTech'.

Critique of Business Model

A brief of the current business model is shown in the 'Current Business Model Canvas' document.

The business model for EDTech was focussed on the sale of Hubs as assets as opposed to a subscription based model. There was a ball park 3-4 years' life span placed on an individual digital library. It was assumed the product would work and that repeat purchases would be sufficient. However, should the hub actually have a life span of 5-7 years, then income drops significantly. Additionally, reliance on the sale of Hubs as one off purchase assets increases the upfront costs to use, making EDTech less accessible to no-fee schools and also conceals the hidden costs, particularly in mobile data/internet connectivity (essential for the full functionality).

EDTech was envisioned as a large scale, multisided platform. This requires EDTech to simultaneously cater for learners in need of extra resources and practice assessments; teachers in need of time efficient teaching materials; and school/class progress reports generated for departmental officials to use. These are three very different user groups. For the value proposition to be realised for each three relies on consistent, widespread use of the online assessment facility.

There were many functions build into EDTech Digital Library and App. This was far above what teachers described as their needs. Teachers were not asking for class analytics. They needed resources which could explain and structure important topics but perhaps more pertinently, time saving techniques.

The current business model has several key strategic weaknesses which include the broad user groups who were intended to be targeted. For instance, learners as users are considered within the classroom under the supervision of teachers and for use at home on their personal devices which they download content to.

This is problematic in the sense that even learners with devices theoretically capable of using the App struggle due to device performance. This essentially creates an exclusive group of potential users who have stable enough socio-economic networks to own devices capable of running EDTech. This increases the relative disadvantage learners from less economically stable families face. Those who can afford technology are the only ones who could realise the full benefit of EDTech.

Key failures in this current business model was the lack of communication with trial schools to identify support needs and explain low utilisation; a lack of any follow-up policy to understand when utilisation does and doesn't happen; and the risky 'build everything, release, and see what happens' development process.

The trial was viewed as a proof of concept exercise, not a prototype test. As such, little thought was given to being systematic in the approach to monitoring and evaluation. This was further compounded by the weak links between the inputs, outputs and impact of the innovation (shown through the CATWOE analysis).

Typical of a traditional product development project, costs can only be recovered after development has finished and a product is perceived by the developers to be market ready. However, this is contingent on the intuition of developers to correctly identify ‘market readiness’ or Product-Market Fit (PMF).

Limited User Engagement and Co-Constitutive Development

The prescriptive approach of EDTech management to implementation did not reflect the lived realities within schools. There was limited target group representation in the foundational phase of identifying EDTech’s purpose and design. The problem definition developed by EDTech was not generally representative of the user market.

The document titled ‘CATWOE Analysis and Root Definition’ outlines the organisational perspective of the environment EDTech saw themselves as operating within. Key insights from this tool show a large gap in how EDTech as a standalone technology can be a pivotal tool in improving education within Mpumalanga. The lack of an explicit, realistic, and testable theory of change model reduced EDTech’s ability to systematically test if, what, how, when, and where the prototype improves education outcomes.

‘Road Map’ to Success

Step 1 – Organisational Introspection

In light of what was broadly perceived as a failure; in the aftermath of the EDTech trial it is vital for EDTech management to engage in an organisational reflection and learning process.

This should focus on:

- How does the organisation feel about the outcomes project?
 - Is there the will to go back to the drawing board?
- **IMPERATIVE:** how can failure be converted to organisational learning?
 - Instead of blaming teachers for non-use; ask why are teachers not using EDTech?
 - What factors (other than lack of training) contributed to non-use?
- Can EDTech identify endogenous factors which limited the chances of success?

- Points of failure should be de-politicised
 - Rather than blaming stakeholders, how can these be framed as non-aggressive barriers?
- Can the organisational structure and business model of EDTech/IMA be changed?
 - Could EDTech form its own dual structure social enterprise EDTech Pty. and EDTech NPO)?
 - Could a different value proposition (and bus. model) be pursued?

The ultimate questions EDTech/IMA should answer by the end of this step are:

- Is there still drive to enhance the experience of education in South African government schools through a digital education solution?
 - AND does this drive to enhance SA education bigger than the drive to finance IMA?
- Is there energy to fundamentally revise the processes through which EDTech is designed, developed and managed?
 - Are users reconsidered as vital assets and strategic partners going forward?

Step 2 – User Consultations

If EDTech answers yes to all of these major questions, then a user consultation is essential. This should prioritise observation and interviews over data gathered through online assessments. This should be the first step in ensuring teachers are involved and encouraged to participate in shaping what EDTech looks like.

At this stage someone with design thinking experience should be brought into the organisation to provide technology focussed design experience.

User Consultations will have three primary functions:

1. Understanding what functionality is needed by teachers
 - a. Do teachers need resources?
 - i. E.g. videos, slide decks, work sheets and when these are useful
 - b. Do teachers need a curriculum tracker/planner?
 - c. Do teachers need ways to save time in the classroom?
 - i. Where are the current bottlenecks in the classroom?
 - ii. Which of these are simplest to address and give the most value? (think Pareto analysis)
2. Exploring what content is required, useful, relevant, and accessible
 - a. Is rich multimedia content appropriate?
 - i. When is it and when isn't it?
 - b. Are teachers' main concerns with regards to textbooks and additional teaching resources for learners to work through?
 - c. When are videos useful and when are they distracting?
3. Understanding when, how, where, and why (not) teachers would use a digital solution
 - a. This must be seen as to constrain the scope of the project brief
 - b. Is there sufficient demand for a digital solution?
 - i. Is this demand clustered within specific schools or spread throughout many different schools?

- c. Why did teachers not use the current prototype?
 - i. Technical reasons?
 - ii. Content reasons?
 - iii. Time?
 - iv. Digital literacies?
 - v. Accessibility, etc.?

This stage will provide rich description of the actual needs, wants and restrictions teachers place on digital solutions within no-fee school settings. It would be most useful to visit every school involved within the trial to gain some level of feedback.

This stage will throw up many ideas. This is why it's important to have a design thinking practitioner to guide and document findings throughout this consultation. This user consultation will naturally lead to the 3rd stage of the road map. However, this is assuming there is no change to EDTech management's drive to continue with the project in light of hearing what teachers bring up throughout this process. This can be thought of as a lighter product design process than what step 3 suggests.

The aim of this step is not to produce a project specification, but rather seen to validate and challenge EDTech management assumptions of the value the EDTech Hub delivers. Without having these assumptions built into the previous prototype, challenged; the same misjudgements are likely to be repeated.

This stage will involve a lot of high level planning such as repeating the use of business analysis tools such as the CATWOE, Root Definition, and Rich Picture development. These tools bring with them benefits of capturing multiple (occasionally contradictory) stakeholder perspectives. This is important for identifying potential tensions which may arise.

Step 3 – Re-design process

This stage is where the design thinking process starts and where iterative design, development and implementation are carried out.

As with design thinking, the idea is not to develop a finished looking solution as quickly as possible. The priority is to add value as quickly as possible. Often times this is not profitably scalable. This is not the goal of the early prototyping phase. The philosophical basis for design thinking will require that the design thinking practitioner take the lead in this process. This is where the most value from their competencies will be garnered.

This step is difficult to pre-emptively plan. Instead the questions that require answering at this stage is to what extent can EDTech be realistically re-designed? These are presented in order of most likely to realise a sustainable organisation in the medium/long term (in the author's perspective).

1. Total overhaul and redesign (back to the drawing board)
2. Significant revisions (retaining a lot of the technical architecture previously developed)
3. Minor bug/error fixes (this is not a good choice as it neglects the structural issues inherent in EDTech's previous prototype)

The researcher's opinion is that the current design lacks appropriacy in ways that the time, effort and resources required to retrofit the current prototype to the context would outweigh the benefits of a radical redesign.

The least financially costly option is to only address minor bugs/error fixes. However, this would limit the chances of success due to its high processor power requirements of devices and the Hub's high internet data requirements.

If the most radical solution is opted for (option 1), this frees EDTech to reimagine how digital solutions can positively impact the experience of learning in South African high schools. This would represent a more authentic design thinking process as overlapping spaces as opposed to stages as it offers a 'fresh start'.

