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EIDU

Investigating the Impact of Content Repetition on Digital Personalised Learning Tools for Early Grade Learners

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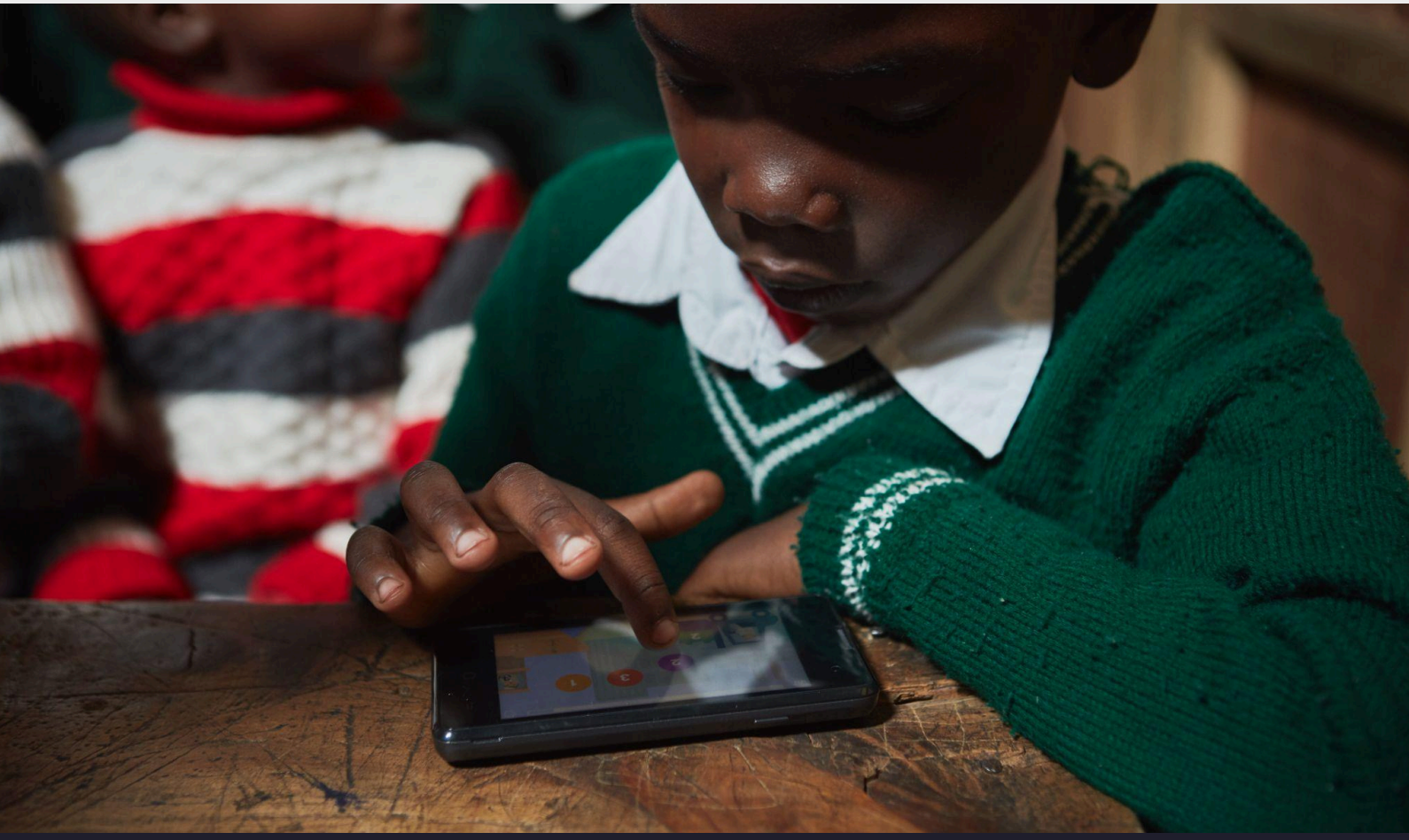

At a glance

Research question ❓

What is the impact of repeating learning content for pre-primary learners on a classroom-integrated digital personalised learning tool in terms of:

- learner device usage?
- learning outcomes?

