Creating the Golden Triangle of Evidence-informed Education Technology with EDUCATE

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Abstract: EDUCATE is a London-based programme that supports the development of research-informed educational technology (EdTech), allowing entrepreneurs and start-ups to create their products and services, and simultaneously grow their companies in a more evidence-informed manner. The programme partners businesses with researchers who mentor, guide and support this research journey, a key aspect of which is the evaluation of the company's EdTech product or service. However, conducting impact evaluations of technology in education is challenging, particularly for early-stage technologies, as rapid cycles of innovation and change are part of their essence. Here, we present the pragmatic approach to evidence-informed education technology design and impact evaluation, as developed and adopted by the EDUCATE programme. The research process is shaped by the core principles of evidence-informed decision making. We describe and illustrate this process through case study examples and conclude that there is great value in industry-academia collaborations. These collaborations are not without their challenges, but it is through reflecting upon these challenges that we are able to observe how the emerging EdTech ecosystem in London is being shaped.
Keywords: Evidence-informed EdTech, Impact evaluations, Stakeholder collaborations

Practitioner Notes:

What is already known about this topic

- EdTech businesses play a key role to shape the current and future EdTech landscape.
- Evidence of the impact of EdTech on learning and teaching is often at the forefront of demands.
- EdTech companies' and practitioners' understanding of, and access to, existing relevant research to adopt an evidence-informed approach is limited.

What this paper adds

- Presents the need and value to bring the stakeholder communities together to move towards an evidence-informed EdTech approach.
- Gives an overview of the EdTech landscape in London.
- Describes the process for the participants in the EDUCATE programme and how it is aligned with our evidence-informed EdTech principles.
- Provides reflections on the impact of the EDUCATE programme.

Implications for practice and/or policy

- There is a lack of systematically reviewed EdTech evaluation reports and most independent EdTech research is not accessible, or understandable to the EdTech sector.
- There is a lack of engagement by academics with both practitioners and developers to provide research evidence and guidance, managers and leaders should see this as a worthy enterprise for which academic staff should be given time.
- The lack of encouragement across the board for educational practitioners to engage with research evidence and practice results in a very unsophisticated research mindset where critical evaluation is absent.

Introduction

Innovation within the development of commercial educational technology (EdTech) is increasing rapidly. Whilst large companies have their own in-house research teams to help them connect to existing research and create their own research projects and publications, there is a growing community of small and medium sized enterprises (SMEs) across the globe, who are also using innovative technology to develop their EdTech products or services, but do not have access to in-house research expertise. Albeit that these businesses play a key role to shape the current and future EdTech landscape, they find it hard to both engage with the research community to learn about (and access) existing relevant research, and to understand how best to generate evidence from their own multiple, valuable data sources.

EDUCATE (https://educate.london) is a unique programme that is bringing together entrepreneurs and innovators, with academics and educators, with the aim to deliver evidence-informed education technology products and services. We describe this linking of the three communities within the EdTech ecosystem: developers, researchers and users (learners and/or educators) as the *golden triangle* (Luckin, 2016). EDUCATE is designed to 'fill the gap' for SMEs that cannot afford their own research labs by providing a rigorous and comprehensive research training programme with a focus on pedagogical EdTech research and investigation of not only 'what works – but also when, how and why'?

In this paper, we begin by explaining why it is necessary to bring the three communities encompassed by the golden triangle together: those who build EdTech; those who use EdTech; and those who understand how to make judgements about whether an EdTech contributes positively to the teaching and learning process (see Figure 1).

