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Technologies for Personalized and Adaptive Learning

WORLD BANK GROUP
Education

EXPLORE

KNOWLEDGE PACK

TECHNOLOGIES FOR PERSONALIZED AND ADAPTIVE LEARNING

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1818 H Street NW, Washington, DC 20433
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Design : Alejandro Scaff, Sarah Kleinmann

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Acknowledgment: KP developed under the guidance of Iñaki Sánchez Ciarrusta and Cristóbal Cobo from the EdTech Team. Much appreciation to Omar Arias and Jaime Saavedra for their overall support. Also we want to thank Juan Baron, Diego Angel Urdinola, Tom Kaye and the rest of colleagues who provided comments to enrich these resources.

Introduction

What is a KP?

Knowledge Packages (KPs) are short, pragmatic guides on individual topics within EdTech, meant to provide sufficient knowledge and understanding so that non-technical stakeholders can make key planning, design, and procurement decisions for education.

They can be used as a starting point for the planning of technology deployment to improve education, especially with education ministries.

About this KP

The objective of this KP is to provide sufficient knowledge on personalize and adaptive learning technologies to help decisionmakers in the early stages on the process to explore the potential of this technology as part of the solution for their pedagogical problems in their context.

Overall, the common questions addressed in this KP are the following:

GENERAL QUESTIONS

- Why technologies for personalize and adaptive learning can be part of the solutions?
- What are these technologies, providing examples. How can AL adjust to the student?
- What is the variability of the adaptability in these systems?
- How these technology can be implemented in a certain context?

Additionnal questions are addressed in the FAQ:*

FAQ

DEFINING THE TECHNOLOGY

- How are the World Bank's 5 EdTech principals applied to personalized and adaptive learning?
- Is there any evidence to support the problem statement?
- What is the difference between adaptive learning, Computer Assisted Instruction (CAI) and self-directed learning?
- What are the main system components of an adaptive learning software?
- How do the algorithms work in an adaptive learning software?

FOCUSING ON THE IMPLEMENTATION

- Is there an initial checklist to analyze if personalized and adaptive programs can be part of the solution to a certain context?
- Is there a checklist to select the most appropiate adaptive program for a certain context?
- What are the next steps for a deployment process?

*To know more about these questions and their answers, go to the FAQ available in the annex.

WHO are the main stakeholders ?

KPs are designed with a **human-centered vision**.

This knowledge pack is meant to provide sufficient knowledge and understanding to help decisionmakers make key planning, design, and procurement decisions of technologies for personalized and adaptive learning.

	RESPONSIBILITY
Task Team Leaders (TTL's) & Bank Project Managers (non-technical)	• Assist MOE leadership in the application of KPs for in-country EdTech programs. Help design Bank-financed projects with practical information to include in project documents.
MOE Leadership (non-technical)	• Use KP to make key planning, design, and procurement decisions for in-country EdTech programs.
MOE Program Managers (semi-technical)	• Use KP to make key planning, design, and procurement decisions for in-country EdTech programs.
Donors, NGOs and Other Partners (non-technical)	• Use KP to align with Bank EdTech programs and establish a common EdTech framework.

WHY is this KP designed ?

PROBLEM STATEMENT

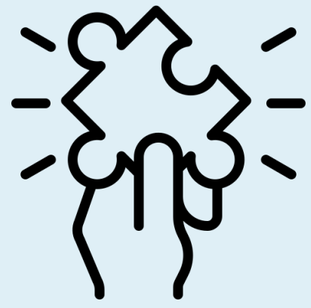
EDUCATION CRISIS AND THE POTENTIAL OF ADAPTIVE LEARNING

Learning gaps are **cumulative** and can lead to dropout.

The number of students per teacher has constantly risen, which makes personalized instruction difficult and/or expensive to implement.

Quality of teaching is the most **important factor** contributing to student achievement.

Pedagogical interventions that promote **personalized learning** and **teaching at the right level are effective.**



WHY is this KP designed ?

POSSIBILITIES OF THIS TECHNOLOGY

PERSONALIZED AND ADAPTIVE LEARNING AS PART OF THE SOLUTION

Technology for personalized and adaptive learning, when integrated correctly, can be a solution to a difficult pedagogical problem: teaching at the right level of every student in a large and diverse classroom, at scale.

Technology can deliver students personalized and adaptive content that adjust to their learning needs. The use of different technologies to foster personalized and adaptive learning has shown to be cost-effective and scalable.

Promising outcomes

The use of technologies for Personalized and Adaptive Learning appears to offer significant promise to improve learning outcomes, including potentially ‘out-of-class’ and ‘out-of-school’ learning.

Close educational gaps

Technology-supported personalized learning may be most beneficial in closing educational gaps for lower attaining students, potentially including those returning to school after an absence.

Personalization

The adaptability of these technologies allows ‘teaching at the right level’, enabling students to learn at their own pace and according to their current proficiency of the subject.

Source: adapted from the key findings from the “Technology-Supported Personalised Learning: A Rapid Evidence Review” report (June 2020), EdTech Hub

WHY **is this KP designed ?**

EVIDENCE

EVIDENCE OF WHAT WORKS AND WHAT DOESN'T

According to the EdTech Hub "Technology-Supported Personalised Learning: A Rapid Evidence Review" report (June 2020), studies report diverse but broadly positive relationships between technology-supported personalized technology and learning outcomes:

	STUDIES	POSITIVE OUTCOMES	MIXED OUTCOMES	NEGATIVE OUTCOMES
RCTs	12	10	2	0
Quasi-experiments	8	5	0	4
Case study	4	3	0	1
Total	24	17	2	7

See more information about research and evidence in the following slides with examples (11,12,13).

