REPORT

UNDERSTANDING EVIDENCE : A BRIEF GUIDE FOR EDTECH PRODUCERS

2022

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FOREWORD

As EdTech users navigate the market with one eye on data safety and the other on evidence of impact, EdTech producers need to balance up their growth investments with scientific evidence. This guide aims to facilitate this process by pulling together some high-level findings and recommendations to support EdTech's road to evidence.

For the past two decades, international research studies have painted a bleak picture of EdTech: many popular platforms have regularly breached Data Protection laws, some of the most popular apps used by children have little to no analysis of their learning impact, and key platforms used in schools are judged as scientifically inadequate.

The need for educational technologies to positively and reliably advance children's learning has been turbocharged by the Covid-19 pandemic. Policy-makers, investors and the wider public across the globe have mobilized to demand proof of which EdTech works and is safe to use - The EdTech Evidence movement was propelled into the public sphere.

Educational technologies ("EdTech") are digital tools, platforms and programs developed for educational purposes.

So that EdTech have a positive impact on children's learning, their design and use need to be driven by science and evidence of what works. This requires an understanding of effectiveness and efficacy standards and broad sets of evidence priorities.

This guide lays out some principles for EdTech producers and developers who want to embed scientific principles into their design, implementation and scale-up. The principles are presented in a simple, four-part framework that can be used to make sense of the need and proven approaches to evidence.

EDTECH'S POTENTIAL

Most of today's EdTech are Artificially Intelligent (AI) in that they are data- and algorithm-driven. This means that EdTech can manage personal information about each learner to tailor the content to individual needs and preferences. Such EdTech has the potential to turbocharge digital personalized education.

"Variability in human development is the norm, not the exception. The pace and profile of each child's development are unique. Because each child's experiences create a unique trajectory for growth, there are multiple pathways—and no one best pathway—to effective learning." (Darling-Hammond & Cook-Harvey, 2018, p.2)

Digital personalized education is the key driver to address educational inequity.

Educational inequality shows differences between groups but does not question their moral or ethical components.

Educational inequity shows differences between learners based on their 'personal and social circumstances, including factors such as socio-economic status, gender, ethnic origin, immigrant status, pace of residence age or disability." (OECD, 2008).

Example of digital personalized learning that integrates the principles of learner variability with EdTech design:

The WISE EdTech platform

Tthe WISE learning environment was developed through a partnership of classroom teachers, technologists, natural scientists, and pedagogical researchers (Linn & Slotta, 2020)

Learner variability is a well-established scientific foundation for understanding how children grow and thrive. Digital personalized learning provides a technological and ideational context for the learner variability science.

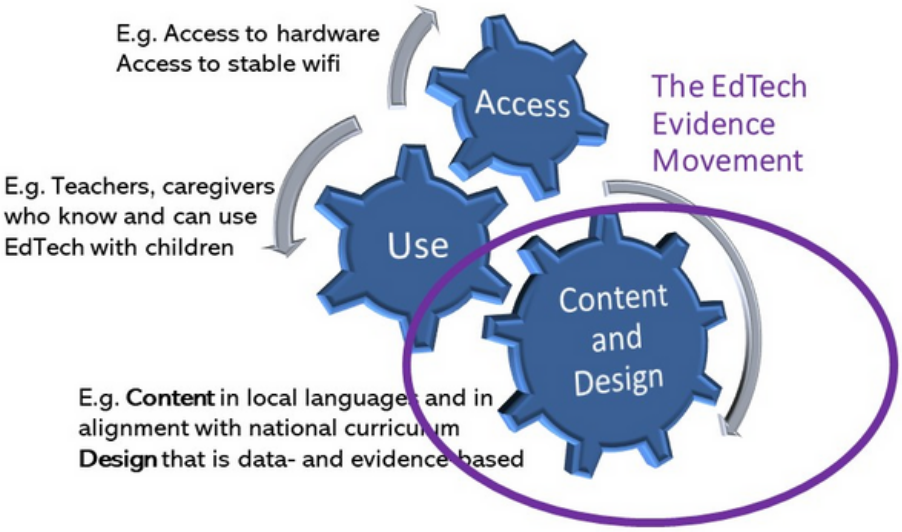
Digital personalized learning can support leading instructional strategies that accommodate and address learner variability, such as: 1) build on previous knowledge and actively engage students in relevant tasks; 2) support inquiry-driven learning; 3) collaborative learning where students build on each other's knowledge; 4) personalized and timely feedback to enable students to revise and improve together with self- and peer- assessment, and 5) reflection on learning (see Darling-Hammond, 2020).