Here, there will be an emphasis on developing paper based/low-tech solutions, rapid prototyping, significantly manual process (not yet digitised and packaged as a final, market ready product).

Step 4 – Re-Development Process

As indicated, this isn't a distinct stage. It rather represents moving from rough rapid prototypes into more 'product resembling' and 'packaged' prototypes. Again, iteration is a key consideration. If something doesn't work like it was expected to after early stage developments – go back and learn something about why it didn't work.

The researcher advises the following tightly scoped boundaries:

- Forget about:
 - Class analytics
 - they are never used and there is nowhere near enough data for any meaningful analysis to take place
 - Nationwide scalability

- the focus in the early stages of rapid prototyping is not of sustainable scaling
 - it's about success replication (even when costs outweigh income)
 - Financial sustainability will come over time with luck and evidence of success (no design process can guarantee commercial success)
- Prioritise:
 - Focus on small number of schools
 - 2-3 schools within easy commuting distance from the EDTech office is vital (think about visibility of the schools to EDTech)
 - 1-3 subjects which from the smaller sample of schools' highlight as subjects where digital education could add most value
 - Listen to teachers, first
 - If an idea does not get the approval of teachers – don't spend money or waste time developing it
 - Ask first, quick and dirty prototype second, ask again, prototype again...
 - Only 'build' when a prototyped element has a realistic chance of being used
 - For every newly designed, built, and revised element, the lean start-up approach to purposeful should guide action
 - Intentional experimentation should be prioritised through the build measure learn cycle – **Fail fast, fail often, fail early, learn.**

Step 5 – Implement in Increments for New Locations

One of the big oversights of EDTech during their failed trial was to seek scale as a primary objective. The EDTech hub had not reached product-market fit.

At the stage of incremental implementation, schools should be added on a case by case basis and perhaps look to phase in the product by modules. This allows for the important process of planning implementation and training/support requirements for new installs to be systematised over time.

New installs are selected strategically for being similar enough to the initial 2-3 schools involved within the re-development. EDTech MUST be expecting to make changes to adapt the product to slightly different operating contexts.

Even with a small pool of schools, this research highlights through the 'Comparisons Across Field Sites' table that even schools within very close proximity to each other have different access to technology, management styles and processes, student bodies with variable strengths and development areas.

The New Business Model

A new business model is presented with this praxis model through a business model canvas. This section outlines the key elements of the suggested approach to developing financial self-sustainability and social impact (organisational hybridity) within the operations of EDTech.

This introduces the new business model's key elements; what has been stripped out from the previous business model; where strategic focus and resources should be; and an overview of some mechanisms to ensure organisational hybridity can be achieved.

Exploring the New Business Model Canvas

The Value Proposition initially presented needs revisions to address the concerns users raised throughout the research process and in keeping with the findings, learning, and reflection of the various steps of the road map to success section.

As opposed to a focus on providing a plethora of content varying in quality, consistency, and appropriateness for the context of no-fee schools; the revised value proposition should seek to structure current curricula into interactive, 'classroom ready' lesson plans with integrated slide decks. These should be given to teachers in formats which can be printed and used manually as well as more integrated slide decks for teachers. Ideally, this would be done in partnership with the NECT group of organisations.

As a time saving mechanism, slide decks following the currently paper based NECT lesson planners/trackers appear to the researcher to be the most appropriate vector of digital content. Videos may be incorporated into these slide decks, but the principal aim should be allowing teachers to talk and show the theory as opposed to verbatim, regurgitations on chalk boards of what appears in current teaching guides. This reduces the time a teacher's back is to the class; may increase student engagement; and ideally provide a more seamless teaching and learning experience.

The idea of developing online assessments as a dual function learner assessment facility (to benefit teachers and learners) and utilisation data source (to benefit EDTech) is not farfetched in principal. However, little thought was given to the context of no-fee schools and the logistics such a drastic change in pedagogy requires. Additionally, the requirement of Internet access to use this feature further reduces the likelihood schools will feasibly be able to implement this feature.

As such, akin to printable lesson plans, printable test sheets would equip teachers with resources that they themselves can manually administer. There is nothing to stop marks (question by question/test by test) being input manually as a way for teachers to track whole class progress. This would reduce the vast data requirements observed in RCS-B where out of a class of 30, only 6 learners could complete an assessment.

The Customer Segments should be reduced to thinking principally about teachers. Teachers are the gatekeepers in a sense of how learning takes place. Therefore, when a teacher decides to incorporate EDTech into their practice, learners will follow suit. It is vital that teachers do not feel undermined by the technology. In fact, it's essential that the technology is build to be viewed as an enabler of teaching as opposed to a subversion of their craft. While considering how learners come to experience EDTech is still an important factor; teachers should remain the priority user group.

Customer Relationships is a key area neglected by EDTech throughout the project. No systematic approach to managing user feedback was in place and there is no log beyond the recollection of E-DBA of issues which arise in use. One quick, easily implementable solution would be to create a customer query database through Google Forms to log every call for support, the school, etc. This could be made in 15 minutes and live instantly providing a systematic approach to recording user support requests.

WhatsApp and Facebook continually emerges as vital communication channels as these require minimal and for many users, free communication platforms (Facebook free-basics on some networks).

These emerged organically as the best way for teachers to communicate and engage with EDTech (via. E-DBA, the researcher and the organisations profiles and pages). There could be room to exploit this preference towards messaging by creating WhatsApp groups for teachers to share their experiences in a semi-moderated, digital group space.

Delivery Channels are interesting to consider in relation to social networks too. Given the rise and power of ChatBots within the tech space, there could be a move to innovate within this space. This could serve content through accessible platforms such as WhatsApp or Messenger where text, images, videos, and audio can be sent. This would be an exciting area to explore and create on demand, digital learning content access. Many mobile networks within South Africa offer mobile data packages specifically tailored for apps such as WhatsApp for under R20 per month (roughly

£1.30). EDTech could explore this with relatively low costs given elementary training in the Watson system by IBM.

Revenue Streams need to be fundamentally revised. The researcher believes revenue streams need to be more intrinsically linked to improved education. While these are broad, one such way highlighted through the business model would be to focus on subscriptions to EDTech as opposed to asset sales. Internet access is consistently highlighted as a top operational concern. If EDTech were to bundle mobile data packages with the Hubs and simultaneously reduce the requirement for internet access through redesign; a service based subscription would allow EDTech to see how much value schools saw in the system. This would also increase the opportunities for usage data to be transmitted from Hubs.

As subscriptions (e.g. monthly or 6-monthly) increase or decrease; this gives EDTech the opportunity to observe which schools don't see value in EDTech. While bundling mobile data could be costly, through the implementation of an APN; significantly cheaper rates and longer usage periods can be spread across all schools. As a guide, through an APN data supplier 20Gb of mobile data valid for 3 months across unlimited sim cards can cost R219³ as opposed to retail rates (for ordinary individual users) 1GB costs R149⁴. Incredible savings are possible against consumer prices and immense value creation in bundling data services become obvious.

As schools already face issues in access to the internet, this is another feature of EDTech which could position it much more favourably in the eyes of schools and could incorporate the costs of mobile data (hidden in the current business model).

Key Activities within the current business model were largely in the development of EDTech. There was no formal follow-up policy to visit schools regardless of performance. Additionally, training was not considered an activity within the remit of EDTech. Content provision was seen as one of the key activities throughout the development phase. In practice however, the output of this activity provided low quality content.

As such, the new business model suggests developing key partnerships with existing content providers who have key competencies in developing engaging, out-of-the-box ease of use, relevant,

³ Source: <https://www.axxess.co.za/mobile/cellc> [accessed August 2018]

⁴ Source: <https://www.cellc.co.za/cellc/get-databundles> [accessed August 2018]

and consistent learning resources. EDTech would act as a vector for such content providers to access new markets unserved without access to the Internet. This should free up time, resources and efforts to focus on providing consistently great learning experiences through technology.

By partnering with organisations providing desirable content such as IXL or homeschoolersSA; EDTech could focus primarily on user experience and the technology which enables meaningful content to be delivered. EDTech have shown through the prototype Hub that technically it can serve content in a somewhat structured fashion. Critically however, spreading organisational resources across content curation/development and technology development phases limited the extent to which the technology could offer seamless experiences. The time and money spent on content curation/development produced sub-standard resources, the vast majority of which were unused entirely.