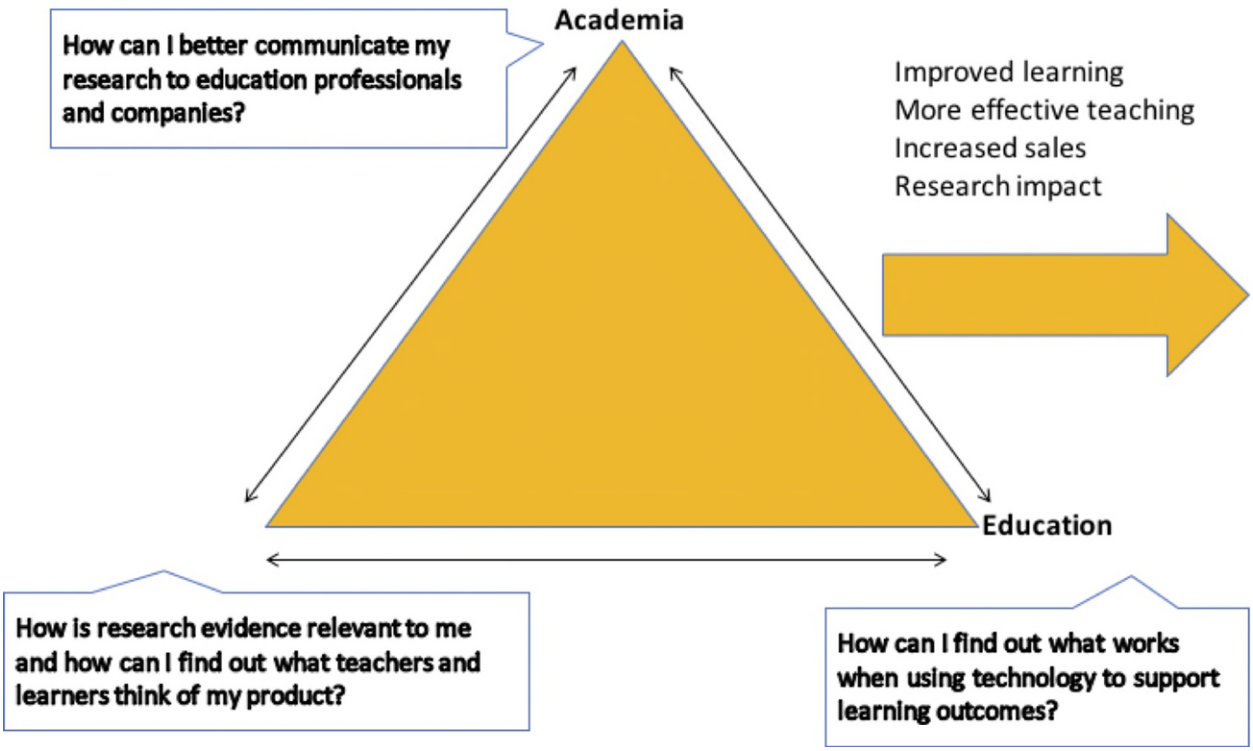

Figure 1 The EDUCATE Golden Triangle of Evidence.

We then draw together the evidence to support this claim and describe both the need and the value of evidence-informed decision-making in EdTech. The paper will give an overview of the EdTech landscape in London, based on the 96 companies that have engaged with the programme as of Summer 2018, which in itself provides further evidence of the problem that EDUCATE programme has been designed to solve: the lack of access to, understanding of, and engagement with research evidence among most EdTech developers and educators. We will describe and explain the process for the participants in the EDUCATE programme and how it is aligned with our evidence-informed EdTech principles. Finally, two case studies will highlight early evidence of the impact of the EDUCATE programme, demonstrating how our approach can increase the shared understanding of both research evidence and practice amongst EdTech, which in turn shows great promise to increase the efficacy of EdTech.

Background

Evidence of the impact of EdTech on learning and teaching is often at the forefront of demands, particularly from those who dictate the funding available to pay for technology within education systems. This is not an unreasonable expectation. However, as has been shown in numerous meta-level investigations (see for instance Cox et al., 2003) evaluation of the impact of technology on educational outcomes is a challenging task. This challenge is even greater when evaluating emerging innovative technologies. Today's emerging technologies include, but are not limited to, virtual reality implementations (Merchant et al., 2014), augmented reality implementations

(Dunleavy, & Dede, 2014), mobile learning devices (Crompton, Diane, & Gregory, 2017), 'internet of things' hardware with sensors (Cukurova et al., 2018), and technologies that allow collaborative learning at a great scale (Cress, Moskaliuk, & Jeong, 2016). Pedagogical change is at the core of these technologies both because their design evolves over time, but also arguably their raison d'être is to transform the learners' experience (Cukurova, & Luckin, 2018).

The increased challenge is at least partially due to the unwritten expectation that, in traditional impact evaluations, evidence regarding the impact of an intervention is considered as a shield against change. The generation of scientifically robust evidence about the impact of an EdTech can therefore be used by stakeholders, such as policymakers, for its standardisation and scaling. However, as already mentioned change is at the essence of emerging technologies. For example, three years after an original report reviewing emerging technology innovations in education (Luckin et al., 2012), there was evidence that only 39 of the 150 innovations were still in active use. Therefore, in the context of emerging technologies, more value is to be found in the careful consideration of different types and sources of evidence that are appropriate to the current state of the technology as well as in the use of robust research methods to generate new evidence. This requires an evidence-informed decision making process *for the design and use of* EdTech, rather than only considering evidence as the outcome of an evaluation. Even when evidence from impact evaluations *is* considered, a pragmatic and collaborative approach to evaluate the subsequent impact of emerging technologies is needed to accommodate the innovative and dynamic nature of EdTech. Hence, an important first step towards evidence-informed and impactful EdTech is to create opportunities to arrive at such shared understandings of the roles and nature of research evidence as both products and processes, for the EdTech ecosystem, which also includes potential investors.

A Definition of Evidence-informed EdTech

One of the fundamental purposes of EDUCATE is to foreground evidence-informed practice in the design, use and evaluation of EdTech. It is hard to argue against the potential value of evidence to inform and improve practice (Petty, 2009). All stakeholders can potentially benefit from a more evidence-informed approach for EdTech. Learners can potentially benefit from better technologies to help them learn, teachers and developers can improve the efficacy and effectiveness of their practice and researchers can generate both the real-world impact of their research and new knowledge in the domain. In this sense, it is almost absurd to oppose to evidence-informed edtech. However, as it is the case for almost all "absurd-to-oppose-terms" in education, the devil is in the detail. So, what exactly do we mean when we refer to evidence-informed edtech?

