Trends in digital personalized learning in low- and middle-income countries

EXECUTIVE SUMMARY
Introduction

Context

In the last decade, advancements in technology and data science have led to an expansion in digital learning solutions that provide a personalized learning experience. *Evidence* from low- and middle-income countries (LMICs) on the effectiveness of digital personalized learning is still emerging. However, it appears to offer significant promise to improve learning outcomes, especially in closing educational gaps for lower attaining students including those returning to school after an absence. The adaptive nature of digital personalized learning to ‘teach at the right level’ is key as it enables students to learn according to their current proficiency. This makes digital personalized learning a potentially useful intervention for remediating learning gaps in the post-pandemic context. The *Global Education Evidence Advisory Panel* also identifies “using software that adapts to the learning level of the child (where hardware is already in schools)” as a good buy.

However, there is little systematic information on the digital personalized learning landscape in LMICs; evidence of effectiveness at-scale is sparse; and research that opens the design, implementation, and scalability ‘black box’ remains thin.

Scope and purpose

Against this backdrop, the UNICEF Office of Global Insight and Policy (OGIP) with support from the Office of Research – Innocenti embarked on a landscape review to take stock of digital personalized learning solutions in LMICs. Based on this, the objective of the landscape review is to:

- Build understanding of how digital personalized learning solutions are being operationalized in LMICs, including, promising approaches, opportunities and challenges
- Cut through the hype and provide balanced and evidence-based insights to inform planning on design and implementation of digital personalized learning solutions.

A major output of the landscape review is the report – *Trends in Digital Personalized Learning in Low- and Middle-Income Countries* – which aims to identify broad trends, noteworthy features and key gaps in terms of design and implementation of digital personalized learning solutions in LMICs.

The *Trends* report is based on a product scan. Starting with 1000+ products that were initially identified, 40 personalized learning products were shortlisted to be a part of the scan. Data on key design and implementation characteristics of these 40 products was collected against a custom-developed rubric – covering 8 themes, 28 sub-themes, and over 125 items – through a combination of desk review, vendor interviews and email communications, and using the products.

The *Trends* report does not examine the policy, financing, implementation and scaling eco-system that affect design and use of digital personalized learning solutions in LMICs – this will be covered in a subsequent publication. Please also note that this report is not intended to be an evaluation or endorsement of any of the products reviewed.
In the context of this study, Digital Personalized Learning refers to edtech products that have the power to tailor instruction based on learners’ needs in specific subjects.

There is no one agreed-on definition of Personalized Learning and the term is used to refer to three different (but interconnected) things:

**Personalized Learning pedagogy** – i.e. an instructional approach that is learner-centered and flexible, responsive to individual learners’ needs as they progress on mastery-based competencies. Implementing this pedagogical approach does not necessarily require technology.

**Tech-supported (digital) Personalized Learning programme** – i.e. when edtech tools are used to support implementation of the personalized learning pedagogical approach. However, it does not automatically follow that the edtech tools used are personalized learning products in their own right.

**Personalized Learning edtech (digital) product** – i.e. an edtech product which has the power to tailor instruction based on learners’ needs in specific subjects.

In the context of this study, Digital Personalized Learning is defined from a product perspective and digital personalized learning products are henceforth referred to as PL products, PL solutions or PL platforms.
PL products deployed in LMICs vary in a number of aspects

Aspects covered in the review

- **Coverage**
  To identify where PL products are deployed and in what kinds of learning contexts – this is key to understanding market potential and gaps

- **Content & pedagogy**
  To identify gaps that are currently unaddressed; to highlight good practices that enable a more effective role for different stakeholders in supporting children’s learning

- **Product design & technology**
  To identify promising approaches and gaps in PL product design and technology – this may lay the foundation for identifying elements that are crucial for product uptake and effectiveness

- **Inclusiveness**
  To identify groups of underserved learners; to know which aspects of design and deployment need a more inclusive approach

- **Scale & sustainability**
  To understand some key drivers of scale and sustainability – including involvement of local stakeholders, types of business models, adherence to open principles, and measurement of results
PL products are deployed across different LMIC settings – the majority of the products reviewed are locally developed but market penetration remains uneven.