Key Partners are explored in part through the CATWOE document. While the various levels of DoE are still the most important external stakeholders; this business model adds content providers as vital to the success of EDTech going forward. Leveraging content providers' competencies (such as IXL and HomeschoolersSA) would allow the burden to be shared and recognise the role EDTech plays within the eco-system of multiple, independent actors.

Additionally, given the limited involvement of teachers throughout the trial and development of EDTech, the involvement of teachers' unions could provide a starting point to engage with professional teaching bodies. This could contribute throughout various stages of the iterative development process for development of design prototypes prior to development with organisations whose purpose is to represent the interests of teachers in South Africa. Additionally, a partnership with one or more teaching union may give further credibility to the project above and beyond the MDoE alone.

Given the social enterprise structure of EDTech/IMA (or EDTech alone should the organisations split); this may allow some level of leverage when approaching mobile network providers when seeking preferential data rates through an APN set-up. Providers such as AXXESS provide APN products which are competitive at commercial rates. This is potentially a partnership which could, over time and with evidence of success, leverage greater buying power of EDTech given the social purpose of EDTech.

Key Resources within the new business model will reduce the burden of content creation/curation from EDTech. Given that much of the content was curated from external, third party sources, this content was never truly an asset belonging to EDTech. Instead, over the course of iterative technology development, the value of EDTech will be more focussed on technology as a key asset.

As such, the development of, for instance, an HTML based interface for the hub (as opposed to the App) could provide a starting point for reimagining how users engage with EDTech. While the App offers somewhat acceptable user experiences, an explicit focus on the technology within the new business model can refocus efforts on delivering consistently seamless and positive user experiences. As has been seen through the negotiations of technology in content model in figure 15 as well as more generally through UX and Technology Acceptance Modelling (TAM); increased user satisfaction, perceptions of ease and usefulness have positive impacts on repeated use. A focus on creating such experiences are vital in ensuring the technology becomes a key resource/asset over the longer term.

The suggested centrality of social media within the new business model as both a customer relationship and delivery channel would mean EDTech need to upskill existing employees such as E-DBA. E-DBA's skill set appeared to be undervalued and investment in their professional development lacking. As a key resource, E-DBA should be cross-trained and reskilled to have a more strategic role within EDTech.

The Cost Structure within the new business model are changed particularly through the suggested bundling of mobile data with the Hub. Regardless of how this is packaged and marketed; it offers EDTech the opportunity to increase interest in the product and actually offer savings to schools such as RCS-B who currently buy their own mobile data for EDTech. This could be recouped through the EDTech as a service subscription model.

By partnering with content providers, EDTech would remove the cost burden of content curation and allow it to be redirected this into technology development. Technology development costs would represent an increase if EDTech were unable to gain donated development time. However, given the particular issues identified with the donation of development time (a rushed, non-chargeable project and development happening in a vacuum of users); this may ultimately allow EDTech to bring development in-house.

With an emphasis on following lean and design methodologies; the benefits of in-housing development could reduce the distance between development and users ultimately leading to a more relevant product. In-housing development will only allow for a more empathetic approach to design if it is supported by iterative, user centred design approach.

Strategic Focus Going Forward

Strategic focus of EDTech within the new business model should be in three main areas:

1. User centred design processes
 - a. Reducing the number of schools who participate in early stage prototype iterations
 - b. Working with teachers with enthusiasm, interest, and experience as key participants in the design process
 - c. Ensuring systematic build-measure-learn cycles are planned, carried out and issues addressed
 - d. Incremental design, early value creation for users, less focus on the short term financial sustainability/commercial viability
2. Building and maintaining relationships with content providers
 - a. This is key for the new business model
 - b. During consultation with teachers (step 2 of road map to success); identify organisations whose resources teachers' liked
 - c. Seek to work in partnership with these organisations to adapt this content for use in offline EDTech environments
3. Systematic approach to and documentation of integration in schools
 - a. At each level, all the resources, time and costs of integrating EDTech into schools should be recorded
 - b. This will give a clearer idea of the true costs of implementing the solution
 - c. Understanding of total cost of implementation will help in designing a systematic approach to integration within schools
 - d. While integration can't be streamlined in initial trials, over time as the technology gets closer to PMF, integration should become systematised

Aligning Commercial and Social Impact Logics

From the dissertation, EDTech/IMA failed to achieve successful hybridity. This is in part due to having two separate value chains (EDTech as commercial and IMA as social). These two value chains are disintegrated. The new business model suggests restructuring the social enterprise model to separate IMA from EDTech, while creating a NPO for EDTech. Such restructuring would allow EDTech NPO to have its own board made up of individuals with a primary remit of ensuring the effective development of a digital education solution.

Within the new business model suggested for EDTech is introducing a subscription model with data bundled within this subscription cost. This allows EDTech to have shorter cycles between customers repeat purchases. This in turn will force EDTech to ensure that user experiences are positive and enough value is delivered to the customers for repeat subscriptions to take place.

As internet services will be bundled with EDTech, this will allow for more utilisation data to be transmitted to EDTech remotely from each school, and in time for remote support to be provided by EDTech.

However, ensuring repeat subscriptions is only broad proxy indicator of social value creation. Within the current organisational structure (shown through the CATWOE document) social objectives and impact are not reasonably measurable. While ‘high school leavers with skills for the economy’ may be a longer term impact of EDTech (assuming excellent learning experiences can be delivered through it); this will not be measurable until years after learners stop attending schools.

E-CEO sought to compare EDTech utilisation and exam grade improvements as an impact proxy measure. This is also not a good measure of the impact of EDTech as there could feasibly be other contributing factors within the school such as improved access sanitation facilities (allowing girls to attend school more regularly); teachers completing ACE/T courses; school management implementing new policies; etc.

Through developing an explicit theory of change, EDTech will find more immediate measures and proxy indicators of social value creation. This, for instance, may include understanding of the time savings slide decks provide teachers (they don’t have to write on chalk boards).

A theory of change is an important process which forces EDTech to think more clearly about the steps in between large scale, long term systemic impact inherent in the organisational vision; and the practical improvements that are more observable in practice.

Summary of the Business Case

The revised business model for EDTech builds upon the research for this dissertation. It is primarily focussed on removing/reducing the barriers to use (e.g. poor internet access; poor user experience; broadening access for low-performance devices); and providing useful, trustworthy, easy to use content.

Addressing these concerns and removing a focus on rapid growth/scaling will allow EDTech to focus on:

- building a solution which is relevant to the needs of teachers by consulting and testing with teachers throughout redesign/development
- understanding the requirements to increase utilisation of EDTech within an individual school
- making it easier for teachers to use EDTech within their classrooms
- building a solution which adequately addresses the issues teachers face implementing digital education in no-fee schools

Contributing factors leading up to and during the failed trial of EDTech in no-fee government schools were:

- a lack of user involvement in adapting EDTech for use within no-fee schools
- self-imposed pressure to scale for financial sustainability quickly
- no resources planned for testing/maintenance/training/post-install support
- no coherent process for measurement & evaluation and impact assessment

Critically, the link between EDTech (in its current form) as a potential social innovation and the wider impact is tedious. There is a significant gap between EDTech contributing to socio-economic growth and how this is achieved. It is almost impossible to measure. The simplistic input-process-output-outcome beliefs (shown in the CATWOE document) did not foster critical engagement with the issues at play.

The value created by EDTech is contingent on the technology being suitable for the context; the opportunity for teachers to implement it successfully; as well as broader support from within education institutions. Therefore, it is not feasible to expect that EDTech alone (as a technology) will impact positive change. Subsequently, a fee-for-service model will allow EDTech resources to provide on-going support and development.

A market ready product may only emerge after 2 or 3 years in smaller scale trials, therefore a long term perspective on financial sustainability must be sought. By partnering with existing players in digital education, EDTech can produce a digital education solution which is high quality, accessible, relevant, and potentially financially sustainable in the long term.