Similar to other professional practice, discussions around evidence in EdTech stress that learners and teachers should be exposed to 'what works' arguing that *only* those pieces of technology that are presented to be effective at achieving their expected learning outcomes *should* be implemented in practice. These ideas are echoed among some key academic figures who emphasise on maximising learning outcomes by research evidence through systematic reviews,

meta-reviews, and best evidence synthesis (see for instance Hattie, 2008; Slavin, 2017). Unfortunately, at one extreme this stream of thinking leads to generating some kind of statistical averaging as an authoritative carrier of facts and underpins the audit culture that dominates public service management and policy including education (Wrigley, 2018). More specific to educational research in England, the Department for Education allocated £125 million to improve evidence-based practice in education, highlighting the significance of the application of research evidence in schools in England (DfE, 2018). Mainly prioritising randomised controlled trial (RCT) types of positivist research methodologies, some of the main supporters of the initiative argue that any other research is unscientific and worthless (Bennett, 2013). Within this context, there is an emerging tendency for educational research, to move towards the experimental research designs that aim to generate evidence to inform teaching practice, which undervalues other research approaches. This movement towards positivist research methodologies has led to heated debate over the last few years about the way in which evidence in education is perceived, and the relationship between research and practice (de Bruin, 2017), with much discussion focusing on how to generate a positive relationship between educational research and teaching knowledge and practice (Pampaka, Williams, & Homer, 2016).

We argue that this positioning of the use of evidence in practice is particularly problematic and extremely limited for educational research in general, and EdTech more specifically. An extensive evaluation of the drawbacks of such an interpretation of 'evidence-based practice' and the research methodologies associated with it is out of the scope of this paper (please see Wrigley, 2018; Simpson, 2017 for detailed discussions on the topic). It is also worth to make it clear that complete rejection or ignorance of evidence is foolish. However, the evidence is a multidimensional construct and the abstraction of it to statistical averaging as the 'gold standard' rather than critically evaluating it from the breadth of types of evidence should be approached with caution. Here, we argue that taking an evidence-informed approach where evidence from research studies is considered as a necessary but not sufficient component of a bigger picture, in which the accumulated experience of educators; learners and teachers' needs and wishes; as well as the peculiarities of the local context in which the EdTech being implemented are all taken into account; can provide a more productive way forward in our attempts to bring in evidence into educational practice.

In the EDUCATE programme, similar to the arguments made by Briner, Denyer, & Rousseau (2009) within the context of evidence-based management, we define evidence-informed EdTechs as those that are designed and implemented through the conscientious, explicit, and astute use of four sources of information: a critical evaluation of the best available research evidence, practitioner expertise and judgement, evidence from the local context, and the perspectives and values of those people who are directly or indirectly affected by the EdTech.

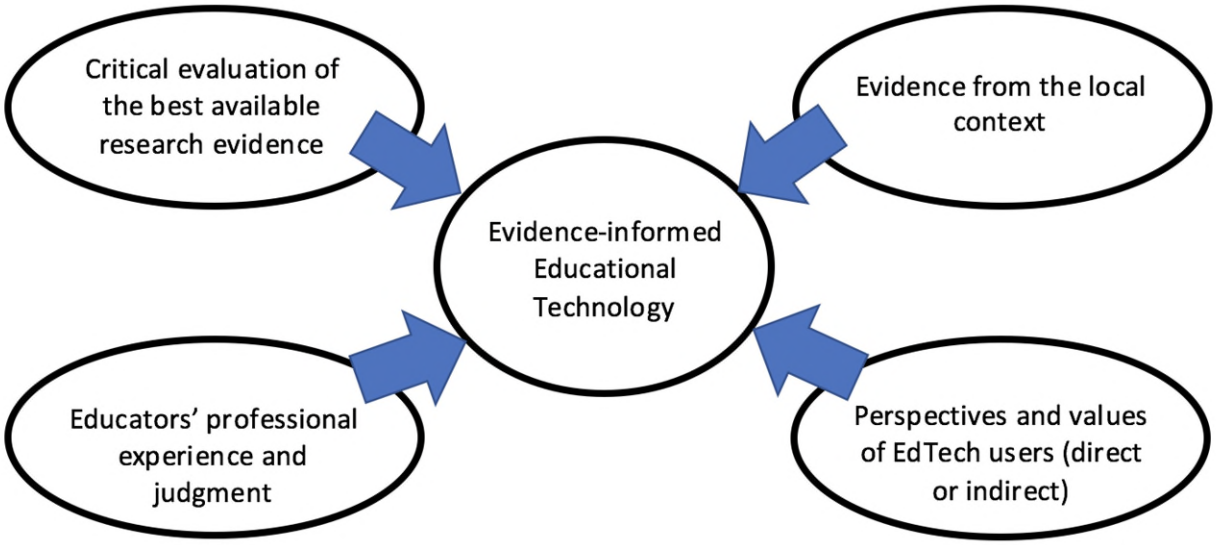

Figure 2 The four sources of information for evidence-informed EdTech.

As can be seen in figure 2, all key stakeholders of EdTech have a significant role to play in order to make its practice evidence-informed. For instance, academics as the originators of the research evidence, have the critical responsibility to make their research evidence available and accessible to practitioners; EdTech developers and practitioners should bring their professional experience and judgment to consider various factors in a strategic manner for particular circumstances; and direct and indirect users of edtech (teachers, learners, parents etc.) should be part of the decision-making process in the design and use of EdTech and clearly express their values, needs, preferences. These are the key members of the EDUCATE's golden triangle. Fundamental to the interpretation of these sources of information is a deep understanding of the local context from which each is generated, a consideration that is most often ignored (Cukurova, Luckin, & Baines, 2018).