The A/B test 👩🏾‍🔬

36,297 pre-primary learners allocated into two experiment groups, one of which was able to repeat learning units on the DPL tool.

Key findings 🔍

Overall, content repetition had a significant impact on learning outcomes for PP2 learners.

PP2 learners' usage of the DPL tool was significantly reduced with content repetition. Caution should be taken in interpreting the results due to varied sample sizes.

About the Evidence Briefs

EdTech Hub has been co-designing and testing software interventions to explore how DPL tools might be optimised to support learning and teaching in early grade classrooms. *Designing DPL Software for Classrooms* is a series of evidence briefs which share results from four A/B/n software tests conducted as part of this research partnership with EIDU—a provider of digital personalised learning technology (DPL) in Kenya. This is Evidence Brief #3.

Other briefs in this series

#1: *Optimising Session Duration on Digital Personalised Learning Tools for Early Grade Learners*. DOI: 10.53832/edtechhub.1046.

#2: *Testing Digital Timer Tools to Support Early Grade Lesson Delivery*. DOI: 10.53832/edtechhub.1047.

#4: *Designing Digital Notifications to Support Teacher Uptake of Data Dashboards*. DOI: 10.53832/edtechhub.1049.

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Introduction

The Evidence Brief series reports on four A/B/n software tests, which explore how digital personalised learning (DPL) tools can be enhanced using data generated by digital assessments to optimise personalisation and inform teachers' lesson planning and instruction. These tests are part of the multi-strand EdTech Hub study 'Digital Personalised Learning to Improve Literacy and Numeracy Outcomes in Kenyan Classrooms'.[1] This is the third of four briefs in the series.

What question does this brief ask?

The following research question informed the design of the A/B test reported on in this brief:

What is the impact of repeating learning content for pre-primary learners on a classroom-integrated digital personalised learning tool in terms of:

- **learner device usage?**
- **learning outcomes?**

What do we know about the impact of digital content repetition on learning outcomes?

While pedagogical theories about repetition are the basis of many educational approaches, there is little research which assesses the impact of content repetition on digital tools, especially for young learners:

- ↑Pinter's (2019) review of the literature suggests that technology-mediated task repetition has the capacity to magnify and accelerate the linguistic and affective benefits of task repetition for young learners.

[1] To find out more about the study, see https://edtechhub.org/evidence/edtech-hub-research-portfolio/improve-numeracy-outcomes-in-kenyan-classrooms/. Retrieved 16 December 2024.

- ↑Szafir & Mutlu's (2013) experimental study demonstrated that adaptively reviewing lesson content on a computer-based educational system improved university student recall by 29%.

What is digital personalised learning?

Personalisation is a common feature of everyday school practice, as teachers and learners continuously adjust to each other's shifting needs, aims, and preferences (↑Beetham, 2010; ↑Holmes et al., 2018). Advancements in technology have led to an expansion of tools which aim to support different aspects of a personalised learning approach (↑UNICEF, 2022). Following ↑Van Schoors et al. (2021), we define *Digital Personalised Learning* (DPL) as tools which feature a digital learning environment that adapts to the individual learner, aiming to optimise individual and/or collaborative learning processes to enhance cognitive, affective, motivational, metacognitive, or efficiency outcomes.

EIDU is a provider of a DPL tool in Kenya. The EIDU tool comprises an application with both a teacher-facing and learner-facing interface for early grade teaching and learning. This application is pre-installed on a low-cost Android device, with one to two devices distributed per classroom and used during the school day. Learners access numeracy and literacy digital content and assessment exercises (aligned with the Kenyan curriculum) via individual user profiles, with the software personalising content sequencing for each user. The tool also offers teachers access to digitised lesson plans and a dashboard indicating learners' weekly usage time and digital curriculum progress.

A/B/n test design

This study has employed A/B/n testing—a controlled experimental approach randomly assigning participants to different software versions to assess each design's comparative effectiveness (↑Friedberg, 2023). This section provides an overview of the methods employed for the A/B test, which investigated the impact of content repetition on usage and learning outcomes.

WHY A/B/n TESTS? 