Appendix B – User Critiques of EDTech

Problem Area	Symptom	Likely/Potential Cause(s)	Impact(s)	Evidence	Remedy
Content	Aspect Ratio (black ‘boxes’ around video)	Inadequate attention paid during video encoding to maximise screen real-estate. Issues in some videos comes from the method used to record screen	Even when videos are ‘maximised’; they do not occupy the screen fully	Images Conversations interviews	May not be possible if the original video uses 4:3 aspect ratio. Must be considered for an in house content developed and be incorporated into content curation checklist
	Black background and coloured text on videos – difficult to see clearly	Inadequate consideration of accessibility (not proactively designing for users’ visual impairments) Inadequate curation of content for use in RCS conditions	Videos are almost unusable in high natural light conditions in RCSs and users with visual impairments suffer most.	Images	Check all content for accessibility in terms of colour contrast e.g. https://webaim.org/resources/contrastchecker/
	Accent/pace of speech of video narrator difficult	Videos designed for other contexts (native/proficient English speakers) not designed to consider the SA context/curriculum	Videos can be difficult to follow and require significant pause, play, rewind, etc.	Interviews Conversations Training sessions	Policy on content curation (external content providers) and make checklist based upon user comprehension metrics Utilise SA developed content by partnering with Mindset, SABC education, etc.
	Videos not made by school teachers or for school classrooms	Videos curated through YouTube may have been considered superficially and not based on evidence	Videos lack the explanations required to deliver core concepts to an adequate level to replace the need for a	Interviews Conversations	Policy on content curation (external content providers) and ensuring content is vetted by

		of appropriacy and ease of classroom integration	teacher. I.e. (not every component of the CAPS documents are covered)		teachers using alternative content curation processes
	Inadequate Content available	Content curated doesn't always cover all modules of all courses. Content curators for visual arts only made content for 2 out of 4 optional modules. Agriculture content not available but teacher wanting to use technology	Visual Arts teachers unable to use the resources for the modules they opted to teach. Teachers wanting to use tech can't because their classes aren't catered for	conversations	Selecting content to be developed/curated in partnership with existing users to ensure resources (time, finances, HR) are mobilised to foster high utilisation.
App Design	Time navigator on the in-App Multimedia Player not functional	Issue in the design of the app meaning users are not able to manually drag the time locator to a specific point to replay a section of the video. The go back button sometimes restarts the video (from the beginning) or moves it by a mater of seconds	Videos where there are content comprehension issues are difficult to use. Seriously impacts user experience as these features are standard across media players	Images Interviews Observation	Requires redesign of the multimedia player within the app. However, there may be difficulties in pushing this update given the high cost of mobile data.
	Full screen mode on iOS app doesn't work effectively	Issue in the design/testing of the app prior to full release.	This exacerbates the aspect ration issue greatly as videos do not occupy the screen fully	Interviews Observation	Requires redesign of the iOS app.

					However, there may be difficulties in pushing this update given the high cost of mobile data.
Limited App OS Compatibility	<p>App was designed to operate on newer operation systems only e.g. Windows 8+.</p> <p>No legacy OS compatibility or alternative App distribution</p>	<p>Users using Nth hand devices struggle to use EDTech due to OS incompatibility.</p> <p>EDTech user market is restricted to less resource constrained individuals – mass market option not available</p>	<p>Observation</p> <p>Interviews</p> <p>Conversation</p>	<p>Consider alternative App distribution methods over and above App stores. E.g. distributing App .exe file through the Hub, EDTech website, etc.</p>	
Inefficient system architecture for low-cost/low-performance devices	<p>App designed on assumption that ‘a Smartphone’ is ‘categorical’ i.e. doesn’t link the rise of smartphone penetration with the increased availability of low-cost low-performance devices.</p> <p>Assumption that smartphones will be typically big brands with mid-high performing components.</p>	<p>App crashes low-cost/low-performance devices. Unusable in these cases. Can cause serious deterioration in handset performance.</p> <p>Low-cost/low-performance devices typically have limited backing storage and cannot store many videos. Users of devices with 8Gb built-in storage typically populate this with music, personal videos/pictures and runs out very quickly.</p>	<p>Observation</p> <p>Interviews</p> <p>Conversations</p>	<p>Could require serious redesign of system architecture prioritising efficiency and building app specifically for low-cost/low-performance devices.</p>	

			These users don't have finances to buy removable storage (e.g. micro SD cards)		
(Mobile) Data consumption of online features	Ineffective (if any) usability testing during SDC. When logging in through the app, the in-app browser is used for this task loading EDTech Enterprise. Users must manually leave the IAB to use streamlined testing facility. By default users are taken out of the native app and presented with the enterprise version.	<p>This poses a potentially significant draw of PPB internet subscriptions and renders the streamlined testing facility potentially unused.</p> <p>Many users may not realise this and inadvertently use more data than is necessary.</p> <p>In RCSs this reduces the number of learners able to do online testing rendering class analytics feature worthless.</p>	Observation	<p>Requires redesign of some app elements to:</p> <ol style="list-style-type: none"> 1. Add streamlined login process 2. Automatically return user to the native app (not IAB) after login through enterprise version <p>Alternatively, reconsidering the assumed importance of class analytics to teachers could allow assessments to be delivered offline.</p> <p>This will impact the data transmitted to EDTech on utilisation but potentially improve UX</p>	
App installs and runs one day and doesn't work the next day	This points to issues with the Windows store for app distribution and the requirement for users to have their own Microsoft accounts to download applications/programs	Support staff can't use their own accounts to install the app on users devices as the Microsoft store and user profile are linked in strange ways, not suited to RCCs that lack uncapped, unlimited internet access	<p>Researcher experience</p> <p>Observations</p> <p>Informal conversations</p>	Consider alternative distribution methods of the Windows App, perhaps providing the .exe file directly from the hub as opposed to exclusively through the store	

				Images	
Hub Design	Confusing Set-up Process	Inadequate initial-use/setup documentation and in-app guidance.	Users may give up quickly if early user experience issues are negative; complicated to remedy; and require ICT soft skills/trouble shooting e.g. switch off and on.	Documentation Researcher experience App store feedback/reviews	Potentially re-design of the hub/app to ensure seamless initial use. Redesign error messages within the app to provide more information about an error. Develop a usable user manual which assumes no technical knowledge.
Hub/App inter-operability	No files appear on first use	Internet access appears necessary to do initial set-up/connection between App and Hub.	Users may not be able to use the app without mobile data or WiFi even when there is a hub available.	Researcher experience observation	Develop a truly offline feature that removes any need to download 'class files' ensuring that this data is downloadable from the Hub
	Mobile data/internet required to move between G7-9 and G10-12 resources	This method is used to reduce the demands on end-user device's processor. However, for teachers teaching multiple grades or learners who share devices (e.g. siblings) it creates a requirement for mobile data (even if it's little amounts)	Users may not be able to use the app without mobile data or WiFi even when there is a hub available. Causes confusion with users	Researcher experience Observation Interviews Conversations images	This is more fundamental to the system architecture of EDTech and may require an overhaul of the platform to re-think the technical aspects of how content is served between the Hub, Internet and App.

Maintenance Process	App is not maintainable as EDTech prioritising communicating 'soft fixes' not app fixes and couldn't be adapted for RCS environments	Development costs are high meaning highly iterative design process is not possible. As development time was donated, this project may have been viewed more as a CSI/R obligation as opposed to 'normal client'	Issues identified within the existing app/Hub architecture aren't fixed. Adaptive, perfective, corrective maintenance isn't possible due to cost implications of development and allocation of resources to other organisation areas.	Interviews Documents Conversations	More systemic to the organisation – CEO was critical of other players in Education technology field viewing CSI/R obligations as a tick-box exercise. However, the approach by EDTech developers appears to mimic this. One approach to remedy this has more to do with organisational perspective viewing users as co-creators not beneficiaries.
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Appendix C – Comparisons Across Field Sites