This common failure to consider contextual factors in EdTech practice is hard to comprehend when one considers that a wide range of research has illustrated that it is impossible to understand how people work or learn without also taking into account the people and artefacts that make up their context (Nardi, 1996, p. 38). Although 'context' is probably the term that is used most frequently within educational research papers to index the circumstances in which learning takes place (Cole, VanTilburg, Burch-Vernon, & Riccio, 1996), it is still a complex concept that is challenging to define sufficiently to inform the subtle, nuanced practice of teaching and learning, particularly with EdTech. In EDUCATE, we interpret and use the word as advocated by Manovich (2006), who conceptualises context for learners as the act of being exposed to a single context that is their lived experience of the world; a phenomenological gestalt. In this sense, context is a reflection of the interactions that the learners have experienced with multiple people, artefacts, and environments. This interpretation of context includes a range of factors such as the learning tasks and the learning interactions within social-constructivist learning processes, as well as its relatively simplistic interpretation as being that which surrounds learning and learners. Therefore,

the clarification of EdTech interventions and their contexts through the development of logic models (or theories of change) plays a significant role of the EDUCATE's research training programme.

The EDUCATE Programme and its alignment to the principles of evidence-informed EdTech design and practice

There is a clear lack of access to, understanding of, and engagement with research evidence among most EdTech practitioners, developers and educators. Although, the fundamental role of academics in this field is to generate scientific research evidence that is accessible and engaging; it is practitioners who engage with (or not) this evidence, make sense of its contextual validity and appropriateness, and incorporate it into their design decisions and problem-solving processes. Hence there is a need to educate EdTech practitioners to increase their awareness of: the value of such an approach; existing research evidence; basic tools and methodologies that might be implemented; and guidance in their implementation.

The overall purpose of EDUCATE is to advance the efficacy of EdTech through an evidence-informed process by making the best research evidence and practice accessible for educators, researchers and technology developers. The project will enable developers and educators to integrate four information sources of information: research evidence, local context, practitioner experience and judgement, and user values and preferences to further drive and inform EdTech design and implementations.

The EDUCATE programme does this by providing research training for EdTech SMEs to develop the skills to design robust pilot evaluation research that help them to demonstrate the effectiveness (or not) of their product or service. The research training, which is offered in two modes of delivery (face-to-face or asynchronous online), is supported by resources on the EDUCATE *virtual hub* of curated resources, which includes research summaries on topical themes like 'Pupil motivation, feedback and mindset', links to curated collections of accessible research papers and additional guidance on EdTech research methods and tools. Alongside this, EDUCATE offers business and product development support through workshop sessions and mentorship to support SMEs to develop the skills and acumen to enhance and commercialise their products as well as ensuring the contextual validity of their designs and products. In addition to these, EDUCATE offers activities and events to leverage research findings for investment and procurement.

The EDUCATE participant's journey

Applicants are given an initial Skype interview to assess whether they are at a stage where they can benefit from engagement on the EDUCATE programme. In general, this would mean they have a minimum viable product and some access to users of their product or service. Once accepted, participants join the programme, based at UCL Knowledge Lab in central London for a period of 3-6 months, where they have access to a co-working space and a wide range of research and business and product design experts. They attend research training sessions

(face to face or virtually), one-to-one sessions with their dedicated research mentor and networking events that all aim to support the development of an evidence-informed decision-making process for their EdTech.

The EDUCATE research training: Taking a pragmatic approach

Educational technologies vary enormously and multiple researchers have made it clear that the design and use of an EdTech plays a big role in its impact on educational outcomes, therefore on the nature of the evidence generated regarding its efficacy (see for instance Reeves 2008; Pilkington 2008). Not all EdTechs are equal in their potential to afford efficacy. Any kind of evidence generation in EdTech research, therefore, also requires detailed knowledge of the nature of the evaluated technology, the representations and interactions it affords, and how it may contribute to learning (Pilkington, 2008). A number of methods might be used to make an EdTech and its context(s) more explicit. The EDUCATE programme has adopted a logic model (or theory of change) as a core construct to both bring this transparency, which also serves as an important boundary object between the participants and the EDUCATE team of research mentors (Star and Griesemer, 1989). In the context of EdTech, a theory of change can essentially be represented as a diagram that explains how a piece of technology might have an impact on its users. It should mainly outline all design features that the technology has, the ultimate impact that it aims to have on its users and all the potential outcomes that lead or contribute to this ultimate aim. We adopt the template shown in Figure 2 for the creation of the underlying logic model, which aims to describe succinctly the technology that will form the basis of the later efficacy research.
As shown in figure 3 below (which has been completed for a tablet-based application to support the development of metacognitive skills for children aged 9-11 years), each participant creates a logic model where resources, activities, outputs, outcomes and expected impact are all clearly presented (with their inter-connections), alongside the assumptions for each step.