**KEY TAKEAWAY**

The 40 PL products in the review are deployed in multiple LMICs across different regions. At least 19 products are deployed in more than one LMIC and 14 are deployed in both LMICs and high-income countries (HICs). In terms of geographic coverage, China, India, and Brazil have the most active PL market. Meanwhile, market penetration is weak in low-income countries and in francophone countries in Central and West Africa – these regions are also home to several countries with substantial learning poverty. In terms of scale too, the user base varies widely – 15 out of 40 products have more than 1 million users while an equivalent number have less than 100,000. Local innovation and entrepreneurship is a driver of PL growth in LMICs with 27 out of 40 products headquartered out of an LMIC. However, products headquartered out of HICs on average have a greater footprint in terms of LMICs covered.

**RECOMMENDATION**

Governments, market connectors and shapers in the edtech industry should support PL providers from LMICs to promote more local innovation, entrepreneurship, and South-South collaboration with LMIC markets that are underserved or with substantial learning gaps.

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*Note: PL products in China and LMICs in ECA are under-represented in the study sample.

**Note: The definition of user base is not consistent across products. Where available, data on number of users is used. Where this is not available, number of product downloads/sold is used as a proxy.
These PL products target both primary and secondary levels but concentrate in Math and Language/Literacy and in widely spoken local languages.

**KEY TAKEAWAY**

Two-thirds of PL products in this review cater to both primary and secondary education levels. About half (21 out of 40 products) are concentrated in 1 or 2 subjects, with Math and Language/Literacy being the two most common subjects on offer. Evaluations have disproportionately focused on learning outcomes in Math and Language/Literacy while the evidence base on PL effectiveness in other subjects and skill domains is thin. More than three-fourths of PL products reviewed are available in at least one local or regional language. However, products deployed in South and Southeast Asia tend to offer a wider variety of local languages compared to products deployed in Sub-Saharan Africa.

**RECOMMENDATION**

PL companies and researchers should consider exploring effectiveness of PL in wider subject areas and skills domains – especially the sciences and transferable skills. Governments, PL companies, funders and other actors in the ecosystem should jointly explore ways to expand coverage of local languages, particularly non-dominant ones.
PL products tend to be implemented mostly for supplemental learning, whether at home or in school

### % of PL products implemented by education purpose

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<thead>
<tr>
<th></th>
<th>Core learning only</th>
<th>Supplemental learning only</th>
<th>Core + supplemental learning</th>
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<tr>
<td>12.5%</td>
<td>62.5%</td>
<td>25%</td>
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### % of PL products implemented by education setting

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<thead>
<tr>
<th></th>
<th>At home only</th>
<th>In school only</th>
<th>In school and at home</th>
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<tr>
<td>12.5%</td>
<td>12.5%</td>
<td>75%</td>
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**KEY TAKEAWAY**

PL products are more likely to have been implemented for supplemental learning (35 out of 40 products) compared to core learning (15 out of 40 products) purposes. However, PL products are used flexibly in a variety of education settings – with 30 out of 40 of products having been used to support learning in school and at home. The flexible use of PL products across diverse settings is not by accident – 75% of PL products reviewed have been designed to support learning in class and at home. However, there has been very less diligent evaluation comparing the different models on their success criteria, effectiveness and impact.

**RECOMMENDATION**

PL companies and researchers should design impact evaluations that consider and compare how PL products produce learning across different educational settings (in-school, after school, home-based, etc.) and purposes (core vs. supplemental learning).
PL products offer multiple types of content – most products align content with local culture and curriculum in at least some deployment countries.

**Key Takeaway**

PL products offer multiple types of content – with practice exercises, assessments, and games being the most prevalent. This aligns with the supplemental learning focus of many PL products. For 38 out of 40 PL products, the content is created in-house though 18 out of 40 of products supplement this with curated materials. Local relevance of content is important. Research also shows that successful edtech programmes are more likely to align with local curriculum. 31 out of 40 products demonstrate some local cultural signifiers in their content, and in 33 out of 40 products, the content is aligned to the local curriculum in at least some deployment contexts. However, the depth of curricular alignment varies. Alignment at the level of learning objectives or topics is more common but alignment in terms of sequencing of content or integration of materials from approved textbooks is less common.