WHAT are the potential solutions?

STRUCTURE OF SOLUTIONS

TYPOLOGY OF TECHNOLOGICALLY-ENABLED PERSONALIZED AND ADAPTIVE LEARNING SYSTEMS

There is not one unique level of adaptation, but five:

RESPONSIVE SYSTEMS → **ADAPTIVE SYSTEMS**

CUSTOM INTERFACE	LEARNING MANAGEMENT	DATA DRIVEN	ADAPTIVE LEARNING	...	INTELLIGENT TUTOR
• Invites student to personalize learning experience by selecting colors and avatars	• Platforms that automate a range of classroom management tasks. • Includes systems that allow students to choose their own path through material.	• Management systems that provide materials appropriate to a students' proficiency level based on data collection.	• Data-driven learning that potentially moves beyond a pre-determined decision tree and uses machine learning to adapt to students' behaviors and competency.	CURENTLY IN DEVELOPMENT	• The image of a proactive learning guide, that could inspire questions, or use facial recognition to respond to emotional states.

Click for more info in the LMS KP

Choose content path → Artificial Intelligence (AI) adapted to behaviors and competencies → Adjusted content according to performance level

Range of personalization

Source: Bulger typology, Personalized Learning: The Conversations We're Not Having, https://datasociety.net/pubs/ecl/PersonalizedLearning_primer_2016.pdf

WHAT are the potential solutions?

STRUCTURE OF SOLUTIONS

SOME EXAMPLES 1/3

	BRIEF EXPLANATION	RESEARCH & EVIDENCE	OFFLINEABILITY	LANGUAGE	ED. LEVEL
ALEKS	ALEKS is a research-based, online learning program that offers course products for Math, Chemistry, Statistics, and more. Constantly adapting to update each student's knowledge state, ALEKS guides students to precisely what they are ready to learn at all times.	"spending approximately 30 h on a $30 intelligent tutoring systems (ITS) was equally as effective as spending hundreds of hours and thousands of dollars of tuition". Hickey, Daniel T., et al. "Internet-based alternatives for equitable preparation, access, and success in gateway courses." The Internet and Higher Education 44 (2020): 100693.	✕	ENGLISH, SPANISH	K-12 students, Higher Ed
Alta Knewton	Includes text-based and video instruction, interactive learning content, assignments and review materials. It can identify and dynamically boost knowledge gaps while you're completing assignments.	Alta makes an impact on learning outcomes for students of all ability levels. Study of Knewton Online Courses for Undergraduate Students: Examining the Relationships Among Usage, Assignment Completion, and Course Success. Wolf R. and all, 2018.	✕	ENGLISH	Higher Ed
ASSIST-ments	Students receive hints and explanations to assist their understanding as they complete their assignments. Teachers get real-time assignment reports detailing student and class performance and common wrong answers and other rich insights.	"the intervention significantly increased student scores on an end-of-the-year standardized mathematics assessment as compared with a control group that continued with existing homework practices." (Roschelle, Feng, Murphy & Mason, 2016).	✕	ENGLISH	

WHAT are the potential solutions?

STRUCTURE OF SOLUTIONS

SOME EXAMPLES 2/3

	BRIEF EXPLANATION	RESEARCH & EVIDENCE	OFFLINEABILITY	LANGUAGE	ED. LEVEL
Mathia	Students get the 1-to-1 feedback and encouragement they need and the chance to own their learning and monitor their progress, even as they work from home. Math.	An independent study funded by the U.S. Dep. of Education, conducted by the RAND, the Carnegie Learning blended approach nearly doubled growth in performance on standardized tests relative to typical students in the 2nd year of implementation. Pane JF et all, 2015. "Continued Progress. Promising Evidence on Personalized Learning".	✗	ENGLISH, SPANISH	K-12 students
Matific	This Digital Math Platform designed by education experts can work offline and is device agnostic, offering a wide range of possibilities to be used in different environments and contexts. Math.	A study from the University of Western Sydney that shows Matific can help raise academic performance by up to 34%. Attard, C. (2016). Research Evaluation of Matific Mathematics Learning Resources: Project Report.	✓	ENGLISH, SPANISH	K-6 students
Math-Whizz	This is an adaptive learning program that uses AI and gamification elements designed to support students from kindergarten to grade 8 in math.	Studies carried out by independent evaluators have shown a relationship between learning gains on Math-Whizz and increased performance in external assessments. Whizz Education Proof Pack, July 2020.	✗ 0.5Mbps Internet connection (per concurrent student)	ENGLISH	K-8 students

WHAT are the potential solutions?

