EdTech Impact in Education

Prepared for: Education Endowment Foundation

Hannah Walker, Nariman Moustafa, Björn Haßler

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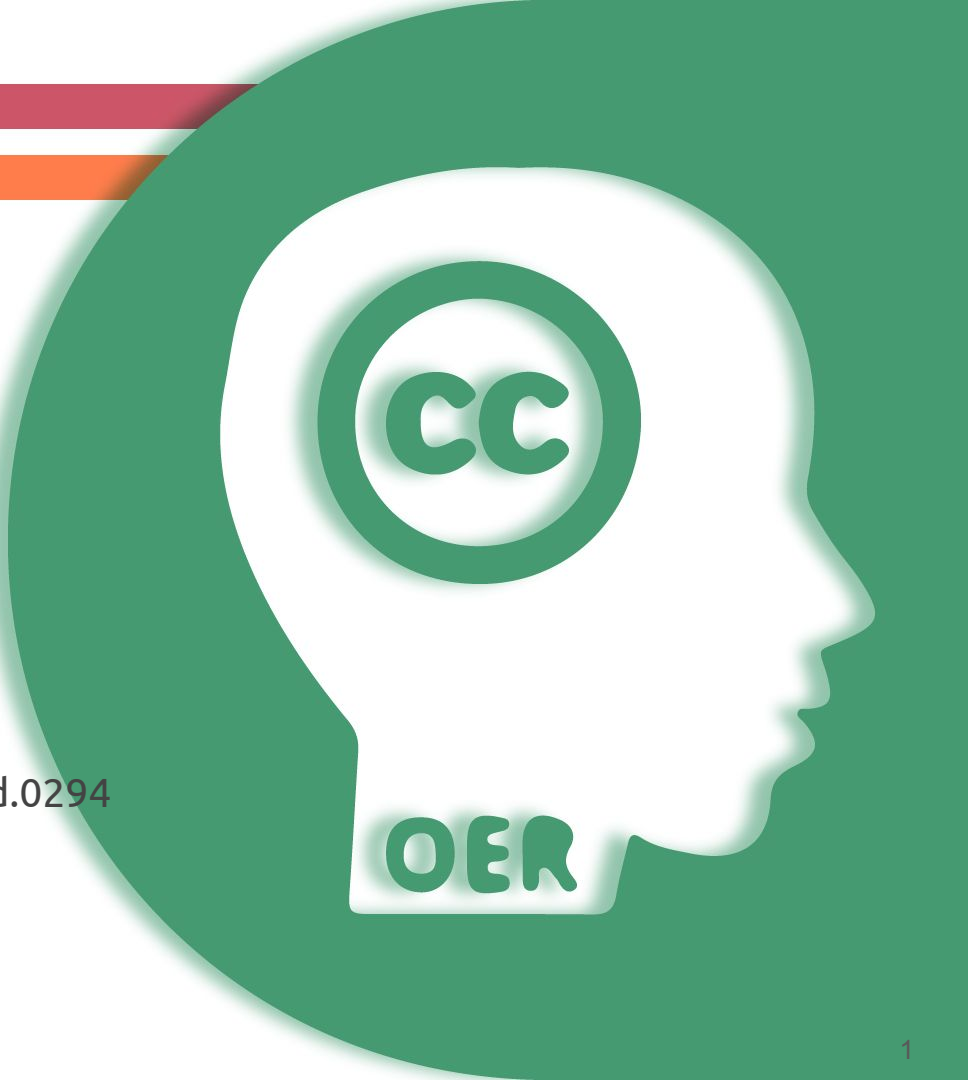


Contents

The partners

Education
Endowment
Foundation

Purpose of the EdTech Impact in Education review

Purpose of the EdTech Impact in Education review

- This is **a collaboration project** between Education Endowment Foundation (EEF) and Open Development and Education (OpenDevEd)
- There is **increasing evidence on the importance of EdTech** in Education & increasing **uptake of EdTech in practice and funding**
- The review r**esponds to a need/gap to collate rigorous evidence** on the impact of EdTech in education, in a way that can improve decision-making on local school and national levels
- This is the **first step of highlighting the evidence that exists on impact**, with a view to **understanding the landscape of evidence, identifying gaps** and **directions for further research,** and **informing EEF's potential evidence toolkit** on digital education

Methodology

Methodology

EEF provided OpenDevEd with 100 papers that are either meta-analyses or systematic reviews around the impact of digital education interventions

The OpenDevEd team did the following:

- Added 10 other papers on the go but not yet a systematic search
- Created inclusion/exclusion criteria
- Created a Zotero library
- Started reviewing the papers for trends and inducing codes
- As the reviews expanded, an inductive approach was mixed with a deductive approach, and a codebook was created
- Papers were divided among 3 reviewers for review and categorisation. Reviewers met regularly for aligning on codes and meanings

Methodology

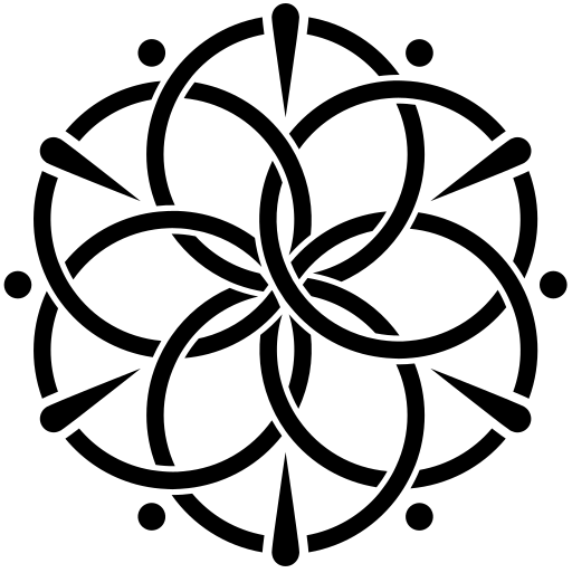
The OpenDevEd team did the following:

- For reliability: an independent reviewer conducted a random check of 20% of each of the 3 reviewers' sets of papers
- The Zotero library was converted into an evidence library powered by Kerko https://tech.eved.io/lib/
- Analysis of emergent trends/themes, gaps, and recommendations for directions of further research

- Both teams checked-in regularly (tri-weekly) for updates, refining analysis and questions
- This project was conducted between November - December 2022

Inclusion criteria

- Edtech intervention in education (from 2000-2022)
- Has a clear focus on measuring learning outcomes
- Study is a meta-analysis (i.e. statistical measurements, reporting on effect sizes and testing for heterogeneity). For this round, only systematic literature reviews were excluded
- Clearly delineated research methods, including mention of inclusion and exclusion criteria and sources of primary studies
- Transparent about limitations