**Recommendation**

A collective, systematic effort within the PL ecosystem is needed to develop quality content catalogues with a variety of resources and relevant metadata which PL products can tap to scale their content repositories and align with local standards more easily.
60% of PL products use Artificial Intelligence (AI) to dynamically adapt learning paths based on learners’ performance.

**KEY TAKEAWAY**

PL products employ different methods to tailor learning paths to learners’ educational needs. These vary based on whether AI is used to enable adaptation, the nature of adaptation, and the types of learner variables used to inform adaptation (e.g., student performance on learning tasks, affective variables, learner preferences), among others. The more common approach is use of AI to dynamically adapt learning paths based on learners’ performance (24 out of 40 products). Even among products that use AI for adaptation, the AI technology and algorithms they use could be different. Further variations are seen in which aspect(s) of student learning on the platform are adaptive (e.g., review, practice, feedback, assessment, sequence), whether learning pathways are adapted within topics or across topics, etc.

**RECOMMENDATION**

More research is needed to better understand the effectiveness, accuracy, and bias of different algorithmic approaches. Also, there is a need for aligning on widely-accepted performance benchmarks or standards against which AI-based solutions can be evaluated for education purposes.
All PL products reviewed offer some features to promote student engagement though little is known about their effectiveness.

**CONTENT & PEDAGOGY**

All 40 PL products enable student **voice and choice** in at least one of these six dimensions:

- What to learn
- When and how long to learn
- Pace of learning
- Language choice
- Interface, avatars, etc
- Learning goals

35 out of 40 PL products offer at least one of the following incentives to promote student **motivation**:

- Completion incentives
- In-process performance incentives
- Progress on leaderboard
- Socio-emotional incentives

24 out of 40 PL products enable at least one of the following **interactions** with others in the learning ecosystem:

- Teacher-student interaction
- Peer-to-peer interaction

**KEY TAKEAWAY**

One ingredient of successful edtech is learners who are engaged and motivated. PL products facilitate student engagement through a combination of approaches. All 40 PL products reviewed allow learners some agency in terms of selecting and/or modifying at least one aspect of their learning experience. Furthermore, most products incorporate features for increasing student motivation, primarily through completion and in-process performance incentives. In contrast, only a minority of PL products enable peer-to-peer communication, collaboration and/or competition to keep learners engaged. Further, products which allow learners to customize the user interface or utilize metacognitive strategies – such as goal-setting – are not very common. Not much is known about the relative effectiveness of these interventions and how they can be optimally leveraged to influence learning behaviours and outcomes in PL environments.

**RECOMMENDATION**

More exploration is needed to understand which interventions are more effective for student engagement and learning outcomes, and whether adaptation models informed by the learners’ affective state and engagement signatures have any additional impacts on their learning behaviours and outcomes.
The relationship between the student and the teacher is at the heart of the learning process. Evidence shows teachers to play an important role in the effectiveness of edtech interventions. While not all PL products are intended for use in institutional settings (i.e. schools or learning centers), 34 out of 40 PL products reviewed are designed to incorporate the teacher’s role. Of these products, 32 enable teachers to monitor students’ progress but less than one-third offer prompts or nudges to teachers to take action. Outside of monitoring, 24 products offer features that enable teachers to engage in some type of instruction. Only a handful enable teachers to communicate with other participating educators (5 products) or parents (3 products).

**RECOMMENDATION**

For PL products intended for use in institutional settings (i.e. schools or learning centers), their design and deployment should explore how teachers can be enabled to play a more supportive role in children’s learning journeys. In particular, future PL design should look at providing actionable feedback loops to teachers. Once the product is deployed, ongoing support and capacity building of teachers should be a priority to ensure they can engage with the PL platform features in meaningful ways.