Digital personalized learning supported by well-designed EdTech can meet children where they are and align social, emotional, and academic learning with each learner's active construction of meaning. Such EdTech can uniquely address inequitable learning models by promoting inclusive digital learning that accounts for the diverse and multiple ways through which children learn (Kucirkova, 2017). However, EdTech's potential to support learner variability through digital personalized learning, is far from being realised.

EDTECH REALITY

The lack of positive educational impact has marred the EdTech reputation for the past decade. National EdTech investments have been described as “faith-based”, driven by commerce rather than evidence of positive learning impacts (Trucano, 2016, Selwyn, 2013).

This approach to EdTech has exacerbated educational inequalities by depriving disadvantaged communities of access to high-quality products, educational content and effective pedagogy of use (the so-called “digital divides”).



The discrepancy between the rhetoric of EdTech’s potential for positive learning and the scientific evidence showing the opposite, has led to a divided public discourse: some uncritically promote EdTech as a force for educational change, while others universally perceive EdTech as a threat to analogue and in-person teaching. The Covid-19 pandemic heated the debates and heightened the global interest in effective digital learning.

So that EdTech is the game-changer in addressing educational inequities, it needs to:
1) integrate technology innovation with educational policies in individual countries and their financing; 2) increase the scientific quality of design of platforms and the content they offer; 3) align with teachers’ expertise and leadership at schools and overall levels of digital literacy among the population (UNICEF, 2022). This holistic approach requires substantial changes to the EdTech ecosystem, with EdTech producers, investors and policy-makers finding sustainable ways to evidence and innovation (Jacobs Foundation, 2022) and major investments in AI improvements (McKinsey, 2022).

The EdTech Evidence movement is a global effort to increase the integration of science with EdTech.

WHY?

WHY?
The commercial reasons:
- Higher chances of long-term success
- Improved visibility and transparency
- Strengthened global market position

The ethical reasons:
Recent national reports (e.g. from **the UK**) highlight not only minimally positive but also negative EdTech's impact on children: EdTech used in 49 countries during the Covid-19 school closures breached Data Protection laws.
The design of educational apps is misaligned with the principles of learning sciences (Meyer et al., 2021) and programs rated as most popular on the educational app store use manipulative features, which harm the learning particularly of children from low socio-economic backgrounds (Radesky et al., 2022).

These studies exemplify the need for EdTech to be driven by independent, rigorous evidence from design, through implementation, to evaluation.

Studies that evaluated EdTech features (designs that target selected knowledge areas), show positive results for specific learning outcomes. For example, interactive features that are aligned with the storyline positively influence children's story comprehension when reading digital books as compared to the same reading on paper (Furenes, Kucirkova & Bus, 2021).

These studies exemplify the need to invest in EdTech research-design that provides answers about which EdTech features work best , for whom and under which circumstances.

Current systematic reviews and meta-analyses (analyses of analyses) of EdTech's overall impact show that EdTech's use can be engaging and motivating for pupils (Higgins, Xiao & Katsipataki, 2012). More research is needed to answer how EdTech can enable teachers to effectively adapt their practice with AI-driven platforms.

The findings can inform pedagogy directions and ensure that ineffective pedagogies are minimised and inadequate solutions eliminated from the market.

It is the advancement of this type of EdTech research that is at the core of the EdTech evidence movement. Ultimately, the aim is to leverage EdTech's potential to address the global challenge of educational inequity.

HOW?

National requirements

EdTech's plan for evidence needs to be adjusted to the national variation in evidence requirements, local practices in their implementation and various levels of decentralized decision-making. In some countries, procurement funding rules are tight to proofs of efficacy, while in other countries, data safety and economic return on investment are used as primary accountability tools. EdTech thus need to tailor their evidence narratives to the different national contexts, while remaining attentive to global evidence trends.

Some countries have been more proactive in pursuing the evidence agenda than others. USA set out **ESSA Tiers of Evidence,** and only includes EdTech with completed randomised controlled trials in the **What Works Clearinghouse List.** Some countries are developing their own certification models for EdTech, while others rely on established recommendations for learning tools more broadly. For low- and middle income-countries, the World Bank and UNICEF's catalogue of **"Smart Buys"** is based on an expert's evaluation of EdTech's evidence portfolio.

Certification options

Internationally recognised seal of approval, such as the **ISTE Standards,** are natural opportunities to leverage on an EdTech's scaling-up journey. In addition, EdTech can apply for a certification from established teacher panels, for example that offered by **EdTech Impact** or **Educational App Store**.