Coding

Studies were coded for the following:

General identification	Outcome measure	Instructional domain	Education level
	Learning site (school or home or mixture)	High-Income Countries (HIC)/ Low-Income Countries (LIC)	Geography (if specified)
Specific mentions	Special groups of students (if specified)	Moderating variables	

Coding

Studies were coded for the following:

Tech-related	Tech hardware	Tech software	Tech mechanism
Learning/pedagogy related	Learning approach (classroom, remote or blended)	Teacher pedagogy	Tech mechanism
Research design	Research methods	Research quality	No. of primary studies included
Results	Effect size/ heterogeneity		

Research quality assessment

We had **8 quality assessment criteria** to measure each study against. These were:

1. A mention of clear methods
2. A mention of clear inclusion/exclusion criteria
3. Conducts statistical measurements
4. Reports on effect sizes
5. Tests for heterogeneity
6. Clear mention of sources of evidence/literature, including grey literature
7. Transparent about limitations
8. Reviewed 20+ primary studies

A study was coded as:

Strong: 6+ criteria met	Medium: 4+ criteria met	Low: 3 or below criteria met

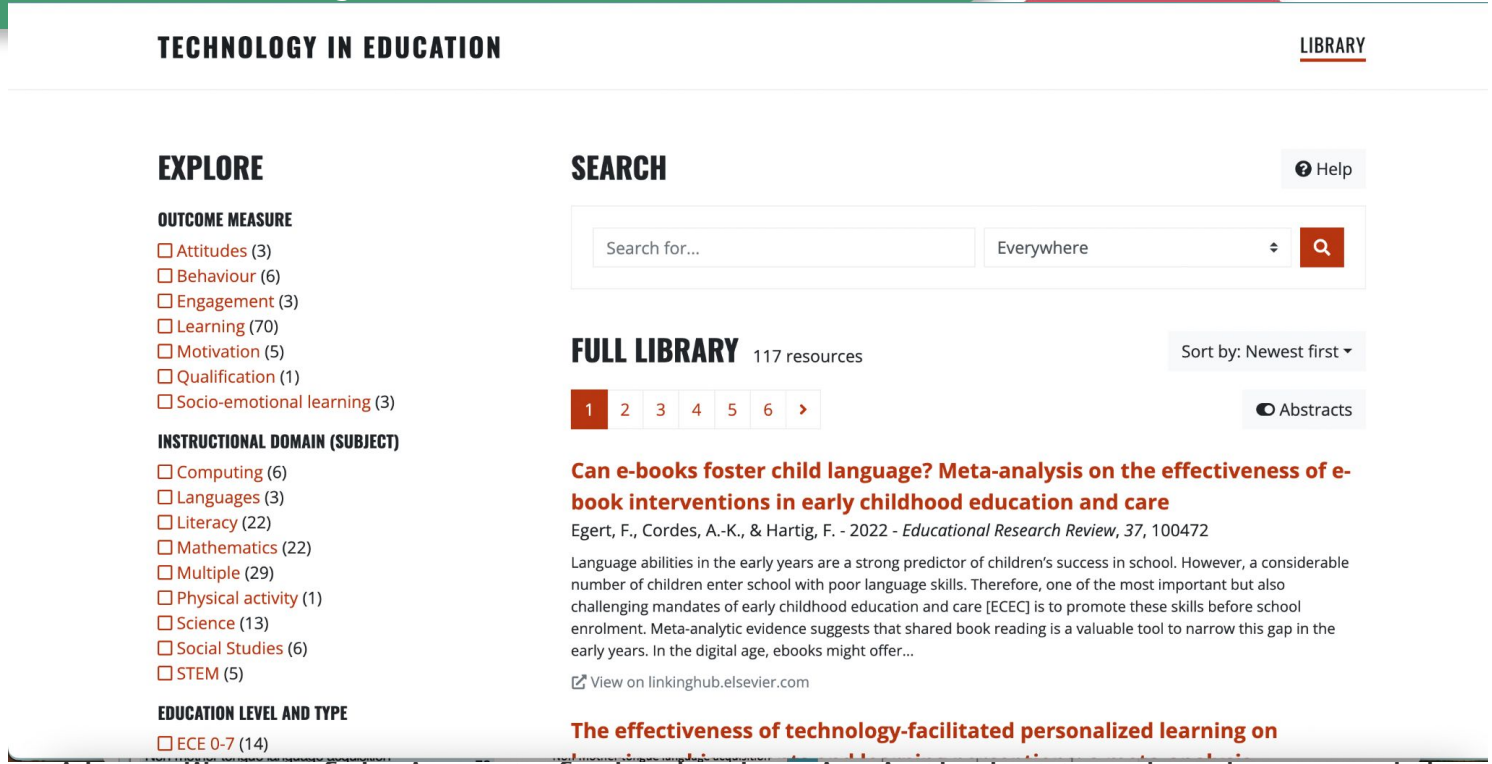
Limitations

Limitations

- Systematic literature reviews not included
- No systematic review is conducted yet, particularly post 2020 with post-COVID innovations
- No grey literature studies or reports
- Papers focused solely on tech interventions and their direct relationship to learning outcomes, not much consideration for systemic factors or confounding variables