85% of PL products incorporate a role for the teacher but this is usually limited to monitoring

**CONTENT & PEDAGOGY**

85% of PL products incorporate a role for the teacher but this is usually limited to monitoring.
Parents and school leaders often have limited access to data about learners – however, even when performance data is available, it is not always actionable.

KEY TAKEAWAY
The PL design architecture affords greater depth and transparency of data on learner achievement than traditional models. Information shared with learners on their performance/progress varies across products. Most learner dashboards reviewed provide data on current results (26 out of 40 products). Half of the products share results disaggregated by sub-skill/domain, while 17 products provide information to the learner about their distance from the intended learning goal. 32 out of 40 PL products share student performance data with teachers through teacher portals but less than half do so with parents and school leaders. However, even where performance results of learners are made available to teachers, parents and/or school leaders, only a few products translate this data into actionable recommendations or follow-up interventions.

RECOMMENDATION
Future PL design should aim for data transparency across stakeholder groups (including teachers, parents and school administrators) and provide greater breadth of data and actionable recommendations on user performance beyond current results.
An enabling ICT infrastructure is essential – only 7.5% of products can be used on feature phones and only 40% offer offline access

Device requirements for use of product

- **Laptop / desktop computer**: 85%
- **Tablet**: 70%
- **Smartphone**: 82.5%
- **Feature phone**: 7.5%

Availability of offline access

- **Offline practice / assessment**: ✓
- **Offline lectures / tutorials**: ✓
- **Offline progress to the next level**: ✓
- **Offline feedback / support**: ✓

16 out of 40 products offer some form of offline access

*Feature phones are aimed at customers that want a medium range phone that is not overly priced and also offers some features of a smartphone. A feature phone has more functions than a basic phone but less features than a smartphone.

**KEY TAKEAWAY**
Successful edtech implementation requires enabling ICT infrastructure – including internet and hardware access. However, hardware and internet access constraints are significant in LMICs. E.g. 53% of the population in LMICs do not have internet access, and even though mobile phone penetration is high, this is not true for smartphones. This problem is pertinent especially to regions like Sub-Saharan Africa, where only a third of mobile users have a smartphone. Against this backdrop, a number of PL products have taken some steps to mitigate connectivity constraints though significant gaps still remain. For instance, 22 out of 40 products are accessible across multiple devices – namely, laptops, desktops, smartphones and tablets – but only 3 products are accessible via feature phones. Further, 16 out of 40 of products provide some form of offline access. Offline features vary among the products and include access to learning content, practice drills, and/or feedback. However, only a few products incorporate access to multiple offline features.

**RECOMMENDATION**
More experimentation is needed with low tech devices to expand access to PL solutions in resource-constrained environments. PL design for LMIC contexts should also prioritize the design of offline features that can be accessed in low-bandwidth and no connectivity settings.

*Feature phones are aimed at customers that want a medium range phone that is not overly priced and also offers some features of a smartphone. A feature phone has more functions than a basic phone but less features than a smartphone.*
PL products offer several features to ease use and navigation but user registration and login requirements can be cumbersome.

**KEY TAKEAWAY**

User experience is an important factor of PL design in LMIC contexts. The ability to login, access content, and easily toggle between platform features may enhance or inhibit access and use if not designed properly. The 40 PL products in the review offer a variety of affordances to ease use and navigation – some of the popular ones being apt use of style, color, graphics and icons for readability, visual sign-posts or voice-based assistance, introduction/orientation to the product. Further, nearly all products offer some kind of tech support. However, only a few products have developed bulk registration processes – i.e. whereby it is a school official or the PL company that creates user accounts for all students in a classroom/school – or other simpler login methods (like single sign-on, images, etc.). Instead, the majority of PL products require users to register themselves using their email or phone at the very least. This could be cumbersome as users in LMIC contexts would still need to have an email address or phone number they can use.