Comparison Factor	Field Sites		
	RCS-A	RCS-B	RCS-C
Use of Technology	<p>Low utilisation generally</p> <p>-some teachers use regularly</p> <p>Restricted by several factors</p> <p>Teachers Find their own resources and keep them personally</p>	<p>High utilisation (relative to other RCSs)</p> <p>-restricted to certain grades and subjects</p> <p>Interactive use of technology (RBT1 using MS Word to create shapes to)</p>	<p>Use spread more evenly throughout staff</p> <p>Content found primarily through search engines</p> <p>-much of this is done 'on the fly'</p> <p>tablets often distributed but not used (sometimes distracting)</p>
Use of EDTech	<p>Limited use of EDTech</p> <p>-RAT1 doesn't think it's a great programme</p> <p>--issues with content cited</p> <p>-RAT1 is the most experienced at digital education</p>	<p>Digital Education delivered primarily through EDTech</p> <p>-Some use of online assessment feature</p>	<p>Almost no use of EDTech</p> <p>-Content availability is a main challenge</p> <p>-EDTech Hub doesn't allow easy access to content (technical structure of files issue)</p>
Management of Technology	<p>Technology is mobile</p> <p>-learners are static</p> <p>Managed informally (RAT1 has responsibility)</p> <p>Individual teachers take their own initiative to use tech in class</p>	<p>Technology is static</p> <p>-learners are mobile in 15/15 groups</p> <p>Clearly defined norms of when and who can use (timetabled and restricted)</p> <p>Allow those who really want to use it, use it</p>	<p>Technology is static</p> <p>-learners are mobile (whole class)</p> <p>Use of ICT centre is open to all (monitored by register)</p> <p>-semi-formal norm and ambiguous sanction</p> <p>More direct approach to encourage use</p>
Support Available	<p>Informally delivered through teachers (and learners as a proxy)</p> <p>No systematic tech support or training</p>	<p>Dedicated technical set-up support (externally funded)</p> <p>High levels of international social capital networks for assistance</p>	<p>Internally appointed ICT centre manager</p> <p>-Not highly skilled</p> <p>-mostly responsible for administering registers</p> <p>-not one of the most frequent users</p> <p>-dual function teacher and ICT centre manager</p>
Teaching and learning (Technology)	<p>No Internet</p> <p>Projectors and screens only</p>	<p>Reasonable Internet connection (high demands on bandwidth and data)</p>	<p>Reliable Internet (2 VSAT networks with lower bandwidth and</p>

	Limited use of EDTech Mostly BYOD -issues in this	Projector and screen (smart board without cable), speakers, tablets, laptops, e-readers Some BYOD Most use of EDTech	data demands than RCS-B) Projectors, and screens, one smart board Tablets, laptops Teachers with MDoE laptops
Teaching and Learning (Facilities)	All delivered within classrooms	Delivered in dedicated ICT centre (15/15 groups)	Dedicated ICT centre to hold whole classes with desks
Limitations of Higher Utilisation	Lack of ICT centre is an issue (set-up and breakdown of equipment) Internet access -for finding content -doing assignments, etc. Formally assigned technical support	ICT centre big enough for whole class More suitable internet access -Uncapped -Unrestricted bandwidth	Assistance in 'moving to the next level' -training and support -peer education and watching other teachers use tech well in class Access to OOTB resources seems important in RCS-C -reduce wasted time in-class -reduce need to vet all content used in class thoroughly
Main Resource Identification Methods	Teachers personal collection EDTech (occasionally)	EDTech	Search Engines

Appendix D – CATWOE and Root Definition

CATWOE Analysis – EDTech Pty. Ltd.

NOTE: This analysis is based upon the perspective of EDTech/IMA as an organisation to more succinctly represent the general understanding of their product, market, competition, stakeholders, and organisational objectives.

CATWOE is a useful tool for exploring problems from one perspective. In this case CATWOE is used to explore the perspective of EDTech/IMA leading up to and during the trial in 11 schools in Mpumalanga. The views expressed here are not necessarily shared by the researcher, nor objective facts. It is important to note that there is subjectivity in the perspective of EDTech/IMA presented below which this tool seeks to make explicit.

For fuller details on the background of this tool and the family of tools within Soft-Systems Methodology, see work by Peter Checkland including:

Checkland, P. B. (1989). Soft systems methodology. *Human systems management*, 8(4), 273-289.
 Checkland, P. (2000). Soft systems methodology: a thirty year retrospective. *Systems research and behavioral science*, 17(S1), S11-S58.

Clients – Learners in no-fee Government Schools	
<u>Current Problem</u>	
<ul style="list-style-type: none"> • Lower than average academic attainment – significantly lower than fee-paying schools • Lack of access to diverse resources (currently only teachers and usually textbooks) • School circuit and district managers need more data to allow them to prioritise visits to schools most in need of support • Teachers need to manage their time better • Teachers need more accountability to ensure they do their job 	
<u>Expected Reaction to proposed solution</u>	
<ul style="list-style-type: none"> • Young people love technology, so they’ll love a digital solution • Learners will be able to learn themselves within the need for a dedicated teacher 	
<u>Winners</u>	<u>Losers</u>
<ul style="list-style-type: none"> • Learners (better education) • Teachers (time/effort saving) • Dept. of Education (improved results) • ‘The economy’ (more skilled workforce) 	<ul style="list-style-type: none"> • Everybody is believed to be a winner

Actors – People Making EDTech Happen

<u>Technology Designers and Developers</u>	<u>Teachers</u>
<ul style="list-style-type: none"> Responsible for the process of turning ideas, needs, and project specifications into end deliverables such as the Apps and Websites 	<ul style="list-style-type: none"> Responsible for implementing the solution within classrooms Adapting their routines to utilise the wealth of new resources
<u>How might they react to the project</u>	
<u>Technology Designers and Developers</u>	<u>Teachers</u>
<ul style="list-style-type: none"> Development time is donated – results in an increase in non-chargeable hours This results in a need for fast pace towards development and handover There is little scope for ongoing maintenance and adaption 	<ul style="list-style-type: none"> Teachers are already over worked The time, effort, and resources to gain digital literacies may overwhelm/demoralise teachers This may result in minimum acceptable use (or non-use)

Transformation – Inputs & Outputs (and what's in between)

What happens to achieve success?

The systematic enactment of Technology Mediated Learning (TML) in schools to improve delivery and comprehension of Learning Outcomes as proxy measures of good education.

<u>Inputs</u>	<ul style="list-style-type: none"> Underperforming schools Under-resourced and under-performing teachers Learners with variable Socio-economic circumstances Technology (laptops/tablets, internet, EDTech)
<u>Outputs</u>	<ul style="list-style-type: none"> Learners with skills for the economy
<u>Steps in Between</u>	<ul style="list-style-type: none"> Giving out EDTech Digital Libraries in resource constrained settings Letting learners learn for themselves and teachers facilitating this process on the fringes
<i>Researchers thoughts</i>	<p>There was limited consideration for the practicality of this deterministic process.</p> <p>This includes a lack of:</p> <ul style="list-style-type: none"> reasonable planning for training provision to teachers varying access to technology within schools support for implementing digital pedagogies

	<ul style="list-style-type: none"> • engaging with schools showing little/no utilisation • no measurement/evaluation metrics of social value creation – it is assumed that EDTech WILL improve education, little thought given to how, when, or what will improve
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Worldview – How Does EDTech/IMA View the Broader Context?

South Africa is a challenging country with many serious problems including violent crime, relatively poor education systems, poverty, lack of motivation to achieve. 20 years into democracy: South Africa should have achieved more.

<u>Bigger Picture</u>	<ul style="list-style-type: none"> • ‘Failing education system’ • ‘Incompetent government’ • ‘Apathetic learners’
<u>Real Problem</u> <i>(these are framed as a set of accusations – not apolitical problems)</i>	<ul style="list-style-type: none"> • Teachers can’t teach the subjects due to subject knowledge • Learners don’t care about themselves, their families, or their future • Parents don’t do enough to support their children • Government doesn’t provide textbooks or other resources to schools
<u>Wider Impact</u>	<ul style="list-style-type: none"> • Long-term socio-economic growth (when learners grow older) • Lower poverty due to individual economic activity (when learners grow older) • South Africa becomes a developed nation
<i>Researchers thoughts</i>	<p>The worldview of EDTech is limiting due to its broad negative perspective and developing a product with little thought to seek alternative conceptualities of what is going on.</p> <p>For instance, the lack of appreciation for implications of historical processes on the current education system play a role in shaping some inequalities. Additionally, there is no thought given to the structural issues of the South African Education institutions such as the fee-based system.</p> <p>The worldview of EDTech/IMA tended to focus on who is to blame rather than constructive discussions of the issues.</p>

Owner – Who Ultimate Responsibility and Authority Rests With

Departments of Education (national, provincial, district)

<u>How can they help?</u>	<u>Why would they help?</u>
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<ul style="list-style-type: none"> • Provide official backing to the project (achieved) • Cooperate with training implementation and scaling the innovation 	<ul style="list-style-type: none"> • Recognition of mutual benefit (improved education outcomes; achieving national objectives) • When success starts happening, scaling it up can be needed
<u>How can they block?</u>	<u>Why would they block?</u>
<ul style="list-style-type: none"> • Exit the agreement/end partnership to develop EDTech • Assign similar projects to competing companies 	<ul style="list-style-type: none"> • Based upon limited effectiveness • Contractual agreement not upheld • No value for money delivered • Encouraging different ways to innovate with the same problem

Environment – The Operational Context of EDTech

Broad challenges within the environment of no-fee schools operating in non-urban areas

Some schools lack adequate teaching spaces, some have fewer classrooms than are needed, some have no electricity or water and many struggle with internet connections. EDTech believe these are governmental responsibilities to ensure.