Output 1
Research library: Overview

Research library: Overview

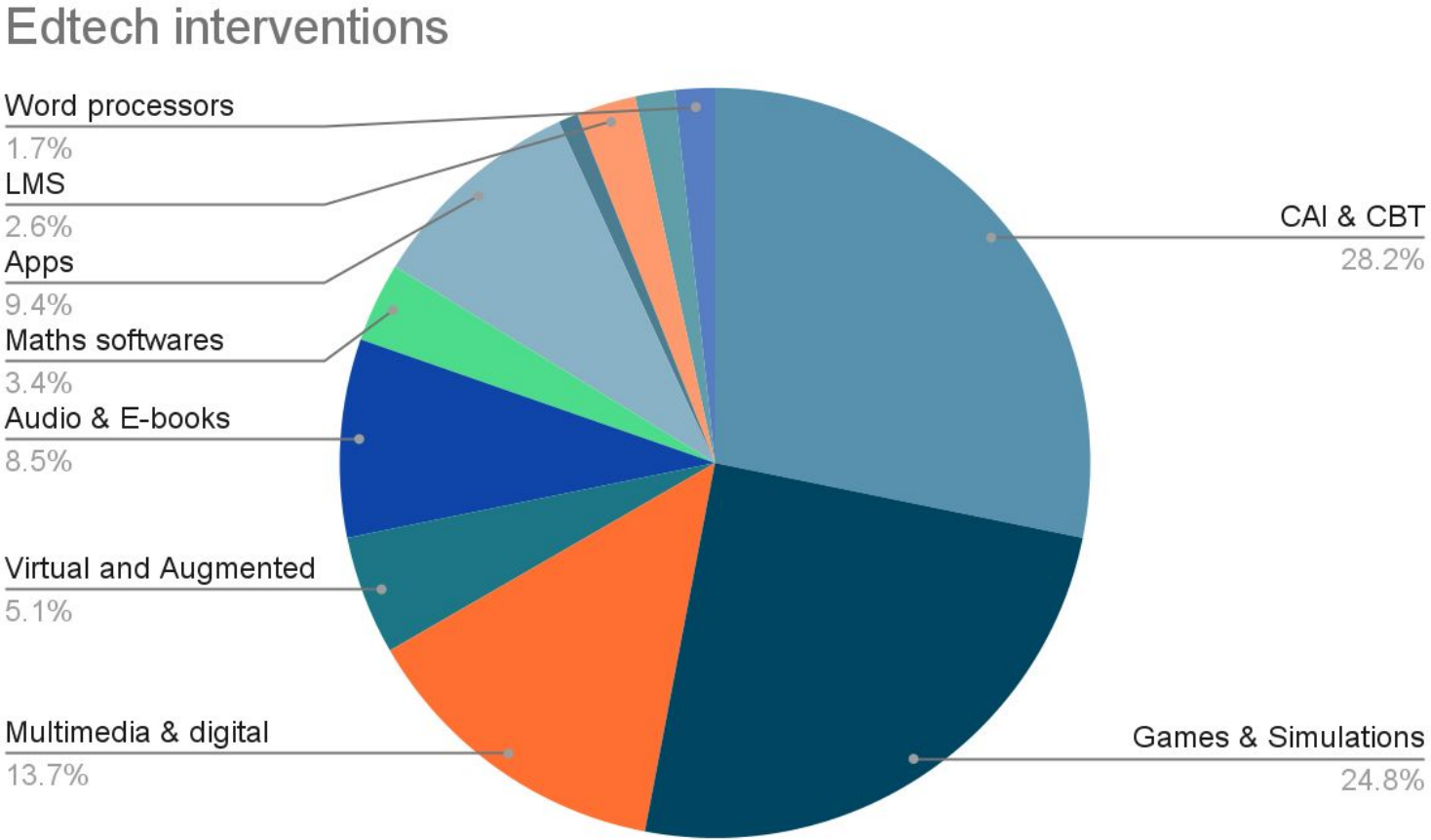


An evidence library of the impact of edtech education in the last two decades around the world, containing 117 papers (meta-analyses, with average primary studies between 40-60) categorised and can be filtered according to search interest.

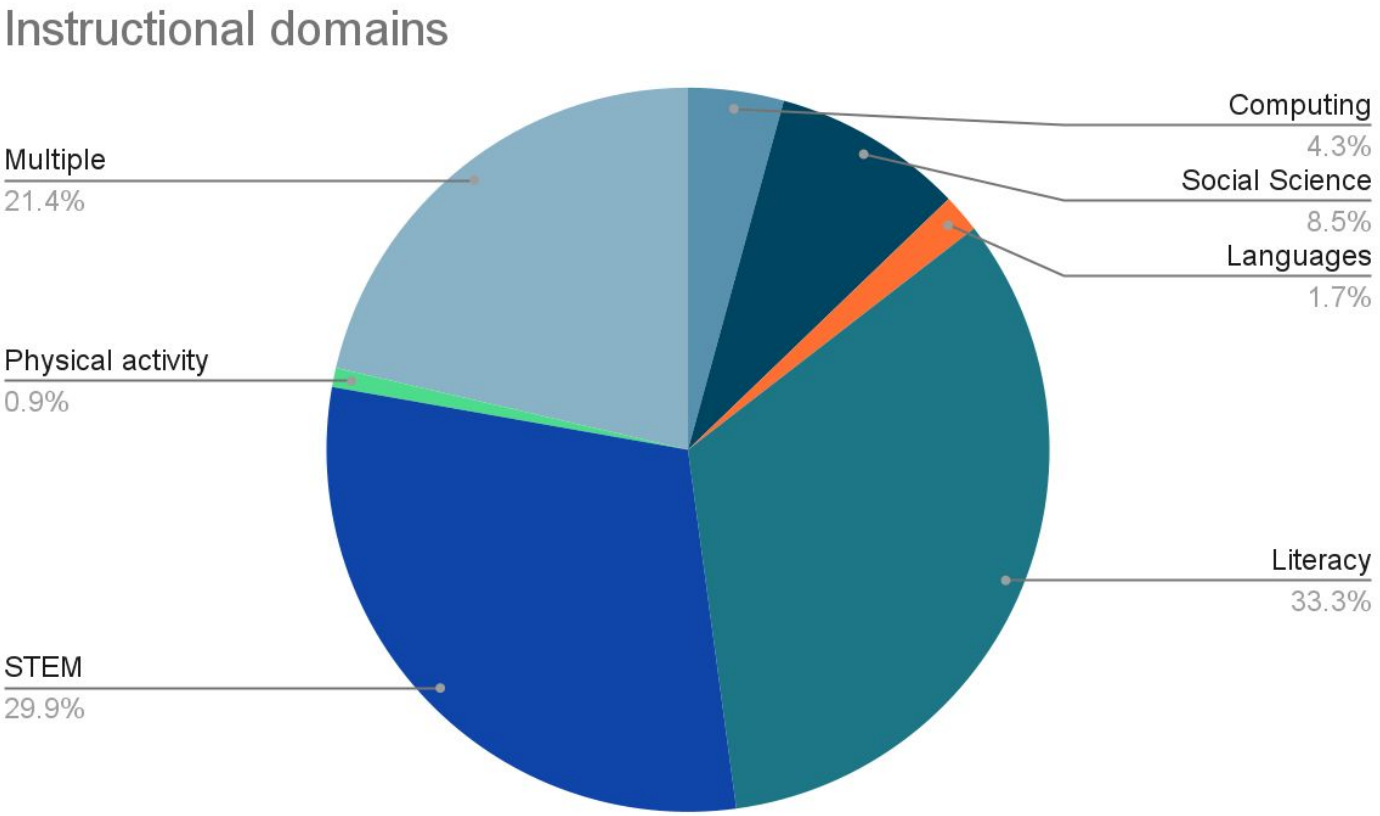
Link: https://tech.eved.io/lib/

Output 2
Analysis of emergent themes
(ongoing)