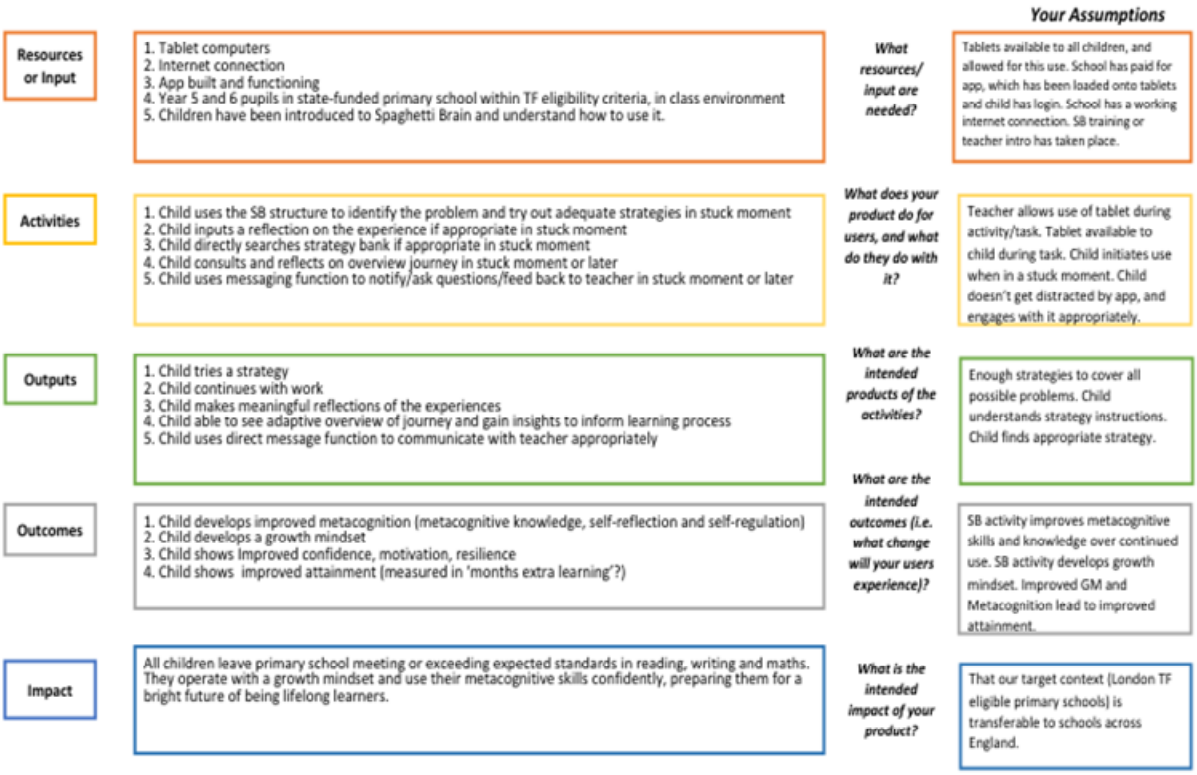

Figure 3 A logic model for an EdTech tablet-based application to support the development of metacognitive skills for children aged 9-11 years

Having created a logic model to articulate more clearly the definition of the EdTech and its potential use case scenarios, evidence-informed EdTech requires the generation of evidence from multiple sources including research literature, practitioner judgement and experience, and associated affective considerations (i.e. preferences and values). However, views about what constitutes " evidence" may vary considerably among and between stakeholders. For instance, although most EdTech developers would present quotes from their users as useful piece of evidence with regards to the preferences and values of users of their product or service, such anecdotal evidence alone would probably not convince academics. With respect to measuring impact, evidence is often categorized in four groups: Anectodal, Descriptive, Correlational, and Causal evidence (Hoeken, 2001). The EDUCATE research training programme emphasises that the type of evidence does not necessarily reflect its quality and different types of evidence have different advantages and disadvantages (Marshall, & Cox, 2008). Whilst an exploration of the quality criteria for different types of evidence is outside the scope of this paper (for further information please see O' Leary, 2004), the point that we accentuate is that each type of evidence should be judged with appropriate evidence quality criteria and a type of evidence' s appropriateness should be considered for specific questions and within particular research contexts. In EDUCATE research training, we support EdTech practitioners to identify the types of evidence required from different sources of information.

A second consideration is that different stages of innovation would require different types of evidence. The spiral shown in Figure 4 was developed by Nesta (2016) to capture the different stages of the innovation process, and it can be used to identify different innovation stages of emerging technologies.