STRUCTURE OF SOLUTIONS

SOME EXAMPLES 3/3

	BRIEF EXPLANATION	RESEARCH & EVIDENCE	OFFLINEABILITY	LANGUAGE	ED. LEVEL
Minds-park	Mindspark is a computer-based, online self-learning tool that helps children improve their skills in Math and English. It allows each student to follow a learning path that is based on their current level and at a pace they are comfortable with. Math, English, Science.	"[students using Mindspark] scored 0.37 standard deviations higher in math and 0.23 standard deviations higher in Hindi over just a 4.5-month period. Disrupting Education? Experimental Evidence on Technology-Aided Instruction in India. Karthik Muralidharan, Abhijeet Singh, Alejandro J.	✗	ENGLISH, HINDI	Class 1-10 Maths Class 4-9 English Class 6-8 Science
PAM	Plataforma Adaptativa de Matemática is a digital online tool for students and teachers offered by Plan Ceibal in Uruguay. It provides immediate feedback to the student after each answer, offering help, theoretical materials and showing alternative solutions. Qualitative studies suggest that communities of practice and good connectivity at school influence teachers' decision to use PAM. Math.	0.20 standard deviations in Mathematics learning gains in children who had used PAM compared to students who had not used it. Higher effects were observed in students of lower socio- economic status. Perera, M; Aboal, D. (2018). The Impact of a Mathematics Computer-Assisted Learning Platform on Students' Mathematics Test Scores.	✗	SPANISH	K-12 students
Read Along	Read Along (called "Bolo" in the past) is an AI-powered reading app designed to help primary grade kids learn to read. So far Bolo has launched in Hindi, English, Urdu, Bengali, Tamil, Telugu, Marathi, Spanish, Arabic and Portuguese.	Google piloted the Read Along app in 200 villages in Unnao district, UP India from Oct '18 to Jan '19 with the help of operational support from the ASER Centre. 64% of participants from the India pilot study with access to the app showed an improvement in reading proficiency, and 92% of the parents noticed some improvement in their child's reading skills.	✓ After downloading the app, this can be used offline.	Hindi, English, Urdu, Bengali, Tamil, Telugu, Marathi, Spanish, Arabic and Portuguese	K-6 students

In addition to the examples provided, the Edtech Hub, a research initiative supported by UK FCDO, the Gates Foundation and the World Bank, has developed a list of different EdTech Tools that enable personalized learning

WHAT are the potential solutions?

WHAT HAS BEEN DONE IN OTHER COUNTRIES - CASE STUDIES

DOMINICAN REPUBLIC

The World Bank team in conjunction with the Ministry of Education of the Dominican Republic (MINERD) designed and implemented the Programate project, which sought to improve learning outcomes in mathematics),carried out in different stages:

- A pre-pilot in 2018 (between March and May)
- Programate 2019 (from March to June)
- Programate 2020 (from January to July)

Criteria to select the right adaptive software:

- available in Spanish (experience in Latin American region. Language was an important challenge, and the cost of translating existing platforms and content can ver very high.
- include resources for students, teachers and staff
- cost-effective: include implementation

capacity building for teachers

2-month pre-pilot in 2018 (420 6th grade students in 5 schools), expanded to 51 schools.

- Results: Students improved in different areas
- Conclusion: positive relationship between the time spend in the software and the results in math.

[Adaptive Technology to Help Improve Math Learning in the Dominican Republic]

ECUADOR

Ecuador's Secretariat of Higher Education, Science, and Technology (SENESCYT), implemented an adaptative computed assisted remediation program in a 4 month

pilot in 2021 (39 technical and technological institutes with more than 4,700 first-year students).
The program was introduced in over 240 different classes with the support and participation of 136 teachers:

- Objective: to contain the increase in student dropout, partly explained by low levels of student academic readiness in mathematics.
- Results: the knowledge of the students' mathematical curricular improved between 8 and 10% per month, (equivalent to two full years of schooling), after using the platform for 16 consecutive weeks.
- Costing: the cost to access the platform from 10 to 20 USD per student per year (tutoring and remedial classes can oscillate between 200 and 500 dollars per student per year).

[Use of adaptive computer assisted remediation programs to prevent student dropout in the context of COVID-19]

HOW to implement next steps ?

DEPLOYMENT PROCESS - AREAS TO CONSIDER TO START IMPLEMENTING ADAPTIVE LEARNING PROGRAMS

The use of technology for personalized and adaptive learning requires a series of enablers to use and adapt this alternative pedagogy in the classroom.

Infrastructure

- What is the **minimum infrastructure required** to implement certain adaptive program (**electricity + connectivity + devices**)?
- Has the hardware the right software?
- Does the adaptive program provide **technical support**?

It is important to consider the most appropriate software according to the context of the country, including those that are **device agnostic** (that work in different devices) and those that can work **offline**.

Equity. PAL solutions have a lot of potential, but they are heavily dependent on having access to digital device, potentially exacerbating the digital divide.

Teachers

- Is there sustained **guidance** and **training** for educators on how to use the program?
- Are the principals, teachers and students **on board**?
- Plan for a **gradual incorporation** of the tool: using these type of programs changes the dynamics of the class.

Adaptive systems are not meant to replace teachers, but rather **enhance their role**. Communities of practice can play an important role.

Teacher training, development and capacity building (digital, pedagogical, technical skills) should be an **ongoing planned development program**.

Another interesting area to explore is capacity building for **parents/ caregivers** to support children using these tools.

Content and platform

- In what **grades** is going to be implemented?
- Is the content **aligned** to the curriculum?
- Is it available in **local/indigenous languages**?
- Is the content **culturally relevant**?
- Does the vendor allow to utilize **locally produced resources**?

Adaptive systems require a detailed **curriculum mapping** and **content development**.