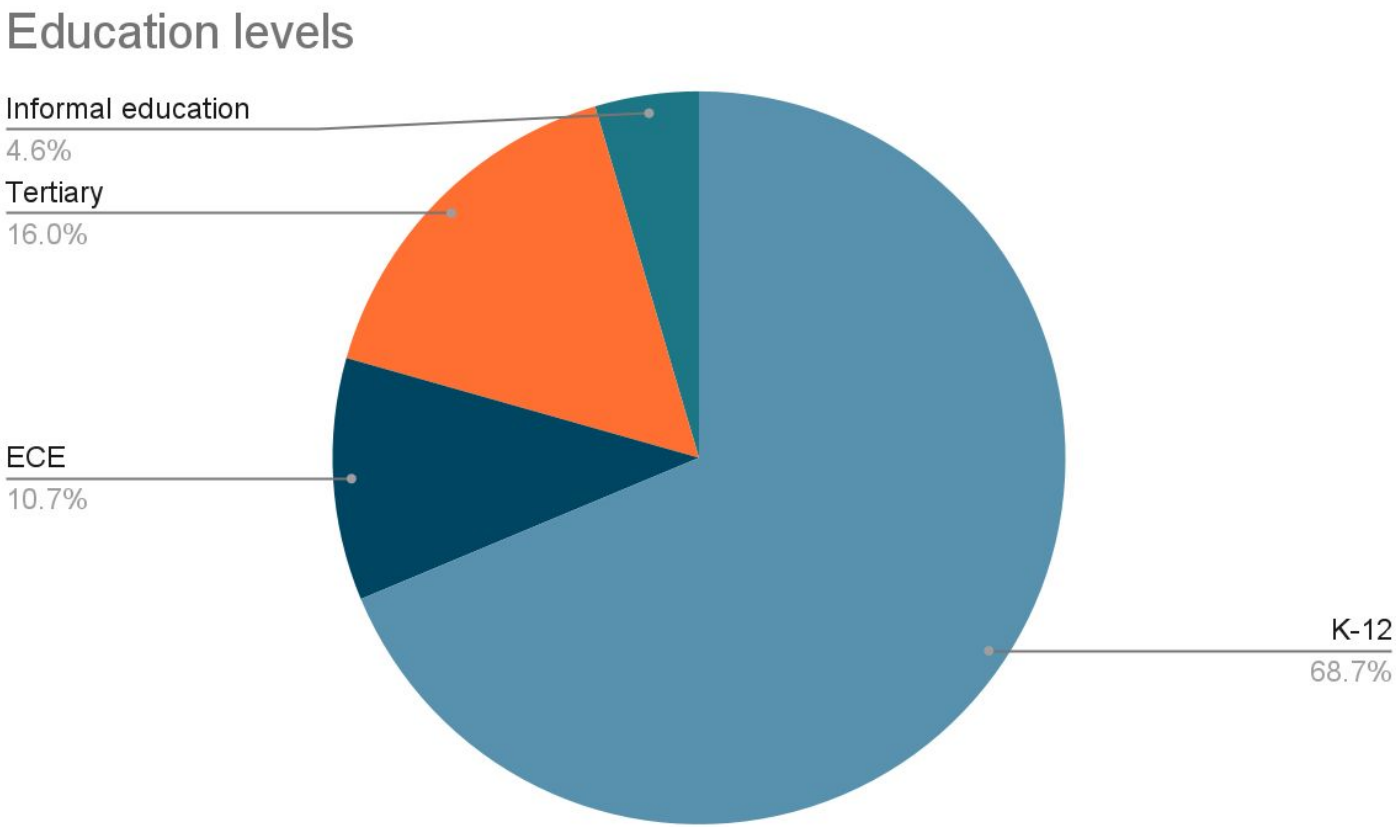
Focus of the papers: Edtech interventions



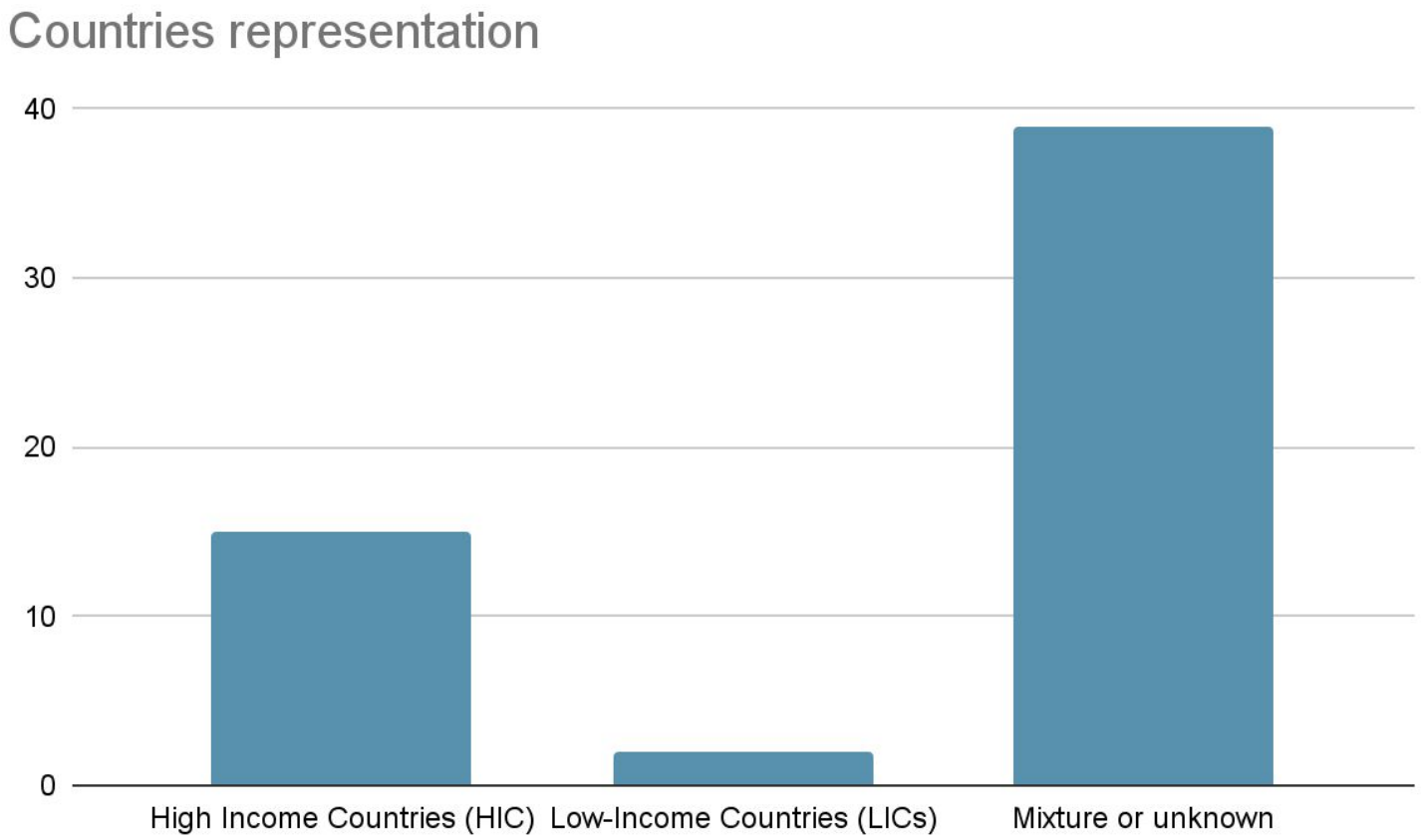
Focus of the papers: Instructional domains