To get high scores on any of these evaluation standards, EdTech need to demonstrate evidence of impact and follow research standards in their design and development

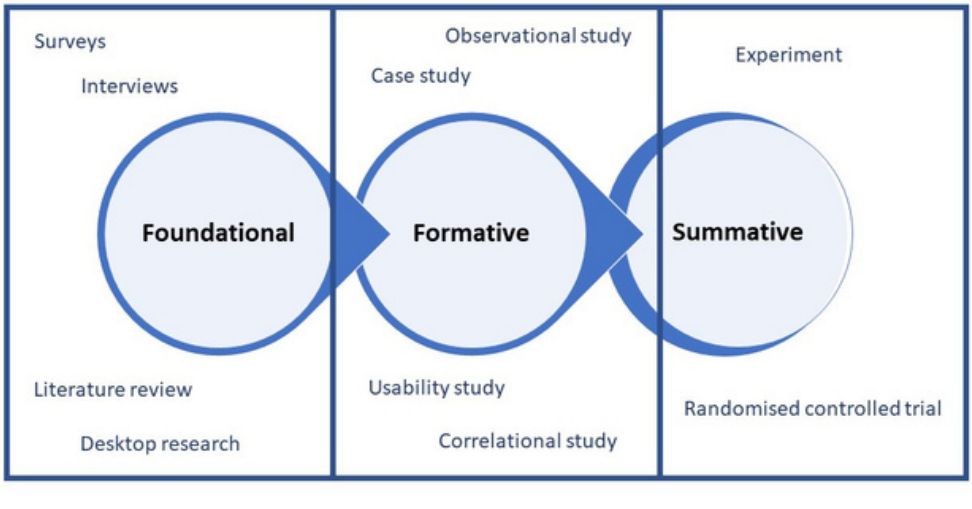
Research consultancy services

EdTech research consultancy companies (e.g. LearnPlatform in the USA, Wikit AS in Scandinavia and Educate Ventures in England) are on the rise, especially for EdTech who need evidence for scale fast with access to a diverse group of pilot partners. Some offer cohort-based learning, others evidence as a service or one-off masterclasses.

THREE TYPES OF EVIDENCE

Simply put, there are three types of research to establish evidence: foundational (literature reviews or desktop research), formative (e.g. observational or correlational studies) and summative (e.g. experiments or RCTs, Zielezinski, 2019). The use of each method is determined by the research question we want to answer but also the maturity of the intervention (programme) and context. The summative type of evidence is considered the strongest measure of evidence, however, there are ongoing academic debates about the gold standard in measuring it.

https://www.slideshare.net/molly_bullock/demystifying-evidence-in-edtech



Quantitative methods can provide evidence of causality. Examples include experiments, A/B esting or randomised controlled trials. Quantitative methods allow for a systematic testing of variables (e.g. features of design or learning effects) and hypotheses by comparing groups. They rely on numerical and measurable data.

Qualitative methods can reveal why and how an intervention works (or not). The reporting of qualitative research can be subjective, or systematic by following the standards of reporting one-to-one and focus group interviews (see Tong et al. 2009).

A strong evidence portfolio has a combination of evidence from both qualitative and quantitative studies over time and conducted by independent research teams.

THE EVIDENCE DEBATES

The benefits of RCTs

Randomised controlled trials (RCTs) follow the "medical model of education" that sets standards of efficacy, with randomised controlled trials as the most rigorous way of demonstrating evidence (Slavin, 2002).
RCTs can separately and causally estimate the impact of various components of an EdTech intervention and as such, determine whether an intervention works or not.

The limitations of RCTs

Given the large cost and resource intensity of RCTs, efficacy research has been criticised for favouring bigger players and stifling innovation in the market. Another criticism is the politicised nature of how RCTs are financed and carried out (Goldacre, 2013). RCT carries ethical implications of having an intervention and a control group, whereby the control group often does not receive the training/mentoring/potentially beneficial learning resources.
The quick road from an EdTech start-up to the market and user's hands does not sit well with the long and resource-intensive timeline of an RCT.

The bottom line is:
no single study can reliably provide evidence of impact for both products and services across contexts and over time. EdTech companies need to develop an evidence portfolio based on independent, rigorous and systematic research.

4. HALLMARKS OF SCIENTIFIC RESEARCH

INDEPENDENT
RIGOROUS
SYSTEMATIC

Independent and standardized measures have greater effectiveness value than measures developed for a specific tool or intervention (Wolf & Harbatkin, 2022).

Rigorous and systematic

Quantitative research	Qualitative research
Reliability: Consistency of data, convergence of measures	**Dependability** Clear definitions, coding checks, researcher role
Validity Objectivity, generalisability, replicability	**Credibility** Authenticity, richness, scope, uniqueness of data

Some common misconceptions in evidence discussions relate to the difference between efficacy and effectiveness, correlation and causation and evidence and experience.