<u>Limits/constraints</u>	<u>Impact</u>
Institutional form/structure	<p>Schools cannot be privatised which limits the impact of market forces in education (a solution E-CEO believes in).</p> <p>Pedagogy can't be instantly revolutionised or easily achieved in the short-medium term</p> <p>** EDTech blamed the lack of training on the MDoE. However, this was a valuable opportunity for EDTech to observe the individual and institutional requirements of implementation beyond a technical view of problems. This would have provided a dual function training/support opportunity as well as user feedback on the design.</p>
Technological Resources	<p>Schools lack adequate internet access to meaningfully use EDTech (<i>even though it should work without it</i>)</p> <p>Learners have extremely limited access to the Internet outside of school</p>
Learner/Teacher Motivation	Learners have become disenfranchised and see no hope. Therefore, they don't take every opportunity to improve their education.

	Teachers have become complacent and don't see any need to be committed, motivated, or be leaders within the classroom.
Distance between developers and users	The geographical distance between trial schools and where EDTech was designed and developed limited the opportunity to travel every day to observe schools.
Researcher's thoughts	<p>EDTech underestimated the complexity of no-fee schools. The oversimplification of rurality and conflation of issues relating to rurality, poverty, black lived experiences, a prescriptive view of need and resource constrained schools reduced the scope for empathy building.</p> <p>The worldview of EDTech/IMA management (leading to their perception of the environment) seems to be a significant detractor from the potential for success. As the research shows, the lack of involvement of target groups throughout the technology design and development process concreted unchallenged assumptions into the technology.</p> <p>The deterministic perspectives of what technology alone can do also is hindered by the simplicity which EDTech views schools and non-urban communities.</p>

Root Definition

Improving Education Standards

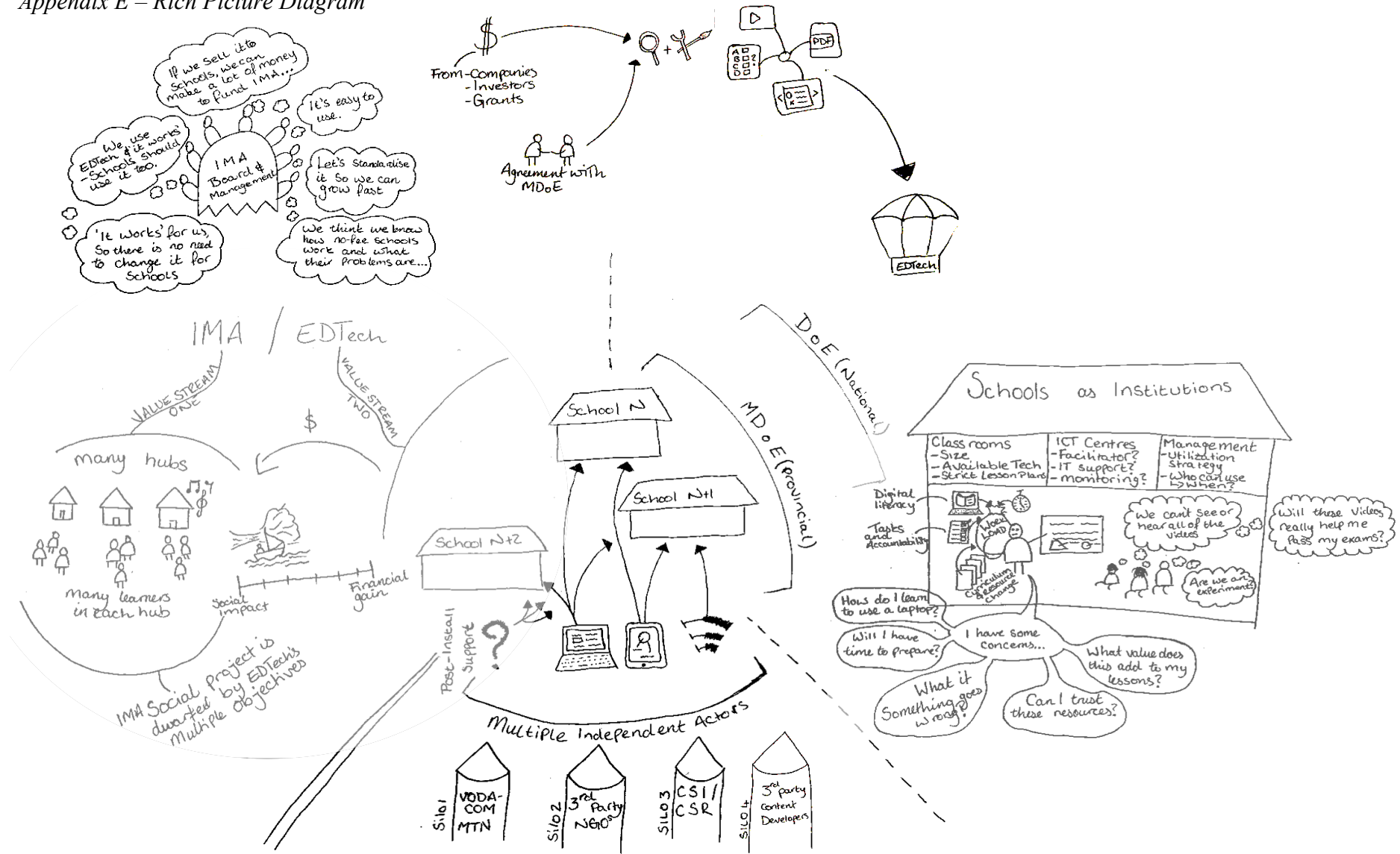
EDTech Perspective

A system owned by the Mpumalanga Department of Education (MDoE) where teachers in no-fee schools teach using technology to improve education standards and future contributions of learners to the economy; because the education system in South Africa 'is broken'. This is constrained by the lack of training available to teachers to use technology; a lack of technology in general; and a lack of motivation by teachers to improve their work.

Apolitical re-definition (researcher perspective)

A system owned by the Mpumalanga Department of Education where teachers in no-fee schools teach using technology to engage learners and explain complicated theory to improve the quality of education learners receive and their final grades because there is historic underinvestment in no-fee schools/teacher training as well as teacher already finding themselves over worked. Achieving improved (digital) education in no-fee schools is constrained by stakeholders in digital education operating in relative isolation; the fact that digital literacies take time and motivation to acquire and implement; and that each school faces nuanced and variable challenges in integrating technology.