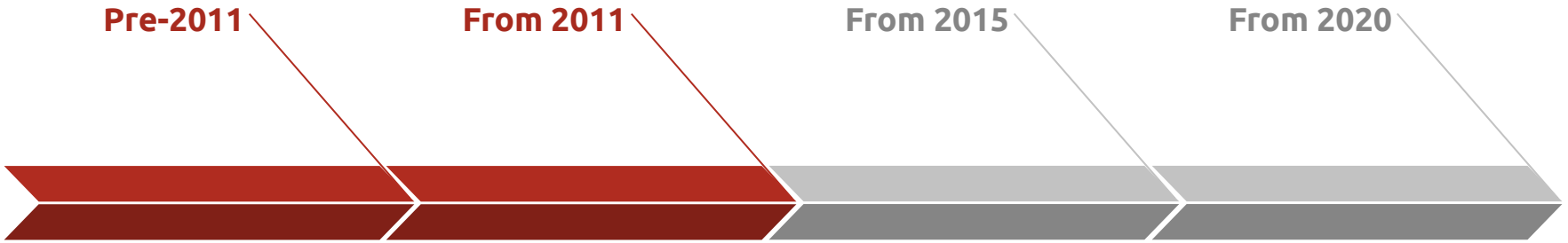
Focus of the papers: Grade levels



Focus of the papers: Countries



Shifts across the years



Low rigour

- Methodological flaws
- Little to insignificant effect
- Inconsistent results

More than just a tech device

considering both **contributing factors and moderating variables** in effectiveness of an ICT intervention.

More specification and design augmentation

- Comparing different design types and sophistication
- Moving to value-added and augmented designs within a tech modality. E.g. games vs. games or multimedia effects vs. same

Popularization of particular tools. Looks beyond learning, too

- Big focus on e-books for literacy, and gamification for STEM
- Explorations beyond learning: engagement, behaviour, etc.

Cavanaugh, 2001; Machtmes & Asher, 2000; Ungerleider & Burns, 2003; M. Allen et al., 2002; Tamim et al., 2011; Karich et al., 2014; Archer et al., 2014; Delgado et al., 2015; Talan et al., 2020; Chen et al., 2020.)

It is not about “tech.” Or “digital” per say! It is about many other factors that need to be considered!

- There is supportive evidence for the overall claim that technology (like CAI or CBT) is beneficial for students’ performance with around 12% *(Tamim et al., 2011; Tamim et al., 2015; Delgado et al., 2015).*
- It is **not about the device.** It is **about how it used, what design is involved, what supportive factors, and for what purpose.**

Example quote:

“*Games as a medium definitely provide new and powerful affordances, but it is the design within the medium to leverage those affordances that determines the efficacy of a learning environment*”. (↑Clark et al., 2015)”

It is not about “tech.” Or “digital” per say! It is about many other factors that need to be considered!

01 How it is used

- **cognitive support** rather than for presentation purposes (Schmid et al., 2014) and to **support instruction** rather than to deliver material

(Tamim et al., 2011; Tamim et al. 2015)

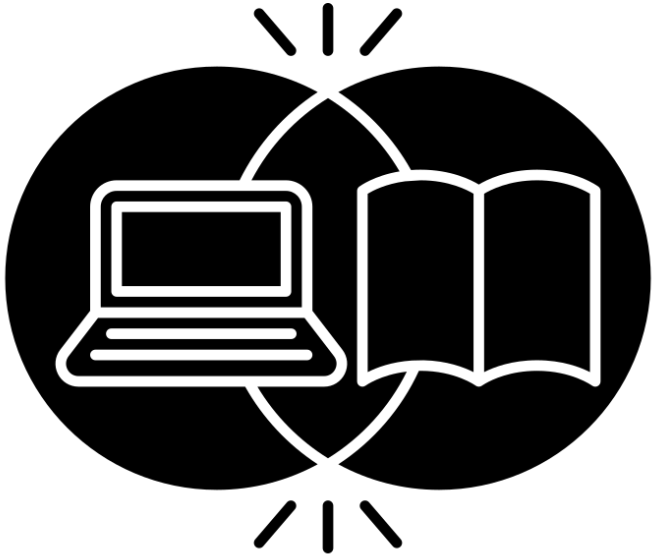
02 Design and supportive factors

- pedagogy, teacher effectiveness, teaching style, personal computer use, experience with and attitude towards technology, teacher professional development, subject/domain, age, socio-economic conditions, fidelity of implementation, training and support that the teacher receives **in and after (ongoing)** delivery of the intervention.

(Wozney, 2006; Mueller, 2008, Tamim et al., 2011; Archer et al., 2014; Verhoeven et al. 2020; Hillmayr et al. 2020).t

A favour for blended learning over face-to-face learning

- Many studies do not mention a focus on either the school or the home as a site.
- However, there is **support of blended learning over face-to-face learning.** (Means et al., 2009; Delgado et al., 2015)



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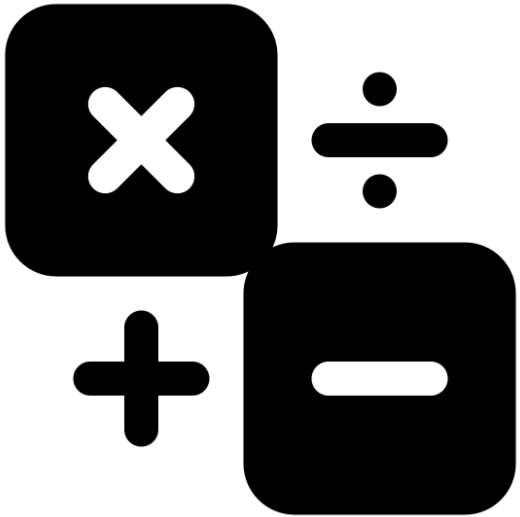
Papers focus on maths, science and literacy, with little focus on social sciences. Technology may also be subject/instructional domain agnostic.