The A/B/n testing method is particularly useful for evaluations of different software versions: the randomised approach can both minimise bias to ensure comparability and avoid direct interruptions to regular teaching activities (↑Savi et al., 2018). It also enables an at-scale approach to education technology research, whereby software design is optimised through continuous iterations and refinements involving a large dataset (↑Friedberg, 2023).

Sample

The test involved 36,297 pre-primary learners: 34,898 from pre-primary 2 (PP2, aged 5–6) and 1,399 from mixed-grade classes (combining PP1 and PP2, aged 4–6). These learners are from 2853 schools across six counties in Kenya (Machakos, Makueni, Kiambu, Murang'a, Embu, and Mombasa).

A/B groups

There were two groups in the experiment: 'content repetition' and 'no content' repetition. The experimental group (content repetition) were able to repeat learning units which they had previously completed on the DPL tool. This was achieved in practice by the personalisation algorithm being able to recommend previously completed units (instead of novel learning units) if it was predicted to lead to better outcomes for each individual learner. The control group could not repeat previously completed learning units—i.e., the personalisation algorithm excluded these units. Each learner was randomly assigned to one of the two partitions, with a final distribution of 18,251 learners in the experimental group and 18,578 in the control.

Duration

A Beta test took place in June 2023 among a small sample of 30 schools with teachers who have been trained in providing feedback to EIDU on software changes. Following analysis of user feedback, the software experiment was released to the full sample for 3 weeks from 12 July to 1 August 2023—during the second term in the Kenyan academic year.

Data collected

Learning outcomes were measured as the scores recorded by the EIDU tool each time learners interacted with the digital learning units, calculated as the percentage of correct answers within each unit. Learners' literacy and numeracy scores were calculated as the average of all successfully completed units by each individual during the 3-week experiment. We note not all learners would have completed the same number and selection of units.

The EIDU tool also recorded learners' usage of the device per session, calculated as the length of time during which an individual learner was interacting with the tool before it switched to a different learner profile. Average learner device usage was calculated as the average session length of all sessions recorded during the 3-week experiment, with sessions disaggregated by learning domain (literacy and numeracy).

Analysis

Simple regressions were used to analyse the differences in learning outcomes and usage data between the experimental groups by grade (PP2 and mixed-grade classes) and by each domain (literacy and numeracy).

Ethical considerations

Consent was obtained from teachers for anonymous learning data to be collected by the EIDU tool, for A/B/n testing on the tool, and for the data to be shared with third-party research groups to improve the software and the learning experience. Teachers gave consent by signing a data usage policy, both on their own behalf and as gatekeepers for the students in their classrooms. The research was also approved by national and institutional ethical approval bodies.

Key findings

The impact of DPL content repetition on learning outcomes

The A/B test revealed that content repetition does have an impact on literacy and numeracy outcomes for PP2 learners. However, considering the small size of the mixed-methods sample, caution should be taken when interpreting these results.

Literacy scores

Results indicate that content repetition is effective for pre-primary learners' literacy outcomes:

- PP2 and mixed-grade learners in the experimental group had significantly higher literacy scores than those in the control group.

Table 1. *Mean literacy scores and simple regression results of the two A/B test groups by grade*

Literacy scores		PP2	Mixed-grade classes
Mean literacy scores (M)	**Repetition**	0.764 (0.159 SD)	0.795 (0.150 SD)
	No repetition	0.750 (0.153 SD)	0.773 (0.146 SD)
Simple regression		β = 0.014 p < 0.001 ***	β = 0.022 p = 0.008**
N.B. * p < 0.05; ** p < 0.01; *** p < 0.001.			

Numeracy scores

Results generally indicate that content repetition is effective for pre-primary learners' numeracy outcomes:

- PP2 learners in the experimental group had significantly higher numeracy scores than those in the control group.
- There was no significant difference in impact on numeracy scores for learners in mixed-grade classes, although the significantly smaller sample size should be noted.