Appendix E – Rich Picture Diagram











Appendix F – Current Business Model Canvas

The Business Model Canvas

Designed for: **EDTech**

Designed by: **Peter Nimmo**

On: Day Month Year
Iteration: No. 1

<h3>Key Partners</h3>  <p>Who are our Key Partners? Who are our key suppliers? Which Key Resources are we acquiring from partners? Which Key Activities do partners perform?</p> <p>Partners: MDoE</p> <p>Microsoft</p> <p>UK-based NGO in RCS-B</p> <p>Suppliers Intel: -Digital Library Hardware</p> <p>Software Developers</p> <p>Doesn't include: -Teachers unions -Principals SchoolsNet SA ICASA MNOs Content Providers -e.g. IXL, Mindset, HomeschoolersSA</p>	<h3>Key Activities</h3>  <p>What Key Activities do our Value Propositions require? Our Distribution Channels? Customer Relationships? Revenue streams?</p> <p>Training and user support -very limited (a couple of days of training)</p> <p>No follow-up policy -imagined all schools should be remote monitored</p>	<h3>Value Propositions</h3>  <p>What value do we deliver to the customer? Which one of our customer's problems are we helping to solve? What bundles of products and services are we offering to each Customer Segment? Which customer needs are we satisfying?</p> <p>VALUE: Learners need to be able to study and learn independently as the school system in South Africa is failing. Learners can use their phones to educate themselves.</p> <p>Teachers need assistance to effectively deliver education which is suited to the 21st century, knowledge economy which students will enter the job market for.</p> <p>Offline: Curriculum aligned, digital resources</p> <p>Online: Weekly learner assessments Class analytics to show cohort performance Targetted revision suggestions</p> <p>Problems (projected/assumed): Teachers don't have access to resources Teachers struggle to keep curriculum pace Teachers don't prioritise learning effectively Teachers don't know their subjects enough Teachers require help to explain LOs</p> <p>Students don't have enough revision resources</p>	<h3>Customer Relationships</h3>  <p>What type of relationship does each of our Customer Segments expect us to establish and maintain with them? Which ones have we established? How are they integrated with the rest of our business model? How costly are they?</p> <p>Aimed at being self-service, OOTB, intuitive</p> <p>Initial training is only formal point of contact</p> <p>Communication with MDoE (and other partners) is limited</p> <p>Informal support provided through WhatsApp -though not recorded or tracked</p>	<h3>Customer Segments</h3>  <p>For whom are we creating value? Who are our most important customers?</p> <p>Mass Market; Multi-Sided Education Platform</p> <ol style="list-style-type: none"> Learners Teachers MDoE staff - Circuit Managers - District Managers
<h3>Cost Structure</h3>  <p>What are the most important costs inherent in our business model? Which Key Resources are most expensive? Which Key Activities are most expensive?</p> <p>Platform Maintenance -requires expensive software developers</p> <p>Platform Development -time consuming, expensive -would force EDTech back to the design process to make the product more suited to resource constrained settings</p>	<p>Training and support is very expensive on an ongoing basis -Impact of scaling too quickly is the increased cost of rectifying issues -currently required for every install (product not OOTB ready) but this isn't provided due to contractual disagreements</p>	<h3>Revenue Streams</h3>  <p>For what value are our customers really willing to pay? For what do they currently pay? How are they currently paying? How would they prefer to pay? How much does each Revenue Stream contribute to overall revenues?</p> <p>EDTech focus on recurring asset/product sales -based upon 3-4 year digital library life span -R3,000 net profit per digital library sold</p> <p>Paid for by: Provincial Departments of Education</p> <p>Other revenue streams come from CSI/CSR budgets of companies to develop content</p>		



The Business Model Canvas

Designed for:










EDTech/IMA (EDTech continues as a project)

Designed by:

Peter Nimmo

On: July 2018

Iteration: 2

<h3>Key Partners</h3>  <p>Who are our Key Partners? Who are our key suppliers? Which Key Resources are we acquiring from partners? Which Key Activities do partners perform?</p> <p>RELATIONSHIPS TO MAINTAIN: Distribution and delivery Reduction of risk and uncertainty Agreement of particular resources and activities</p> <p>Relationships with DoEs are important! -they will assess success and future opportunities to invest in a platform showing results (results first) -In all agreements, ensure there is sufficient financial planning for rolling training, assessment, tech dev.</p> <p>Building relationships with existing Education tech players whose core competencies are content. -build joint ventures, share risk, costs, rewards -utilise their resources in content along with EDTech technology -content is not EDTech's strong point</p> <p>Teachers Unions -Having buy in from local branches of unions may help to encourage inclusion of target groups within existing professional teacher networks -Unions deal with professional concerns of the professional body (main customer segments)</p> <p>Discussing with mobile network operators how to facilitate low data costs for e-learning</p>	<h3>Key Activities</h3>  <p>What Key Activities do our Value Propositions require? Our Distribution Channels? Customer Relationships? Revenue Streams?</p> <p>KEY ACTIVITIES: Content creation Production Professional development Product delivery Customer support</p> <p>Constantly developing content and being strategic with what subjects and grades are developed. -This requires a lean approach where only content which will be most used is created</p> <p>Allow time and resources for on-going app dev./ maintenance ensuring that the UX is always heading towards optimal.</p> <p>goals, measures, and processes for dev.</p>	<h3>Value Propositions</h3>  <p>What value do we deliver to the customer? Which one of our customer's problems are we helping to solve? Which bundles of products and services are we offering to each Customer Segment? Which customer needs are we satisfying?</p> <p>VALUE PROPOSITIONS: Network Professional development Product delivery Customer support "Getting the Job Done" Speed Reliability Cost reduction Risk reduction Accountability Customer loyalty</p> <p>Fully equipped lesson plans which can be printed and used digitally</p> <p>Consistent video formats/ designs for key theories -These must be designed cooperatively with users -must be made in SA -should consider different video for lg/sm screens</p> <p>Powerpoint slides prioritised over videos. -aim is to help teachers delivery lessons without having to write everything</p> <p>Must consider the existing teacher resources and actively link to them (e.g. NECT)</p> <p>Assessments offline -allow learners to download test data from Hub</p>	<h3>Customer Relationships</h3>  <p>What type of relationship does each of our Customer Segments expect us to establish and maintain with them? Which ones have we established? How are they integrated with the rest of our business model? How costly are they?</p> <p>RELATIONSHIPS: Personal assistance Dedicated personal assistance Self-service Automated services Communities</p> <p>Teachers require more assistance – sharing best practice in other schools</p> <p>Facebook and whatsapp groups share experiences, tips, user feedback, show EDTech listens and responds. -requires EDTech is proactive in managing these spaces.</p> <p>Events outside of the school are important. -selecting teachers based on utilisation would help engage the early adopters.</p>	<h3>Customer Segments</h3>  <p>For whom are we creating value? Who are our most important customers?</p> <p>MARKET SEGMENTS: Mass Market Niche Market Segment of customers Multi-sided Platform</p> <p>Teachers in no-fee government schools -teachers are central to the education system. -their buy in is paramount to success -(the aim is to become mass market eventually - not within 2 years)</p> <p>Learners not a major priority -learners will use when teachers buy in (if appropriate for low-end devices)</p>
<h3>Cost Structure</h3> <p>What are the most important costs inherent in our business model? Which Key Resources are most expensive? Which Key Activities are most expensive?</p> <p>KEY RESOURCES: Cost-efficient resources Low price value proposition, maximum automation, extensive automation Value Drivers (Based on value creation, premium value proposition)</p> <p>KEY ACTIVITIES: Efficient Content creation, video, content Efficient Content delivery Efficient Content support</p> <p>APP/HUB DEVELOPMENT -may have to recruit a developer who can write code for many platforms -more realistically a small team -This is essential for iterative development. building, rolling out, testing.</p> <p>CONTENT - this requires teachers with diverse skills and experience -These teachers will be at the tip of the teacher development pyramid -This learning content creation process requires agility based upon user feedback -strategic partnering with an organisation known for quality learning resources -Ease cost burden on EDTech alone. focus on tech development.</p> <p>MOBILE DATA - If a bundling approach is opted for then, this allows for EDTech to push updates to devices. Assuming they are left on.</p>	<h3>Key Resources</h3>  <p>What Key Resources do our Value Propositions require? Our Distribution Channels? Customer Relationships? Revenue Streams?</p> <p>KEY RESOURCES: Intellectual Property, Copyright, Patent Human Resources Physical Resources</p> <p>CONTENT - it's an expensive paperweight without it</p> <p>USABLE APP (HTML based interface on Hub?)</p> <p>HR FOR SOCIAL MEDIA MANAGEMENT - organic self-management of these spaces may result in these becoming wasted relationship opportunities</p> <p>getting an APN to centrally manage and allocate mobile data</p>	<h3>Revenue Streams</h3>  <p>For what value are our customers really willing to pay? For what do they currently pay? How are they currently paying? How would they prefer to pay? How much does each Revenue Stream contribute to overall revenues?</p> <p>REVENUE STREAMS: Transaction Fee Usage Fee Subscription Fee Licensing Fee Advertising</p> <p>I think a software as a service (SAAS) model is most appropriate -gives EDTech clear and instant feedback on non-use via cancelled subs -provides steady streams of income and forces EDTech to continually think about development of the platform.</p> <p>Bundled data services - take the responsibility of internet access from MDoE -APN would allow EDTech to buy data monthly in one account spread across X schools -This overcomes potential for lack of internet to be a direct cause of non-use</p> <p>How can the EDTech programme be developed over time into an Adult Basic Education/ Training (ABET) tool which could be licenced to education providers and corporates -This was successful in the current EDTech trial with Woolworths staff CPD courses</p>	<h3>Channels</h3>  <p>Through which Channels do our Customer Segments want to be reached? How are we reaching them now? How are our Channels integrated? Which ones work best? Which ones are most cost-efficient? How are we integrating them with customer routines?</p> <p>CHANNELS: Direct sales Partners Retailers Distributors Other sales</p> <p>Whatsapp is a vital channel for communication -Think about building chat-bots which serve content</p> <p>Facebook and social media are successful, but highbandwidth content is not served free</p> <p>include a 4g sim-card with data (APN to transmit utilisation data and provide remote support cost effectively)</p>	<h3>Channels</h3>  <p>Through which Channels do our Customer Segments want to be reached? How are we reaching them now? How are our Channels integrated? Which ones work best? Which ones are most cost-efficient? How are we integrating them with customer routines?</p> <p>CHANNELS: Direct sales Partners Retailers Distributors Other sales</p> <p>Whatsapp is a vital channel for communication -Think about building chat-bots which serve content</p> <p>Facebook and social media are successful, but highbandwidth content is not served free</p> <p>include a 4g sim-card with data (APN to transmit utilisation data and provide remote support cost effectively)</p>