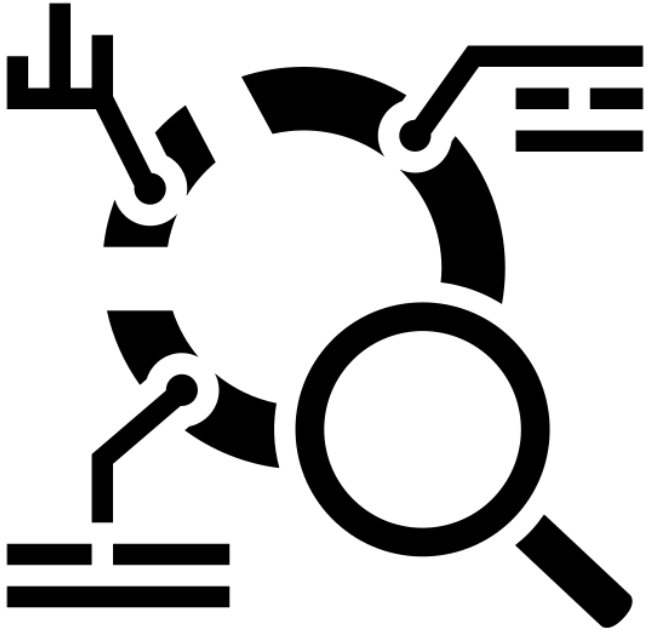


- Literacy, maths and sciences are the biggest focus. And not social sciences.
- As for the over-all effectiveness of technology: More consistent, promising effect sizes for mathematics and mixed effect sizes for reading. (↕Delgado et al., 2015; Guler et al., 2021; Cai et al., 2022; Hillmayr et al., 2020; Benavides-Varela et al., 2020; Chen et al., 2020; Ran et al., 2021)

Research design and strength of results

- Studies that tend to **focus on one intervention**(e.g. E-books, audio stories, Dynamic Geometry Software, etc), or breakdown components of a subject area (e.g. within literacy) and **stringent inclusion criteria** tend to **produce specific results** regardless of the number of studies involved, grade levels or subjects.

- Studies that **test** for **many multiple tools or a general CAI environment,** especially when coupled with testing for many moderating variables, tend to **produce much less concrete results**; but also perhaps these studies tend to account for more complexity.



Research design and strength of results

- In many studies, it is **unclear whether the intervention is implemented by a teacher or by a researcher.** This may have **an implementation fidelity effect.** It may also have **an effect of a simulation versus an authentic environment.**

- **Results** are **extremely varied** across **how effective a technology software can be** - e.g. e-books may be helpful for improving vocabulary, but, depending on characteristics, e-books may hinder students' comprehension of the story (Furenes et al., 2021).

- **In terms of sources consulted: Very little, almost none, grey literature is involved.** English and journal articles were major inclusion criteria markers.

Headlines here and there …

While a 2014 study on **learner control in a CAI environment produced no effect size,** there is a **renewed interest in the topic**, especially from a**n angle of personalisation and personalised learning.**

Within digital games, many studies offer **valuable, meticulous insights into what effective game design can look like.**

Studies **did not look at** moderating variables such as **device per pupil or costing implications or Value for Money (VfM) of technology.**

There was a big focus on games. When comparing digital and non-digital educational games within 154 studies, Talan et al., 2020 found tha**t non-digital games had the largest effect size** on academic achievement.

Other than games, and counter-intuitively, **the shorter the implementation duration** of a tech intervention, the better the learning results. **A novelty effect** had a big influence in many interventions.

What actually supports learning?

What moderating variables emerged in the papers which are worth noting? What are the insights on the relationship between the tech intervention and teacher pedagogy? What characteristics within the tech intervention supported learning?

Tech intervention/ software	Subject	Design features: Associated theoretical pedagogy within the tech	Teacher involvement/instructional strategies (if at all)	Papers mentioned	Other notes

Link: https://docs.google.com/spreadsheets/d/1KxGxHy_fpG8rhuzLCYwTkynfiQTst-ru6BF6DTWCudA/edit?usp=sharing

What actually supports learning?

- CAI environments
- DVDs
- Shared active touch surfaces
- Games

Better results for SEND students in:

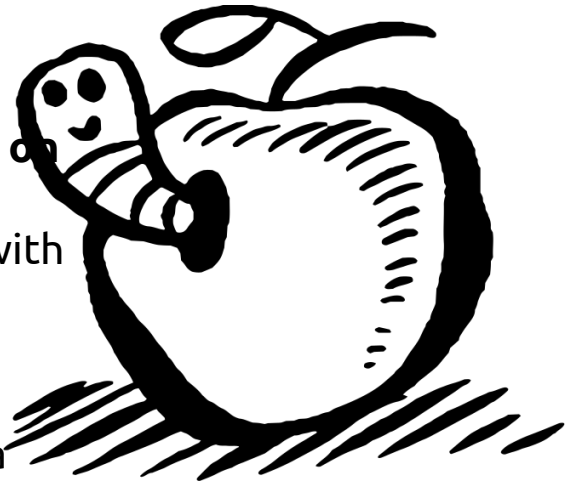
Literacy, socio-emotional skills, behavioural training.

This is due to: consistency of clearly defined tasks, specific focus, reduced distractions, predictability of responses,

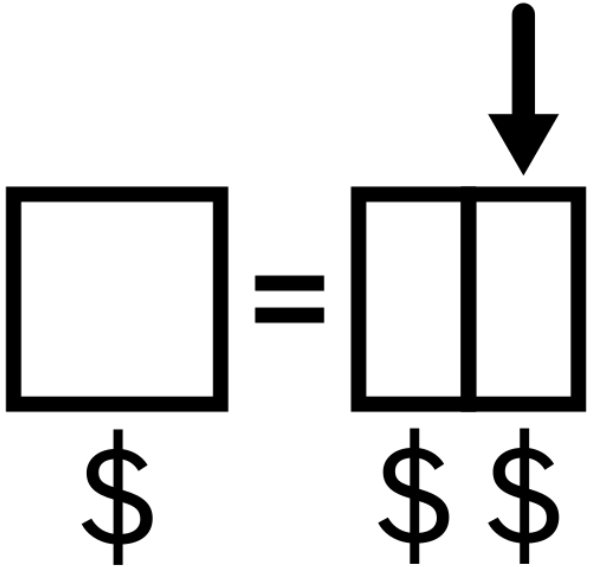
Drilling & tutoring opportunities.