Table 2. *Mean numeracy scores and simple regression results of the two A/B test groups by grade*

Numeracy scores		PP2	Mixed-grade classes
Mean numeracy scores (M)	**Repetition**	0.778 (0.162)	0.815 (0.133 SD)
	No repetition	0.768 (0.157 SD)	0.810 (0.128 SD)
Simple regression		β = 0.010 p < 0.001 ***	β = 0.005 p = 0.515
N.B. * p < 0.05; ** p < 0.01; *** p < 0.001.			

The effects of DPL content repetition on learner device usage

The A/B test revealed that content repetition reduces usage of the DPL tool for PP2 learners, possibly due to familiarity with the learning content. However, considering the small size of the mixed-methods sample, caution should be taken when interpreting these results.

Usage of literacy content

Results indicate that content repetition reduces pre-primary learners' device usage of literacy content:

- PP2 and mixed-grade learners in the experimental group had significantly lower usage of literacy content on the DPL tool than those in the control group.

Table 3. Average device usage per individual literacy session (in minutes) and *simple regression results of the two A/B test groups by grade*

Literacy usage		PP2	Mixed-grade classes
Average device usage per individual literacy session (mins)	**Repetition**	1.92 (0.732 SD)	1.78 (0.635 SD)
	No repetition	2.01 (0.724 SD)	1.89 (0.617 SD)
Simple regression		β = -0.088 p < 0.001 ***	β = -0.011 p = 0.002**
N.B. * p < 0.05; ** p < 0.01; *** p < 0.001.			

Usage of numeracy content

Results indicate that content repetition reduces pre-primary learners' device usage of numeracy content:

- PP2 learners in the experimental group had significantly lower usage of numeracy content on the DPL tool than those in the control group.
- There was no significant difference in numeracy content usage for learners in mixed-grade classes, although the significantly smaller sample size should be noted.

Table 4. Average device usage per individual numeracy session (in minutes) and *simple regression results of the two A/B test groups by grade*

Numeracy usage		PP2	Mixed-grade classes
Average device usage per individual numeracy session (mins)	**Repetition**	2.22 (0.995 SD)	2.09 (0.972 SD)
	No repetition	2.33 (1.000 SD)	2.15 (0.894 SD)
Simple regression		β = -0.108 p < 0.001 ***	β = -0.060 p = 0.269
N.B. * p < 0.05; ** p < 0.01; *** p < 0.001.			

What next?

Evidence should inform decision-making. This section outlines:

1. How this A/B test led to changes in the implementation of EIDU's DPL tool.
2. Recommendations for other DPL providers and/or researchers.

Iterating the EIDU tool

EIDU considers these results to be indicative that allowing personalisation algorithms to suggest previously completed units was potentially beneficial. For this reason, EIDU has implemented a software update whereby, once a learner has completed five novel units, they can be recommended a previously completed unit if it is predicted to lead to high learning impact. The ratio of repeated vs novel units is tracked through monitoring and evaluation dashboards. Learners' progress through the curriculum is also tracked to ensure repetition is helping learners advance.

Recommendations for other DPL providers and researchers

Interpreting these results for other contexts

We recommend considering the following points:

- ➔ While results suggest that there may be benefits of content repetition for PP2 learners, this may be due to familiarity with repeated content and/or depend on factors including the personalisation design of the tool. For this reason, similar tests should be considered to assess the applicability of these findings on other DPL tools.
- ➔ The impact of content repetition on reduced usage of the DPL tool by learners has possible implications for software design. While the reason for his reduction is not clear, it could be that familiarity with repeated content results in learners completing learning units faster due to higher levels of proficiency or efficiency with the tool. DPL providers should consider how best to maximise opportunities for further learning, while balancing this with the potential affordances of content repetition.

Conducting future research

The evidence base on this topic could be further strengthened by investigating:

- Whether content repetition has a positive effect on summative assessment outcomes, in addition to formative assessment, and can therefore be identified as having a broader impact than increased familiarity with specific learning units.
- Whether—and if so, at what point—content repetition has a ceiling effect on learning progress and engagement with the tool.

References

These references are available digitally in our evidence library at https://docs.edtechhub.org/lib/8P8KRW8B

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Front cover photo: A learner engages with a numeracy activity on the EIDU platform. Photo credit: Juozas Cernius / EIDU.

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