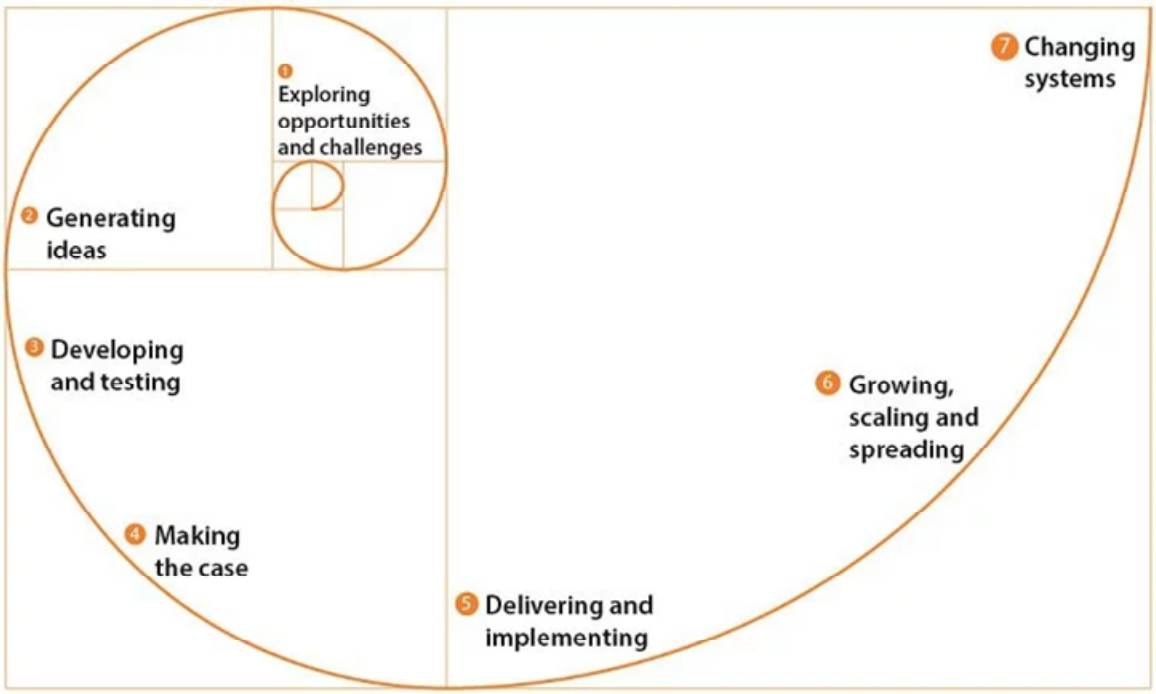

Figure 4 The Innovation Spiral (Nesta 2016)

For instance, initial stages of exploring opportunities and challenges, as well as generating ideas, it would be beneficial to focus on literature reviews and design principles, identifying what has worked or failed in the past in different contexts and using this evidence in the design decisions made for the emerging technologies. These design principles and lessons can help both developers and users of emerging EdTech follow strategies that are more likely to have an impact. During the developing and testing stage, rapid cycle evaluations that would generate anecdotal and descriptive evidence would be beneficial, whereas at making the case stage it would be beneficial to undertake impact evaluations that would generate some correlational evidence. Once an emerging technology reaches certain level of maturation through these stages, during the delivery and implementation stage (See Figure 4), it would require causal evidence that would show causal impact. On the other hand, growing, scaling, and spreading stage would require bigger scale experimental evaluations. System-level change can only be provided through multiple big scale evaluations from various contexts and clear implementation manuals that would ensure impact in multiple places. It is interesting to note here that by the time an emerging technology reaches to system changing level, or even the growing and scaling level, it would have reached a certain level of maturation so much so that its emerging nature would be questioned (Cukurova, & Luckin, 2018).

Next, we present a classification of EDUCATE companies, both at the descriptive and more conceptual levels with the purpose of attempting bringing such systematic landscaping of EdTech in London.

Classification of EDUCATE companies and their challenges

This paper describes the picture as of Summer 2018, and includes data on the 96 companies that have engaged with the EDUCATE programme to give an indication of their diversity. Figure 5 indicates the intended users for whom the products and services are being designed to impact.