Policymakers can **adapt** a pre-existing, proprietary system for their context (developing a system from scratch is the least preferable option).

Policy

- Does **funding** exist?
- Is there **organizational experience** and expertise to drive the implementation?
- Can the program be **scaled up**?
- Is the team planning to **measure the impact** of technology on learning and other variables?
- Are **data privacy** protection policies being considered?

District education leaders need to be able to **monitor/track the progress** of their designated schools and support as well as hold accountable the school leaders to implement such initiatives in their schools.

Good use of the collected data must be ensured, collaborating with other agencies, as indicated in this UNICEF's report.

HOW to implement next steps ?

COSTS AND BUDGETING

Depending on the context, **the biggest cost on these interventions can be upfront costs**, such as hardware and connectivity infrastructure.

COST ELEMENTS

- Importance of marginal cost, the cost of allowing an additional student to use the technology. This will be different in different countries.
- Content development, curation and production (including research, translation and adaptation to local languages and contexts):
  - Vendor resources
  - Adaptation of other resources (including OER)
- Copyright fees
- Student Licenses
- In-the field support capacity
  - Technical (responsiveness to connectivity and hardware issues)
  - Faculty training (to build familiarity and confidence with the platform)
  - Educational/pedagogical (to allow integration with schools' learning and teaching)

REDUCING THE COST ELEMENTS

- The expertise/implementation layer is relatively fixed and at scale is a small percentage of overall cost, yet highly impactful.
- Curate existing content instead of developing new content.
- Work in coordination with the platform provider to allow using already created content, instead of creating all from scratch.
- Try to get a better price per license based on scale including maintenance and updates.
- Some adaptive learning systems are increasingly device agnostic so can work on smartphones, which aligns with "bring your own device" policies.
- The upfront cost of investing in building local field support capacity for schools and communities sets up for lower overall long-term cost.
- In those countries were there are some computers in some schools, if those can be used, the cost of expanding/starting this program is lower.

QUESTIONS

- Does funding exist?
- Is there existing infrastructure that could be used to reduce to cost of starting/ expanding this program?
- Is it going to be implemented in schools?
- Is there organizational experience and expertise to drive the implementation?
- Can the program be scaled up?

HOW to implement next steps ?

MONITORING AND EVALUATION

It is essential to **monitor** the implementation and **measure** the impact of technology on learning, in order to understand if the intervention is achieving the proposed objectives and to correct based on the lessons learned (course correction).

Based on the 4 areas previously introduced in this KP, it will be important to ask some questions to better understand the impact, e.g.:

Infrastructure

- Was the technology adequate to the currently **available infrastructure** in the context (in terms of **electricity, connectivity and devices**)?
- **Equity:** How did the program dependency on having access to digital devices. Impact the existing digital divide of the students?

Teachers

- Were **teachers trained** on how to use the technology, and in how to incoporate the tool effectively in the classroom?
- Were teachers trained on how to utilize the data and findings to Support personalized learning?

Content and platform

- Was the content **mapped** to the local **curriculum**?
- Was the content **contextualized**?

Policy

- Are national/regional education leaders able to **monitor/track the progress**?
- Was MoE staff trained to work with such systems and were policies adapted accordingly, providing the Ministry with the ability to make evidence-informed policy decisions (data-driven)?

Conclusion

PROS

- Technology can deliver students personalized and adaptive **content that adjust to their learning needs**.
- Adaptive systems are not meant to replace teachers, but rather **empower** them, providing them with tools to teach at the right level and supporting them to be more responsive to the specific needs of each student in the classroom.
- The use of different technologies for personalized and adaptive learning **has shown to be cost-effective and scalable**.

CONS

- The use of technology for personalized and adaptive learning **requires a series of enablers**, such as infrastructure and teacher readiness, to use and adapt this alternative pedagogy in the classroom. The high dependency on devices could potentially exacerbate the digital divide.
- Algorithms can only measure what they are programmed to measure. It is important to **understand the limitations** of the different technologies and have clarity in the outcomes. Good use of the collected data must be ensured.
- **Further research is needed** to investigate the various complex and nuanced factors associated with technology-supported adaptive learning.
- It **requires time** (It require also time, institutional support, technical assistance, incentives, etc.)

Conclusion

WHO

In order adaptive and personalized learning programs to work, **principals** and **teachers** must be on board and trained, and **students** need to be engaged. **Adaptive systems should empower teachers**, rather than replace them.

WHY

Personalized and adaptive learning programs, when integrated correctly, can be a solution to a difficult pedagogical problem: **teaching to the right level** of every student in a large and diverse classroom. The use of different technologies for personalized and adaptive **learning has shown to be cost-effective and scalable**.