**RECOMMENDATION**

PL companies should consider easier registration and login features to reduce barriers to accessing the platform from cumbersome procedures.
The seamless exchange of data between different edtech applications (i.e. interoperability and integration) allows building a more composite picture of student learning; enables communication with different education stakeholders; saves time and costs; and may also reduce the risk of vendor lock-in. There are various ways in which data from PL products can coexist and be exchanged with other technology applications – this data can be embedded or fully integrated in another tool (or vice versa) while maintaining full or partial functionality of the PL product, and/or accessed through a hyperlink or file export. 35 out of the 40 PL products reviewed offer at least some type of interoperability and/or integration – the most popular feature being the use of APIs and plugins. However, fewer products can be integrated with LMS or SIS platforms and only a handful report adhering to industry standards for interoperability.

Most PL products enable some type of cross-platform data sharing but only a few adhere to interoperability standards.

KEY TAKEAWAY
The seamless exchange of data between different edtech applications (i.e. interoperability and integration) allows building a more composite picture of student learning; enables communication with different education stakeholders; saves time and costs; and may also reduce the risk of vendor lock-in. There are various ways in which data from PL products can coexist and be exchanged with other technology applications – this data can be embedded or fully integrated in another tool (or vice versa) while maintaining full or partial functionality of the PL product, and/or accessed through a hyperlink or file export. 35 out of the 40 PL products reviewed offer at least some type of interoperability and/or integration – the most popular feature being the use of APIs and plugins. However, fewer products can be integrated with LMS or SIS platforms and only a handful report adhering to industry standards for interoperability.

RECOMMENDATION
PL companies should strive to align with industry standards for interoperability while being mindful of responsible data practices. Governments should also have a strategic vision and plan for implementing safe and secure interoperable data systems, which they should share with vendors.
Many products have gaps in their data protection policy and practice

Examples of some approaches to data protection

User data captured by PL products

Ownership of PL product data vests with:

Examples of some approaches to data protection

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Description</th>
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<tbody>
<tr>
<td>50%</td>
<td>Products reported their data being encrypted*</td>
</tr>
<tr>
<td>45%</td>
<td>Products reported that data is not shared with third parties</td>
</tr>
<tr>
<td>775%</td>
<td>Products reported having both a data management and data protection policy</td>
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</table>

* A technique of translating data from text to hashed code that is decrypted with a special key.

KEY TAKEAWAY
PL products capture a range of personal information during login, access and use. However, in the case of 30 out of 40 products reviewed, data ownership rests with the solution provider (though they are not always the only owners). Solution providers report being the sole owners in the case of 18 products and indicate shared data ownership in the case of the other 12 products. There are a number of ways through which PL providers protect this data – data encryption, anonymization of personal data, third party sharing controls, and data security policies, etc. – though these measures are not adopted in a similar manner across the board. A few providers – mainly those headquartered out of HICs – also report compliance with known data protection standards like GDPR, COPPA, FERPA.

RECOMMENDATION
PL companies should follow approved standards for data ownership, security and protection and budget for associated costs. Funders should consider making data protection and privacy measures a necessary component in funding applications.
PL products cater to diverse populations but some categories of learners who are already highly disadvantaged remain underserved.

**KEY TAKEAWAY**
To some extent, PL products cater to diverse segments. 33 out of 40 scanned products have been implemented in urban contexts and 30 in at least some rural contexts. The majority of products also make some effort to represent racial/ethnic and/or gender diversity in use of imagery or through balanced representation of race/ethnicity/gender in user interface or content. However, there are specific categories of learners who remain underserved by PL products. This includes learners with disabilities; out of school children; ethnic minorities; displaced children, etc. These learners are highly disadvantaged to begin with – not only in terms of their access to edtech but also in terms of having large learning gaps that PL could potentialy help remediate.

**RECOMMENDATION**
PL companies should continue to incorporate features that cater to diverse racial/ethnic/gender representation in product design. However, they need to pay more attention to designing features that cater to the needs of learners with disabilities. In addition, deployment models need to better address the challenge of reaching marginalized children.
Local stakeholders are often involved in content development but less so during implementation, and government ownership is weak throughout.