Efficacy vs effectiveness

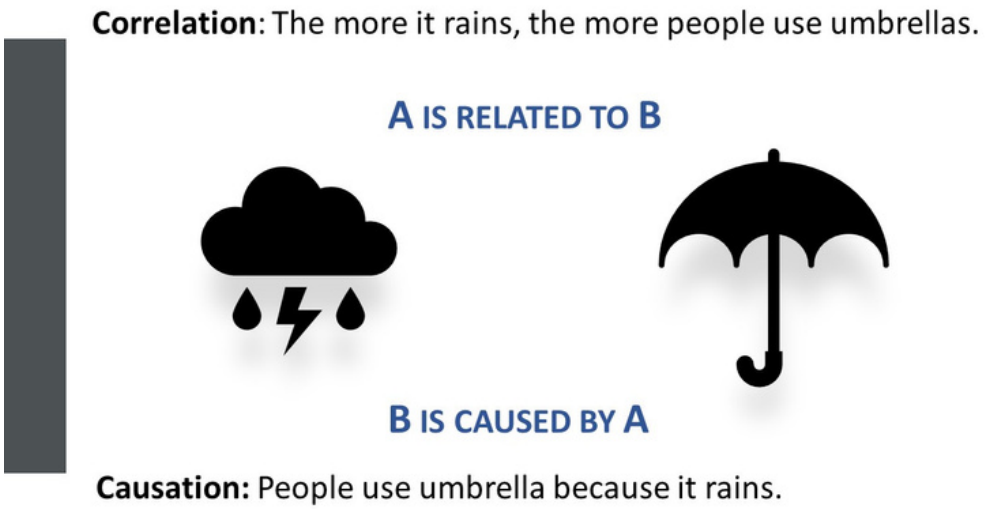
	EFFICACY	EFFECTIVENESS
Example questions	Does the EdTech work as it was designed to work?	Does the use of the EdTech benefit children in the classroom?
Testing site	"Ideal classroom" selected based on strict criteria	Typical classroom
Participants	Children selected based on inclusion/exclusion criteria	All children in a given classroom
Intervention	EdTech is used according to an established protocol	EdTech is used flexibly, parallel with other tools already in the classroom

Experience versus evidence

Teachers' positive attitudes towards an EdTech product are essential for the EdTech to be used in the classrooms. Yet, there are debates about whether teachers' experiences should count as evidence. Teachers are not independent evaluators and their pedagogies (professional way of using EdTech in the classroom) influence the products' impact on children. This complicates quantitative evaluations of EdTech's impact.

The evaluation and accommodation of teachers' and students' voices are important ingredients in ethical research that is not "on" but "with" EdTech. Teachers' perspectives and experiences of using the EdTech in the classroom, their evaluations of the product's usability, alignment with their teaching plans, national curriculum and children's progress, should feed into every EdTech evidence portfolio. Children's / students' views, their engagement levels and enjoyment ratings are important usability metrics.

Correlation versus causation



Closing summary

To drive down the industry-wide problem of EdTech's minimal or negative learning impact, investors and governments have begun demanding evidence of efficacy and effectiveness. The global aim is that gradually, all schools will use EdTech based on causal, and not casual, evaluations of what works.

The EdTech Evidence Movement is changing how national and international procurement teams assess which EdTech are adequate and acceptable for classrooms. Differences in national requirements for EdTech evidence are likely to result in different guidance and guidelines for producers across the globe.

Researchers agree that teachers' experiences and children's perceptions, engagement and enjoyment of use, need to be part of EdTech's evaluations. The current evidence debates are whether randomized and rigorously matched experiments should be the only or primary basis for policy decision-making.

There are areas of EdTech use where an efficacy-based approach to evidence is not appropriate or where the time for a result to be validly seen is disproportionally long. Being evidence-aware and striving for the most judicious combination of qualitative and quantitative research is the core of a strong evidence portfolio.

In closing, the following questions are intended to help EdTech reflect on why and how they approach evidence.

As you build your evidence base, ask yourself:
What do you define as "success"?
(try to define this in terms of educational inequality or inequity)
Which parts of your offer are key for this success?
(try to think about your "non-negotiables")
Which parts could be removed as you scale-up?
(try to think about how you can simplify for greater adaptability)
How do you monitor the achievement of your success?
(try to think of all the ways you track engagement and outcomes)
What internal capacity do you have to sustain this strategy?
(try to think of your own research capacity and needs)

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Recommended citation:
Kucirkova, N. (2022) Understanding Evidence: A Brief Guide for EdTech Producers, Report for WiKIT, AS, DOI: 10.13140/RG.2.2.30096.07687/1,

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