WHAT

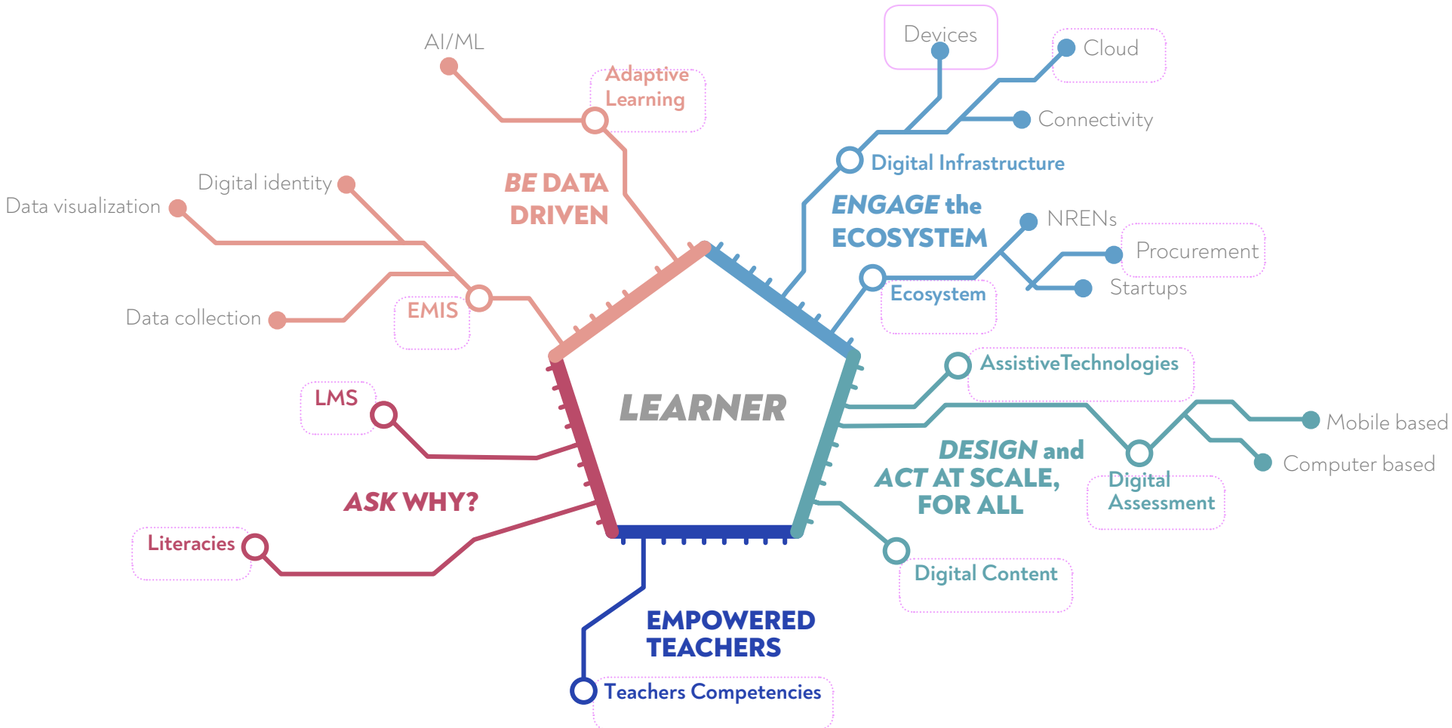
Adaptive systems can provide **personalization at scale**, using a **data-driven approach to instruction and remediation**. This technology can dynamically adjust to student interactions and performance levels, delivering the types of content in an appropriate sequence that individual learners need at specific moment to make progress.

HOW

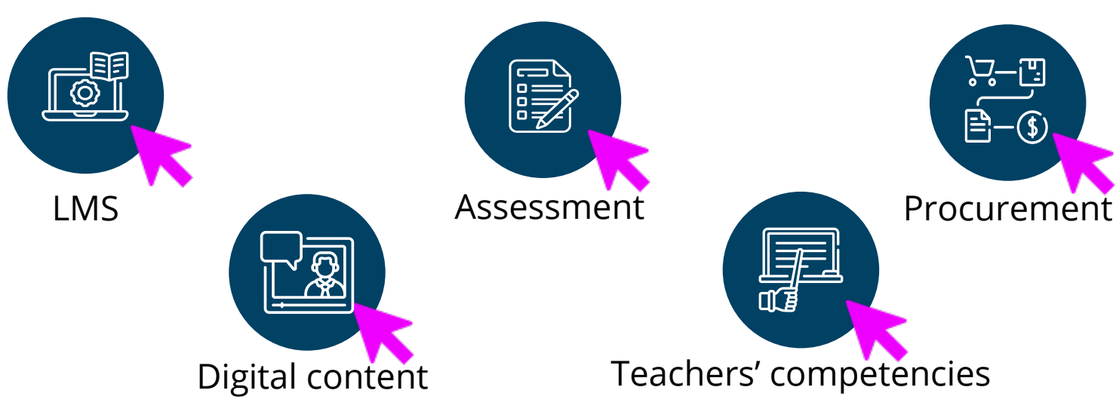
The deployment process should include three phases: **Design, Deploy, and Sustain**. It is essential to understand the problem, identify if the use of adaptive learning technology could be part of the solution and study the best alternatives based on the context. Before the implementation, consider the status of the **enabling conditions** (at the **infrastructure, content, capacity and policy levels**).

To go further

CLOUD OF KPs



OTHER EXISTING RELATED KPs



RELATED SOURCES

Blog: Considering an adaptive learning system? A roadmap for policymakers

Podcast: Adaptative Learning Podcast

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Annexes

GLOSSARY

AI (Artificial Intelligence): A discipline concerned with the building of computer programs that perform tasks requiring intelligence when done by humans. (Source: A Dictionary of Computer Science). There are different AI technics (including machine learning and neural networks –including deep learning-, among others).