**Activities in which local stakeholders are engaged in product design**

- **31** Content development
- **13** Piloting with users
- **3** Hardware prototyping
- **5** Other

**Type of stakeholders in product implementation**

- Ministry of education
- Private sector
- Local NGOs
- International NGOs
- Bilateral / multilateral partnerships
- Telecom providers
- Science & Technology
- Ministry of ICT

**Role of governments in product implementation**

- Government-led or supported field implementation
- Government support for promotion
- Government support for funding
- Government adoption after implementation

**KEY TAKEAWAY**

Scaling and sustaining edtech requires much more than eager learners and motivated educators. It demands the alignment of multiple actors in local ecosystems – including government, education innovators, funders, etc. During product design, 36 out of 40 PL products have engaged local stakeholders in a variety of ways – among these, local engagement has been most common in the area of content development. During implementation, 27 out of 40 products have engaged in some form of cross-sectoral partnership in at least one implementation setting. However, more than a half of products have had no government engagement in implementation in either a supportive or leading capacity in any implementation setting. Even where government has been involved, its role has been limited, barring some exceptions.

**RECOMMENDATION**

As local engagement efforts tend to be ad-hoc, more emphasis on a systemized process and models for engaging local stakeholders are needed to build local capacity and cultivate buy-in and support. There is a need for more long-term partnerships with government as well as engaging government from the outset.
Few products have established a self-sustaining business model

**KEY TAKEAWAY**
To support innovation and ensure they survive and thrive, entrepreneurs (whether for-profit or nonprofit) need viable business models that produce consistent revenues. Most PL products reach students through a combination of B2B and B2C channels. In terms of pricing, 7 out of 40 PL products are offered completely free of cost to any user while the rest are fee-based. However, 6 of the fee-based products offer a basic version for free – albeit with limited features and functionalities. The main source of revenue for most PL companies appears to be product sales though a minority have been able to diversify revenue generation through tech licensing and add-on services. However, earned revenue on its own does not appear sufficient for sustaining operations. Around half of the PL companies seem to rely on multiple sources of funding (apart from earned revenue) for their sustenance and growth. Such sources include grants, private investment, loans, etc.

**RECOMMENDATION**
There is a need to explore alternative business models and financing strategies that minimize or eliminate cost to students and their families while enabling PL companies to sustain and grow.
Only 17.5% of PL products reviewed have adopted open principles – i.e. made their content and/or technology freely available

<table>
<thead>
<tr>
<th>Open source software only</th>
<th>Openly-licensed content only</th>
<th>Open software and open licensed content</th>
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7 out of 40 products claim to follow open principles

KEY TAKEAWAY
Open source is broadly defined as when the original source code is made freely available and may be redistributed and modified. “Open” ensures the software, data, AI model, standard or content can be adopted, scaled and adapted in various contexts. It is said to ensure transparency, contribute to project sustainability, and reduce the risk of vendor lock-in. Because it substantially lowers the financial investment necessary to create a tech product from scratch, open source promotes equity in access to technology and innovation for countries, companies and tech entrepreneurs in LMICs with limited financial resources. The vast majority of the PL products reviewed are proprietary and only 7 of the 40 PL products claim to follow open principles: 4 products have their code openly available while 6 products provide openly-licensed content.

RECOMMENDATION
Promote principles of digital development to increase collaboration, catalyse innovation and avoid duplication of efforts.
Most PL products conduct some kind of evaluation but they are often not publicly available and cross-comparison of product effectiveness is difficult.
We are seeing a lot of innovation and new developments in the areas of product design, technology, research, and market reach.