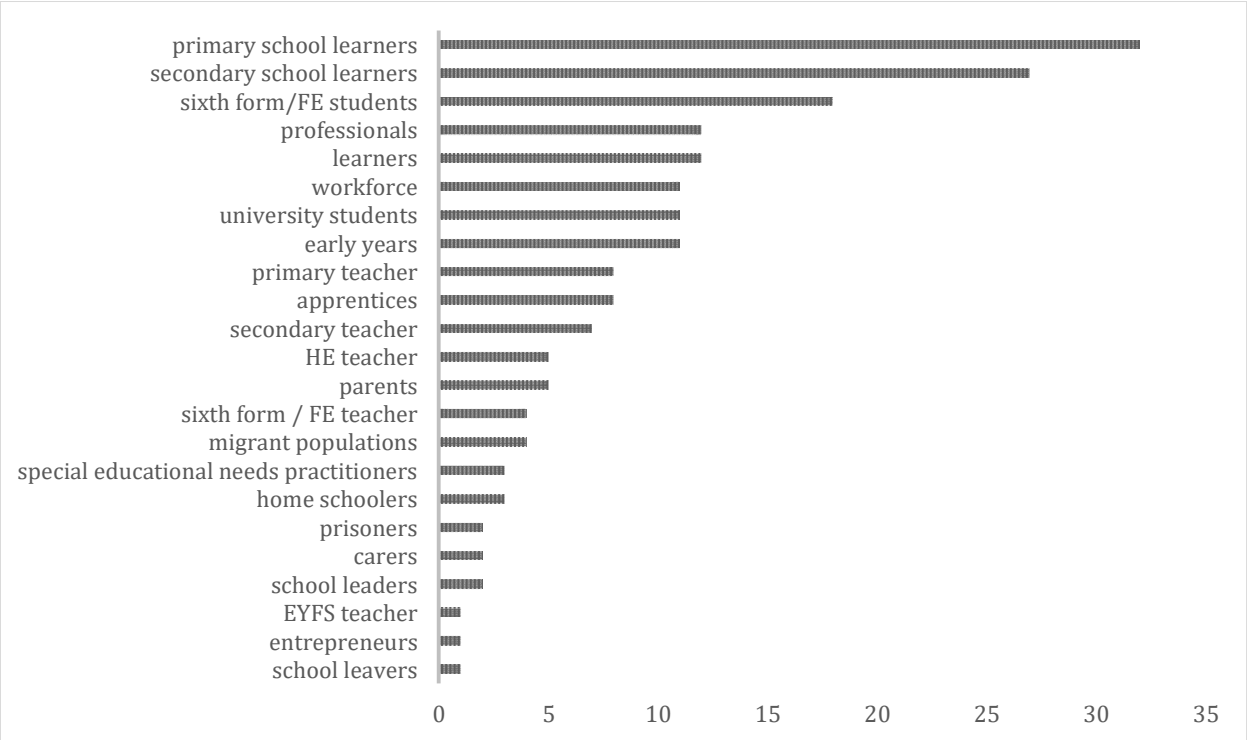

Figure 4 The intended users of the EdTech (as frequencies of companies, where products may have more than one class of intended user).

Perhaps unsurprisingly, the majority of EdTech is being designed to support primary or secondary aged learners. However, there are a notable number seeking to impact on teachers and some highly specialist products and services addressing particular needs of smaller user populations such as home-schoolers, migrants and prisoners.

Table 1 lists the intended impacts of these companies.

Intended impact	**Frequency**
improve attainment	62
improve skills	54
improve engagement	29

improve access to learning	22
improve wellbeing	13
reduce /attainment gap	12
increase opps for lifelong learning	11
improve social mobility	9
improve creativity	9
improve quality of assessment	9
prepare for school	7
improve quality of lifelong learning	7
improve teaching efficiency	7
improve teachers' assessment practices	7
improve teachers' productivity	6
improve teachers' selection of content	6
improve resilience	5
improve educational equity	5
improve parenting	5

Table 1 The intended impact of the EdTech (as frequencies of companies, where products may have more than one class of intended user).

Again, it is unsurprising that two thirds of the companies are designing EdTech that aims to improve educational attainment, which in turn face the traditional content domains such as English language/literacy (15), mathematics (10), science (7) and coding/computing (10). However, there are also companies that are designing EdTech seeking to impact broader domains such as entrepreneurship and citizenship. Furthermore, five companies are designing EdTech for medical education and 3 companies to address the needs of adult education in the workplace. Cognition (2), meta-cognition (6) and 21st century skills also feature.

Finally, with regards to the "type" of EdTech being developed, this has prompted a rich and productive line of research amongst the project community with regards to definitions and classifications of EdTech according to its functionality, digital access requirements and nature that will be the topic of future academic papers.

Two EDUCATE case studies

We present two case studies to describe each company's context, engagement and outputs during the programme. These are selected from different stages of the innovation spiral (see figure 4) to highlight differences in their research questions and methodological approaches.

Readalo

Readolo, a product between development stages 3 and 4, is an online computer/tablet product to (at its basic level of use) is being created to support university students and academics to both store bibliographic data with the associated sources and highlight/annotate/note-take to produce syntheses of ideas that can be exported for use in academic writing. The small team of four is simultaneously designing, building and fundraising, and two members are highly engaged with the EDUCATE programme. The Readolo logic model underwent several iterations before it was refined for the use case scenario of Master's level students with a need to both adopt a bibliographic tool and learn to read, extract information and synthesise ideas from multiple data sources. The company developed has five research questions, which broadly span their anticipated product development process, the first of which was: What knowledge organisation approaches help with grasping the "bigger picture"? For their initial methodology, they chose to conduct interviews with experienced academics from a range of disciplines (medicine, law, education, mathematics) as a means to understand how academics think and work. The data revealed by this early research highlighted how their product might need to read (and possibly interpret) textual, graphical, numerical and equation formats and the very different approaches that academics used, from highlighting paper versions of academic texts with a pen, to the use of combinations of existing digital products and services.

Pobble

Pobble, a product at development stage 5 is an online computer/tablet product for English primary schools that enables a teacher to set writing tasks for their class and upload their pupils' outputs for sharing within the Pobble online school community as a means to both engage children in writing and support processes of peer assessment. As such, Pobble faced a challenge that is common to much school-facing EdTech, which is that they have more than one user group, and therefore multiple or nested logic models. Their intended impact is on the pupils, although the use of the product is determined by teachers. So, although the initial research question for Pobble was "Does the implementation of Pobble improve children's engagement in writing?", unpicking the meaning of the word 'implementation', would require the company to make a critical set of assumptions to define what such an implementation might look like. This has led the company to pause, whilst it rethinks its process of teacher support to establish the features of a successful implementation, to include some quantifiable metrics such as

Challenges and Reflections on the EDUCATE Programme

EDUCATE is a step towards bringing much expected evidence-informed approaches to EdTech to shape the future of EdTech. However, despite the significant amount of academic interest

and policy focus as well as the resources directed to bring evidence into EdTech practice, it is still a significant challenge to generate and identify robust evidence on the effects of technology in education at a scale, particularly for emerging technologies.

There could be numerous reasons for this lack of robust and reliable evidence regarding the effects of technology in education discussed in the academic literature (see, for instance, Cox, & Marshall, 2007). Moreover, there are other challenges that are more practical in their nature such as the lack of investment and interest from EdTech companies to adopt an evidence-informed process for their products, or strategic challenges such as the lack of cross-sector learning and multidisciplinary collaboration in EdTech research and practice (between developers, designers, entrepreneurs, educators, and academics) (Cukurova, & Luckin, 2018). EDUCATE is an attempt to fill in this gap.