Adaptive systems / Responsive systems: Adaptive systems aim to functionally mirror and support the learning process, which is a flexible and changing, rather than fixed, process. Responsive systems are more limited, essentially offering an interface to predetermined content, like a hyper-linked menu or a series of digital buttons. In comparison to truly adaptive systems, responsive systems are further from the neurological processes of teaching and learning, offering something much closer to an interactive textbook than a tutor. (Source: Personalized Learning: The Conversations We're Not Having).

Algorithm: A prescribed set of well-defined rules or instructions for the solution of a problem, such as the performance of a calculation, in a finite number of steps. (Source: A Dictionary of Computer Science).

LMS (Learning Management System): An LMS is at the core of an eLearning system and has to interact with several other systems that can be integrated or standalone.

Click for more info in the LMS KP

ML (Machine Learning): A branch of artificial intelligence concerned with the construction of programs that learn from experience. (supervised, unsupervised, reinforcement learning). (Source: Adaptation from A Dictionary of Computer Science).

Annexes

REFERENCES AND LINKS OF INTEREST

REPORTS

- Personalized Learning: The Conversations We're Not Having https://datasociety.net/pubs/ecl/PersonalizedLearning_primer_2016.pdf
- Technology-Supported Personalised Learning: A Rapid Evidence Review, by the EdTech Hub, https://docs.edtechhub.org/lib/?all=major+pal&page=1&page-len=1&sort=score&id=A2II5ZV7
- The effectiveness of technology-supported personalised learning in low- and middle-income countries: A meta-analysis, https://docs.edtechhub.org/lib/?all=major+francis&page=1&page-len=1&sort=score&id=5U948655
- Artificial Intelligence in Education: Promises and Implications for Teaching and learning. https://circls.org/primers/artificial-intelligence-in-education-promises-and-implications-for-teaching-and-learning
- The Case for Better Governance of Children's Data: A Manifesto. https://www.unicef.org/globalinsight/reports/better-governance-childrens-data-manifesto
- Technology-mediated personalised learning for younger learners: Concepts, design, methods and practice https://bera-journals.onlinelibrary.wiley.com/doi/10.1111/bjet.13150

BLOGS

- Considering an adaptive learning system? A roadmap for policymakers https://blogs.worldbank.org/education/considering-adaptive-learning-system-roadmap-policymakers
- Use of adaptive computer assisted remediation programs to prevent student dropout in the context of COVID-19 https://blogs.worldbank.org/education/use-adaptive-computer-assisted-remediation-programs-prevent-student-dropout-context-covid
- Adaptive Technology to Help Improve Math Learning in the Dominican Republic https://blogs.worldbank.org/education/adaptive-technology-help-improve-math-learning-dominican-republic

PODCASTS

- Mitigating Learning Losses and Accelerating Learning through Adaptive Learning https://open.spotify.com/episode/6IqG04BaEuzzmbAouKiMAG

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FAQ

DEFINING THE TECHNOLOGY

How are the World Bank's 5 EdTech principals applied to personalized and adaptive learning?

Is there any evidence to support the problem statement?

What is the difference between adaptive learning, Computer Assisted Instruction (CAI) and self-directed learning?

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FOCUSING ON THE IMPLEMENTATION

Is there an initial checklist to analyze if personalized and adaptive programs can be part of the solution to a certain context?

Is there a checklist to select the most appropiate adaptive program for a certain context?

What are the next steps for a deployment process?

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FAQ

Back to FAQ

DEFINING THE TECHNOLOGY

How are the World Bank's 5 EdTech principals applied to personalized and adaptive learning?

ASK WHY?:
If technology is the answer, what is the question? Considerations of the use of adaptive learning technology should focus on "education", on the pedagogical problem to solve and not just on the "technology". It is essential to set very clear objectives with clear learning outcomes measurements

DESIGN AND ACT AT SCALE, FOR ALL:
EdTech interventions must be designed for scale for all children.
Adaptive systems can provide personalized learning at scale.

EMPOWERED TEACHERS:
Technology should enhance teachers' access to content, data and expertise to improve teaching and learning. To be deployed effectively, adaptive systems must include training for educators.

ENGAGE THE ECOSYSTEM:
Education systems should take a whole-of-government and multi-stakeholder approach, both inside and outside the system. They must bring together stakeholders, like various ministry departments (such as the curriculum department, the teacher development department and the examination board), educators, adaptive software companies, implementation capacity/partners with expertise and contextual experience, content creators, infrastructure partners, and local EdTech startups.

DATA DRIVEN:
Valuable information can be collected in adaptive learning programs regarding the differences in the learning experience. This data presents an opportunity for teachers to better cater to student's learning gaps and to inform decisions to improve teaching and learning. This must be combined with clear policy guidance and rules related to data privacy, ownership, usage and security. Program stakeholders can also use the date for continuous improvement, targeted investment, and to inform policy.

Click to read the EdTech Strategy

Annexes

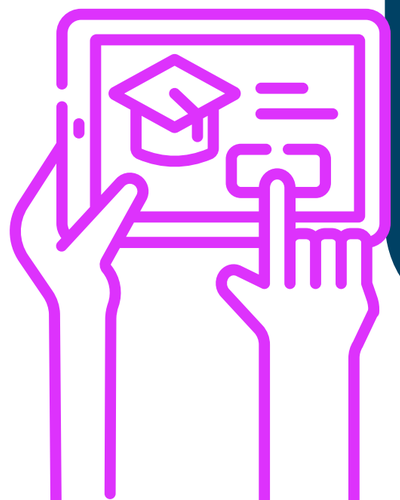
FAQ

DEFINING THE TECHNOLOGY

Back to FAQ

Is there any evidence to support the problem statement?