**Product design**
- More PL products are incorporating parental engagement features / portals
- An increasing number of PL products are adding new courses / products in underserved domains – esp. 21st century skills
- Several PL products are transitioning to AI-powered adaptation at the backend

**Market expansion**
- Brand new PL companies are entering LMIC markets
- Edtech providers not offering PL are incorporating PL in their products
- Novel approaches are emerging to scale content and technology quickly

**Technology design and research**
- Affective and engagement variables are used to improve PL experience
- Virtual assistants are used to provide personalized feedback and support
- Testing and research on the effectiveness of different personalized learning algorithms is ongoing
Our key observations

1. **FLEXIBLE USE**
   - of PL products across multiple settings (home, class, after-school), purpose (core, supplemental), and use cases (individual, blended, group-based)

2. **HOMEGROWN SOLUTIONS**
   - and local innovations

3. **EMERGING INNOVATIONS**
   - in content development and localization approaches, and experimentation with new technologies

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**SUMMING UP**

We were happy to see...
- Large number of PL products and countries reached in LMIC contexts
- Many variations in personalization approaches in terms of what pedagogical steps are personalized, types of variables, technologies and algorithms used, etc.
- Several products offer additional features beyond personalized learning (synchronous classes, discussion forums, live tutoring, competitions, content creation, etc.)

We were surprised to learn...
- There are many variations in personalization approaches in terms of what pedagogical steps are personalized, types of variables, technologies and algorithms used, etc.
- Even PL products that have scaled to at least a few million learners rely on external funding to sustain.

We would have liked to see...
- More features to support parental engagement and learners with disabilities; availability in more local languages; and better implementation outreach to marginalized learners.

What we still do not know...
- Effectiveness of AI use and different AI algorithms and approaches to address AI accuracy and bias?
- How to reliably evaluate and compare different PL solutions; how cost-effective are they, etc.
- How teachers, parents, school leaders act on the data provided? What interventions support them best?
- What are the ecosystem factors which affect implementation, scaling and financing of PL solutions?
- Deeper governmental involvement, given the promise of PL solutions and the recent need due to school closures
- Impact evaluations regarding learning impacts on subjects other than Math and Language/Literacy; comparative effectiveness of different PL features, implementation models, and support mechanisms for stakeholders; at-scale evaluations, etc.
- More attention to adherence to industry standards for interoperability and data protection, and open principles

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Effectiveness of AI use and different AI algorithms and approaches to address AI accuracy and bias? Do use of engagement signatures and affective state to inform adaptation effective? How teachers, parents, school leaders act on the data provided? What interventions support them best? What are the ecosystem factors which affect implementation, scaling and financing of PL solutions?
Some critical actions are required by stakeholders to help PL products deliver on their potential

**PL COMPANIES SHOULD...**

- Incorporate features that go beyond displaying learners’ progress to providing more *ACTIONABLE INSIGHTS AND RECOMMENDATIONS* to teachers and other key stakeholders (parents, school leaders)
- Provide features for *OFFLINE ACCESS* and explore compatibility with low-tech devices
- Integrate features to *SUPPORT LEARNERS WITH DISABILITIES*
- Align with *INDUSTRY STANDARDS* for interoperability, and data privacy and protection

**GOVERNMENTS SHOULD...**

- ENGAGE WITH PL COMPANIES AND OTHER COLLABORATORS* throughout the product life cycle – design, curriculum alignment, localization, deployment, evaluation, etc.
- SUPPORT LOCAL TECH INNOVATION and entrepreneurship to enable market expansion and help scale effective solutions
- Draw up policies, partnerships and incentives to promote more *EQUITABLE ACCESS* to effective solutions and for *ADEQUATE PROTECTION OF LEARNERS’ DATA.*

**OTHER COLLABORATORS* SHOULD...**

- Draw up *STANDARDS FOR COMPARISON* between solutions – on quality, efficacy, ease of use, etc.
- BUILD RESEARCH-PRODUCT PARTNERSHIPS to assess whether and how the use of such solutions improves learning in different education settings; study the accuracy and bias of different algorithm approaches, etc.
- Explore alternative business models to *PROMOTE OPERATIONAL SUSTAINABILITY* while keeping in mind affordability and equitable access considerations
- CONVENE AND COLLABORATE on systematic efforts in the areas of quality content development and its localization

*Other collaborators include academic bodies, researchers, funders, development agencies, etc.*
UNICEF works in the world’s toughest places to reach the most disadvantaged children and adolescents — and to protect the rights of every child, everywhere. Across 190 countries and territories, we do whatever it takes to help children survive, thrive and fulfill their potential, from early childhood through adolescence. And we never give up.