Missing evidence sources

- There is a need for rapid evidence reviews on **more recent data.** Perhaps an **inclusion of systematic reviews.**
- Some of the evidence appears to be relatively out-of-date considering the technology and **education boom during Covid-19,** especially the usage of technology between teachers and students in the UK. **E.g. no research focused on virtual classrooms.**
- **More systematic review from 2020 onwards is needed**, with a more precise coding when it comes to pedagogical mechanisms.
- Very little, **almost none, grey literature.** English language and journal articles publishing were major inclusion criteria markers for most papers. There is a missing out on toolkits, knowledge packs, manuals produced by multi-laterals or CSOs or think tanks or evidence organisations.



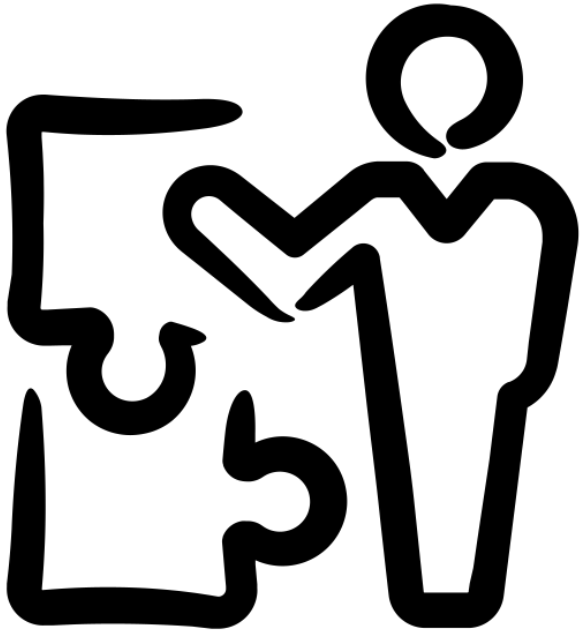
Missing geographies, costing and equity



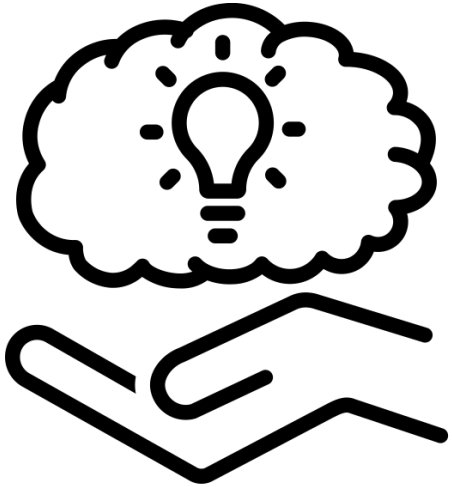
- Significant gaps in **low-income countries representation**; a lot of research is excluded from meta-analyses if it not in English or a European language or grey literature.
- Gaps on **costing effectiveness and value for money and equity markers in general.**

Missing linking teachers to technologies

There generally appears to be a gap on **how to use the research to support teachers to improve pedagogy using digital technology.** In general, the papers don't focus on teachers or teacher involvement, instead the focus is on student learning- but **not how technology can inform teachers to change or improve their pedagogy.**



Suggested directions for future research



“Understanding what factors contribute to maximising learning gains when using ICT interventions is critical to ensuring effective use as well as accurate assessment of actual learning gains that may be achieved.” (↑Archer et al., 2014)

Refining the library

- ***Considering systematic reviews?***
- ***More systematic search for meta-analyses from 2020 - 2022 (accounting for the COVID innovations period)***
- ***We have 22 more studies that are mostly systematic reviews or evidence maps (found on Zotero >>>Inbox)***

Possible deep dives: knowledge packs

What evidence exist for how can technology be used to OR what efforts need to be devoted to develop technologies to

- *Support SEND students? (systematic review or meta-analysis)*
- *Support basic literacy and numeracy?*
- *Support early childhood education?*
- *Support higher-order thinking and learning?*
- *Support STEM subjects?*
- *Support low-socioeconomic status students?*
- *Support minorities, people of color, refugees?*

Possible deep dives: knowledge packs

What are the effective pedagogical mechanisms, design features and instructional supports within particular tech interventions that appear to have high effectiveness? How do they align with well-known theories of learning? How do they involve teachers? e.g.

- *Games, simulations and the multimedia learning theory*
- *Multimedia effects (like audiovisuals, e-books, interactive story books, etc)*
- *Scaffolds and instructional supports in Edtech (within the tech. Or within the classroom)*
- *Personalised learning softwares*
- *Intelligent tutoring softwares*
- *Virtual learning environments*

Possible deep dives: knowledge packs

What evidence exists for how can technology be used to support particular areas of instruction

- *Feedback and assessment?*
  - *"*Future investigations should account for and describe characteristics of the feedback, the task, the learning context, and the learners in order to advance the research field. As well as multimedia feedback."(↕Feskens, 2015)
- *Transferability (rather than just recall) and retention?*

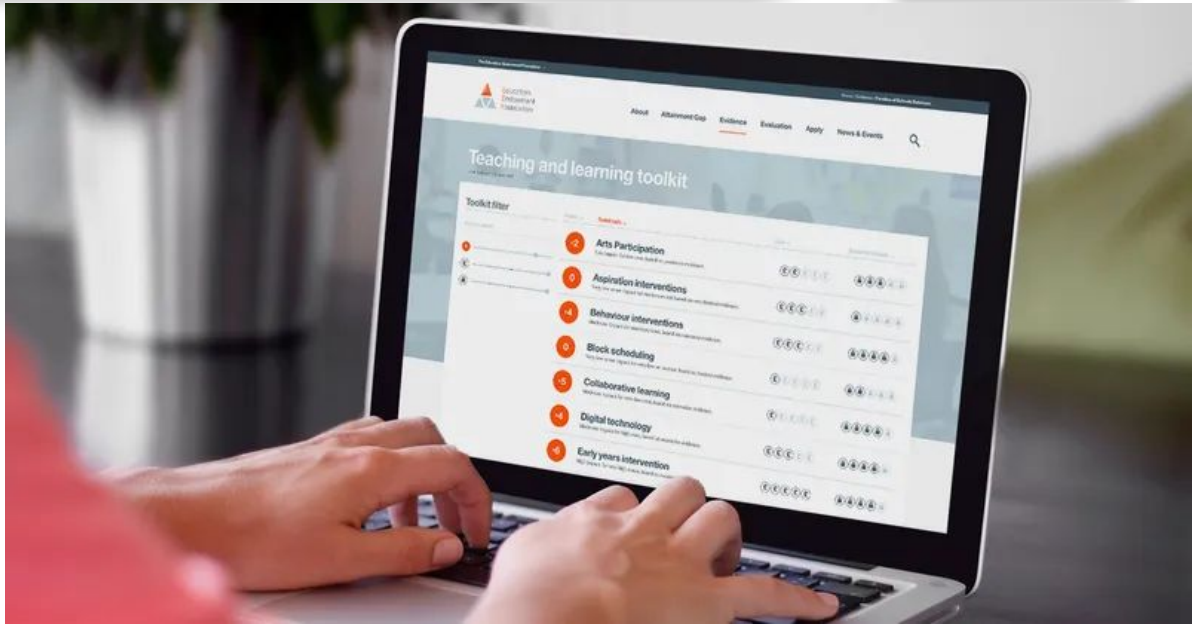
Possible new studies

What evidence exist for how can technology be used to:

- *In LMICs (any focus areas)*
- *As part of comprehensive, structured pedagogy interventions*
- *Support social sciences*
- *Cost-effectiveness and cost comparison analysis*
- *Support teachers in-classroom (explicitly)*
- *Relationships between teacher professional digital development (digital skills) and classroom usage of technology and student achievements. (there seems to be a gap between installation of hardware or software and actual usage)*

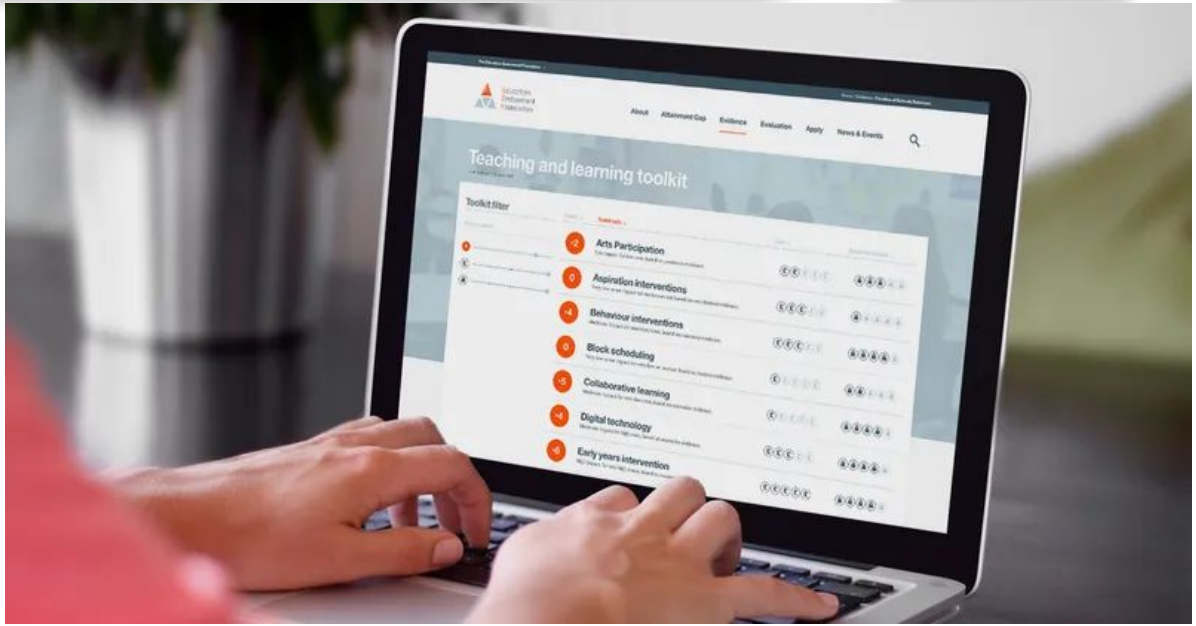
Categorisation of toolkit strands

Recommended categorisation for toolkit strands



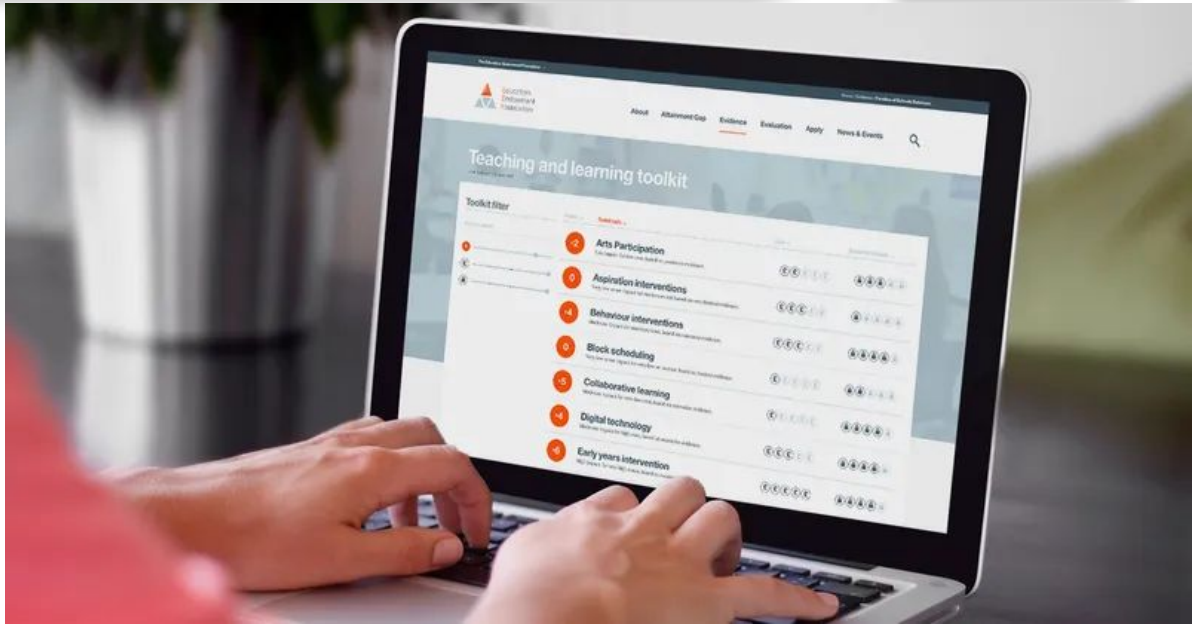
- The tech hardware and software are not the means for creating change on their own. They also change rapidly.
- Focus on interventions that can answer “how can technology support …” a particular instructional domain or area to enhance learning outcomes.

Recommended categorisation for toolkit strands



- Focus on showcasing the number and breakdown of moderating variables (like age, type of skills possibility for transfer/training, tech design features, **types of scaffolds within tech** and within classroom needed) to make this intervention effective.
- **Possible categories** that have started to emerge **are areas such as:** Literacy, Mathematics, Students with SEND, home learning, feedback, assessment, foreign language learning, student engagement, student cognition, exam preparation etc.

Recommended categorisation for toolkit strands



- It maybe important to have **a general category of: Minimum foundational characteristics** of using technology in a school. Things like infrastructure, professional development of teachers' digital literacies, etc.

Discussion