- The world is in the midst of a technological revolution. **Students are not being adequately prepared** to thrive in this rapidly changing world.
- Education systems, especially in low- and-middle-income countries, **face many daunting challenges**. 258 million students are out of school, including 59 million children of primary-school age. The situation is even worse in communities afflicted by conflict and violence. Girls and children with special educational needs are particularly being left behind. This **learning crisis has been exacerbated by the health and economic crisis of COVID-19**.
- The most important factor contributing to student achievement: **quality of instruction** (Hiebert and Grouws, 2007; Rowan et al., 2002). Most effective interventions at increasing student learning are concerned with improving the quality of instruction (Evans and Popova, 2016):
  - » Pedagogical interventions that **match teaching to individual student learning levels**
  - » Individualized, repeated teacher training, associated with a specific method or task
- **Teaching in developing country contexts is difficult**: Hight student-teacher ratios, Teaching to the top of the distribution (Banerjee and Duflo, 2011; Glewwe et al. 2009; Glewwe & Muralidharan, 2015; Pritchett and Beatty 2012), Curricula in developing countries originally designed to screen gifted students for positions of responsibility, etc.
- **The number of students per teacher has constantly risen for the last decades** (Nicol & Macfarlane□Dick, 2006), **making impossible to provide an individualize support to the students**. This leads to **poor learning outcomes, high drop out rates and dissatisfaction** (Brinton et al., 2015; Eom, Wen, & Ashill, 2006; Hone & El Said, 2016).
- **Gaps in the knowledge** of curricula are **cumulative** and can lead to the dropouts.



Personalized and adaptive learning programs, when integrated correctly, can be a solution to a difficult pedagogical problem: teaching to the right level of every student in a large and diverse classroom, at scale.

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DEFINING THE TECHNOLOGY

What is the difference between adaptive learning, Computer Assisted Instruction (CAI) and self-directed learning?

DEFINITION of ADAPTIVE LEARNING

It makes possible to adapt and/or redesign learning materials for each individual learner. Taking different parameters (such as student background, performance, goals, abilities, skills, and characteristics) into consideration, adaptive learning tools allow education to become more personalized and student-centered than ever before. The level of "adaptation" varies from doing an initial assessment to determine a fix set of content and a fix learning path, to use large data pools and analytics to update the learning path by adapting the content and instructional strategy in real time to maintaining a complete learning profile for each learner. These systems offer different levels of personalization based on intensive use of data: the more data, the more personalized the experience will be.

COMPUTER ASSISTED INSTRUCTION / LEARNING

Computer Assisted Instruction (CAI), also sometimes referred to as computer-assisted learning (CAL), uses computers together with traditional teaching. Computer-assisted training methods use a combination of multimedia such as text, graphics, sound, and video in order to enhance learning. The primary value of CAI is interactivity – it allows students to become active learners instead of passive learners.

SELF-LED/SELF-DIRECTED LEARNING

'Self-directed learning' describes a process by which individuals take the initiative, with or without the assistance of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implement appropriate learning strategies, and evaluating learning outcomes. There are self-led learning programs that are not adaptive and vice versa.

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DEFINING THE TECHNOLOGY

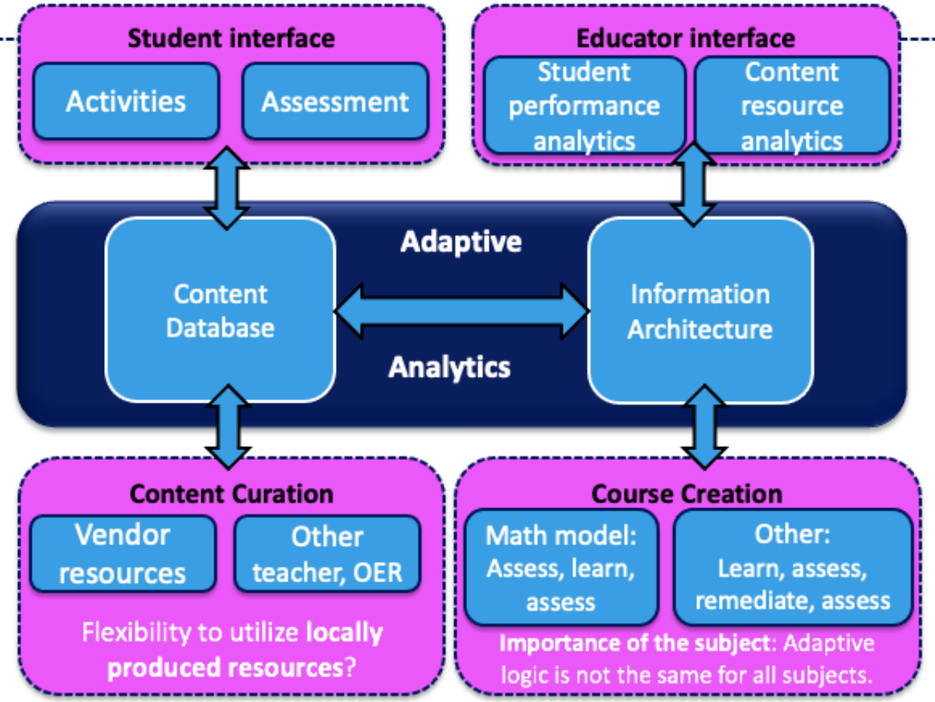
What are the main system components of an adaptive learning software?