Appendix H – Interim Research Findings Presentation to EDTech

Structured Uses of EDTech, Mpumalanga

- Research Project Aims:
 - Exploring the **adoption, use cases, and contexts of EDTech use** within places of learning in Mpumalanga, South Africa
 - Comparing and contrasting **context specific routines/practices** of EDTech/ technology use and traditional 'chalk and talk' pedagogies
 - Providing narratives of the **EDTech user experience** for development
- Researcher: Peter Nimmo B. A (hons. 1:1), from SBS, Glasgow, UK
 - Studying MPhil. Inclusive Innovation @ Graduate School of Business, UCT
 - Pro-bono NPO consulting/research experience around Mpumalanga over 5 years
 - Passionate about inclusive tech education and development in non-urban SA

Theoretical Background and Methodology

- **Theory:** Using 'structuration of technology' and 'technology-in-practice'
 - Related to research of Jonathan Donner, Mark Warschauer, Marion Walton
 - Use contemporary IS theory to provide **use analysis** and **user perspectives**
- **Field sites:** three non-urban, resource constrained government schools and an independent music academy
- **Methods:** Inspired by ethnographic enquiry:
 - semi-structured **interviews**; passive and participant **observation**; research **diaries**; **document/multimedia analysis**
- **Duration:** 1 week observation per school dovetailed by
 - 2 months between music academy as 'living lab' and EDTech office

Interim Findings (prior to comprehensive analysis)

- **Principals play a key role** in advocating, managing and increasing technology-classroom integration within schools
 - RCS-C:RCP ICT centre register and it's purpose/use
- **Teachers use various digital and paper based resources** in curriculum delivery
 - Policy and resource changes impact a teachers' professional self-confidence and self-efficacy and subsequent use of resources
 - NECT planner and tracker's trial in schools develops teachers daily topic coverage

Interim Findings - cont'd

- **Developing the digital literacies/competencies** of teachers happens **gradually, informally, through personal and professional networks**
 - Teachers who are pro-active in learning show higher curiosity
- Learners and teachers with limited technology experience have **low-cost, used/hand-me-down devices** with very **variable compatibility and fitness for purpose for e/m-learning**
 - Device supply chain within resource constrained settings

Interim Findings - cont'd

- M-learning isn't as valuable as it is often imagined to be
 - Screen size plays a major role in what functions are possible/fit for purpose through M-learning platforms
 - In using 'low-cost: low-performance' or 'Nth hand: diminished performance' devices are often not able to handle multiple apps/mass storage of content
 - 'Lower than ideal' performance devices often have limited internal storage and lack funds to buy SD cards
 - Not all Apps allow you to select a download location (e.g. memory card)
 - 'Less than ideal' performance phones can struggle to handle the processing speed required to run certain apps

Interim Findings - cont'd

- There is a multitude of potential motivations to use and applications of technology (including EDTech) in an education setting
 - Developing teachers' domain specific knowledge
 - Teachers' revision prior to teaching a new/blurry topic/learning outcome
 - In class content delivery to learners in conjunction with teacher
 - To add clarity to a teacher's definition
 - To add visual communication (efficiency in LO delivery)
 - Independent learner revision/self-learning
- Rather than considering there to be an 'archetypal' implementation; each school has varying strengths, needs and gaps to fill.

Interim Findings - cont'd

- Townships, schools, learners, teachers, communities who are in non-urban areas are not homogenous
 - Certain individual schools, townships, learners, etc. have fluctuating socio-economic flexibility even within 5Kms
 - Rather than equate 'rural' or 'township' with 'poor', the term **'Resource Constrained'** may offer a more dignified and accurate terminology
 - Resource Constraints cover:
 - HR
 - Time
 - Electricity/Water Supply
 - Internet Provision (incl. subscriptions/payment structures and infrastructure available)
 - Financial Resources (within a school, the SGB, and broader community)
 - Etc.

Interim Findings - cont'd

- Dedicated and knowledgeable ICT management staff aid implementation
 - RBF's role facilitated a smooth transition between traditional classrooms and the ICT centre
 - Set-up prior to lesson
 - In-house support/technical assistance
 - Technology domain knowledge
 - Unfortunately these staff are often not available due to school fundraising constraints
 - Where they are present ICT managers are either dual function teachers/ICT managers or funded by external agencies/organizations

Interim Findings - cont'd

- Content available through EDTech and more generally on-line must be sensitive to the context of it's development
 - American accents, pace of speech, quality of visuals (eg. colour contrast)
- Consistency of resources' aesthetics and quality can be issues
 - KA to independent YouTuber resources
- Locally produced content should be a priority, by local teachers with local accents and understanding of local vernaculars
- Usability issues with EDTech iPad App and resource aspect ratio

Appendix I – Mpumalanga Department of Education Research Approval



Building No. 5, Government Boulevard, Riverside Park, Mpumalanga Province
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Tel: 013 766 5552/5115, Toll Free Line: 0800 203 116

Litiko le Temfundvo, Umnyango we Fundo

Departement van Onderwys

Ndzawulo ya Dyondzo

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NELSPRUIT
1200

RE: APPROVAL FOR THE RESEARCH REQUEST FOR PETER NIMMO

Your application to conduct research was received and thank for your interest in our province. Your research study seeks to explore the use of ICT by our young adult learners in our schools. The title of your study and the subsequent aims and objectives suggests that your study will make interesting recommendations for the province. I therefore approve your application subject to you observing the provisions of the departmental research policy which is available in the departmental website. You are also requested to adhere to your research ethics as spelt out in your research ethics document. Note that the department reserves the right to withdraw the approval at any time if the researcher does not adhere to the proper ethical issues as set out in the research policy. Note further that this approval is only valid up to the end of this academic year (2016).

In terms of the departmental research policy, data or any research activity can only be conducted after school hours as per appointment. You are also requested to share your findings with the department so that we may consider implementing your findings if that will be in the best interest of the department. To this effect, your final approved research report (both soft and hard copy) should be submitted to the department so that your recommendations could be implemented. You may be required to prepare a presentation and present at the department's annual research dialogue.

For more information kindly liaise with the department's research unit @ 013 766 5476 or a.baloyi@education.mpu.gov.za.

The department wishes you well in this important project and pledges to give you the necessary support you may need.


MRS MOC MHLABANE
HEAD OF DEPARTMENT

05/7/16
DATE