However, there are various challenges we face within the first two years of the project that need to be addressed. First of all, there is a clear lack of systematic reviews and accessible research evidence for EdTech practitioners to take into account. EdTech in education field immediately needs systematic reviews that are replicable and present the collective body of evidence on a particular topic. A general consensus across all fields interested in evidence-based practice is that a synthesis of evidence from multiple studies is better than evidence from a single study (Hunter & Schmidt, 2004). Systematic reviews have become fundamental to evidence-based practice and represent a key methodology for locating, appraising, synthesizing, and reporting available evidence (Briner, Denyer, & Rousseu, 2009) and ideally, research evidence in evidence-informed EdTech should come from such studies.

Second, there is a lack of engagement of academics with the practitioners to provide research evidence and guidance to implement it as well as help practitioners generate other valuable sources of information from users and context. The average academic colleagues are already too busy with their everyday research, teaching and administrative roles and they lack the required encouragement to spend the required time and effort on engaging with the evidence-informed practice of EdTech. Such engagements should be supported and encouraged by academic organisations.

Third, most practitioners lack the required skills, tools, and knowledge to take an evidence-informed approach in their EdTech practice. Such development costs those practitioners time, and other resources, therefore there is an immediate need for programmes like EDUCATE's research training to provide this support for free.

Fourth, although at the policy-making and governance level there is some pressure to move towards evidence-based practice in education, due to the lack of appropriate training and engagement with practitioners, such pressure may lead to either blind adoption of research evidence without its critical consideration, or to overemphasising it over other important sources of information such as practitioners' professional experience, user values and preferences, or local context. Certainly, most EDUCATE practitioners' first reaction to research evidence is to adopt it as the holy grail. This attitude can lead to research evidence replacing other valuable sources of information which is not the essence of evidence-informed EdTech practice. Related to this issue, as the fifth challenge, there is the danger of taking a top-down approach in which academics or policy-makers tell practitioners what to do and what not to do where practitioners simply follow rules. Evidence-informed Edtech is all about asking the right questions, identifying problems and an astute combination of four different sources of information to make the best

decision for particular circumstances. EDUCATE programme aims to create this dialogic exchange between practitioners and academics, however, such engagements take time and effort. Particularly, for these different communities which mainly speak with a different terminology, it is an ongoing challenge. At last, but not least, one of the key challenges for EDUCATE is the lack of clarity in terms of terminology in the field and the lack of blueprint project examples to take as an example. Due to this challenge, in many cases, we took a trial and error approach particularly during the first year of the project. However, we hope that there will be many other examples which will take our approach, criticise and improve it in the future. Regardless of the academics engagement with EdTech practitioners, they are shaping the present and future of EdTech. With a better shared understanding among key stakeholders, we can increase the possibility of shaping this future in an evidence-informed manner.

Conclusions

In this paper, we have described the EDUCATE programme and the way in which it foregrounds evidence-informed practice in the design, use and evaluation of EdTech for small and medium sized companies in the London region. The EDUCATE approach is grounded in previous research concerning the evaluation of educational technology and acknowledges the importance of recognising the innovative and emerging nature of the technology being developed by EDUCATE companies, and the need to move away from the view that the context of the technology's use is unchanging and that change is undesirable. We have argued that this positioning of the use of evidence in practice is particularly problematic and extremely limited for educational research, particularly when technology is involved.

It must however be recognised that the EDUCATE approach is not without its challenges. We have noted the a few challenges summarized below, and stress that their identification is valuable in helping us to understand the EdTech ecosystem in London more thoroughly.

- Unlike many products, such as medicines and food, EdTech products can go straight to market without any evaluation and, if there is any evidence, there is no check on its validity. This creates uncertainty around the impact of EdTech and may encourage companies to believe that it is unnecessary;
- There is a lack of systematically reviewed EdTech evaluation reports and most independent EdTech research is not accessible or understandable to the EdTech sector. EDUCATE is an attempt to fill in this gap by helping SMEs to develop a research understanding that can help them understand existing research more effectively as well as helping them to design their own research;
- There is a lack of engagement by academics with both practitioners and developers to provide research evidence and guidance. The only disappointing feature of our EDUCATE work to date is the reticence of academics to engage with developers and practitioners and for managers and leaders to see this as a worthy enterprise for which academic staff should be given time;
- The lack of encouragement across the board for educational practitioners to engage with research evidence and practice results in a very unsophisticated research mindset

where critical evaluation is absent. This must change so that both teachers and learners know: the right questions to ask, how to get the answers, and how to recognise the answer when it is provided;
- For emerging EdTech companies, who design and prototype in rapid cycles, the act of researching each stage can be perceived to slow product development. However, the evidence from the EDUCATE project so far, suggests that the value of building a more thoughtful research evaluation stage into each cycle, although slow and painful at first, becomes easier with experience – leading to a more research-minded company culture.

The challenges faced by participants in the EDUCATE programme help us to see the current and developing future of the EdTech ecosystem in London. This vision is complemented by the data about the companies we work with.

Conflict of interest statement

There are no conflicts of interest in the communications of this research.

Ethics statement

The ethical approval of the project was granted by the UCL Institute of Education Ethics

Committee (REC 1056).

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