Some of the key components include: the **curriculum** (modules of the content to be learned by the students), the r**esources and activities** to increase student's engagement and interaction and the **assessment** (that creates datapoints about the student's progress and provides feedback, linked to the next activities presented to the learner) and a **database** with the students' information.

SYNCHRONIZED vs SELF-PACED

An important initial decision regarding the students 'learning experience is around the pedagogical model:

- **Synced:** fixed exam dates, lesson alignment, interactive
- **Self-paced**: complex tracking, flexible dates, independent



TEACHER TRAINING

To be deployed effectively, adaptive systems must include training for educators, including:

- **Role shift** the from an instructor to a tutor,
- Use the platform and **technology**
- Utilize the students' analytics to provide **individualized support** to students
- Use the data to plan lessons and **differentiate instruction** based on students' needs.

Source: prepared by author based on a presentation by the Arizona State University (ASU)

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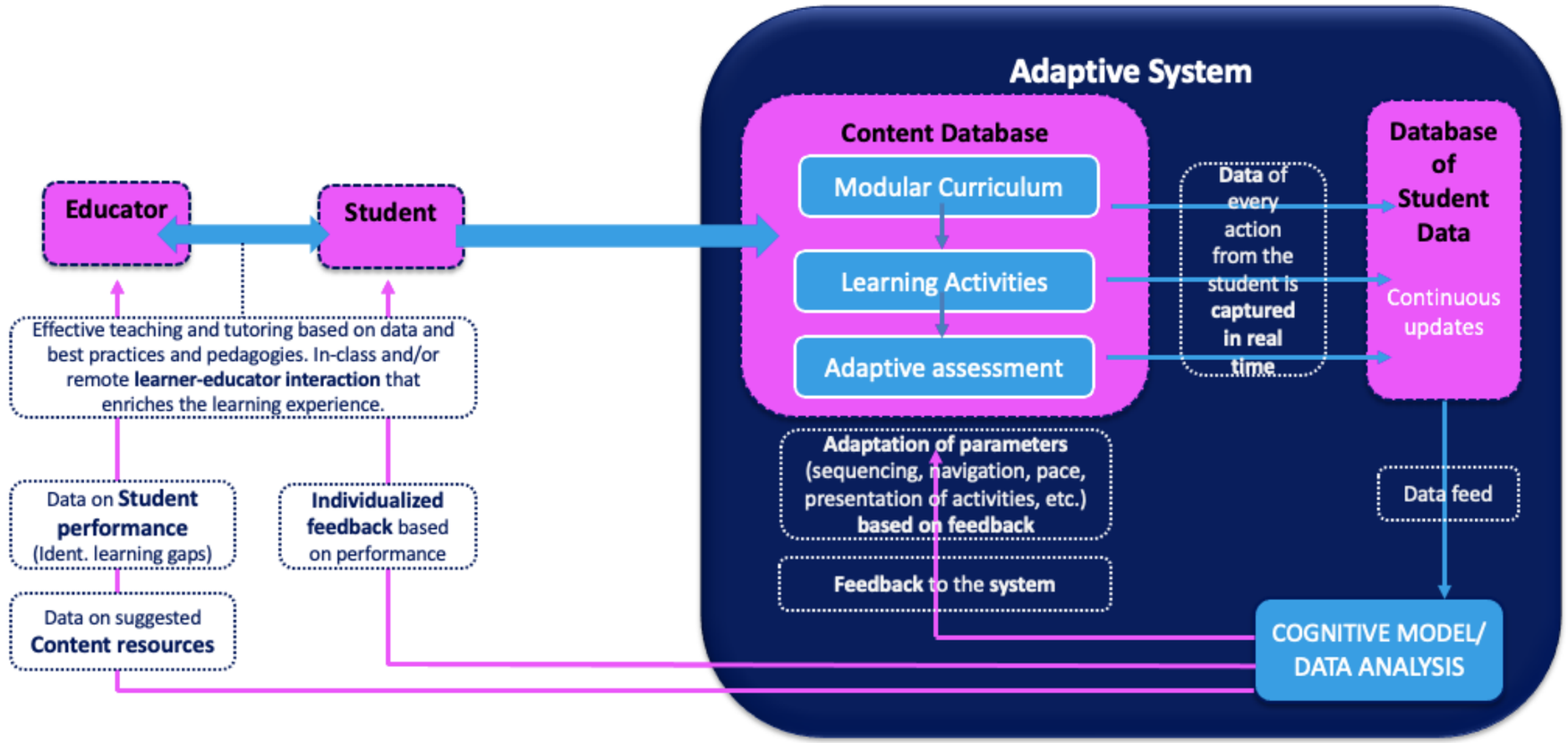
DEFINING THE TECHNOLOGY

How do the algorithms work in an adaptive learning software?

Looking into the **"black box"** of adaptive learning systems, including:

- **Regular flow feedback** to the system and users
- **Personalized sequencing** of the content
- **Individualized pace of learning & regulation** of the **cognitive load**



Source: adaptation by author based on a Dreambox learning scheme

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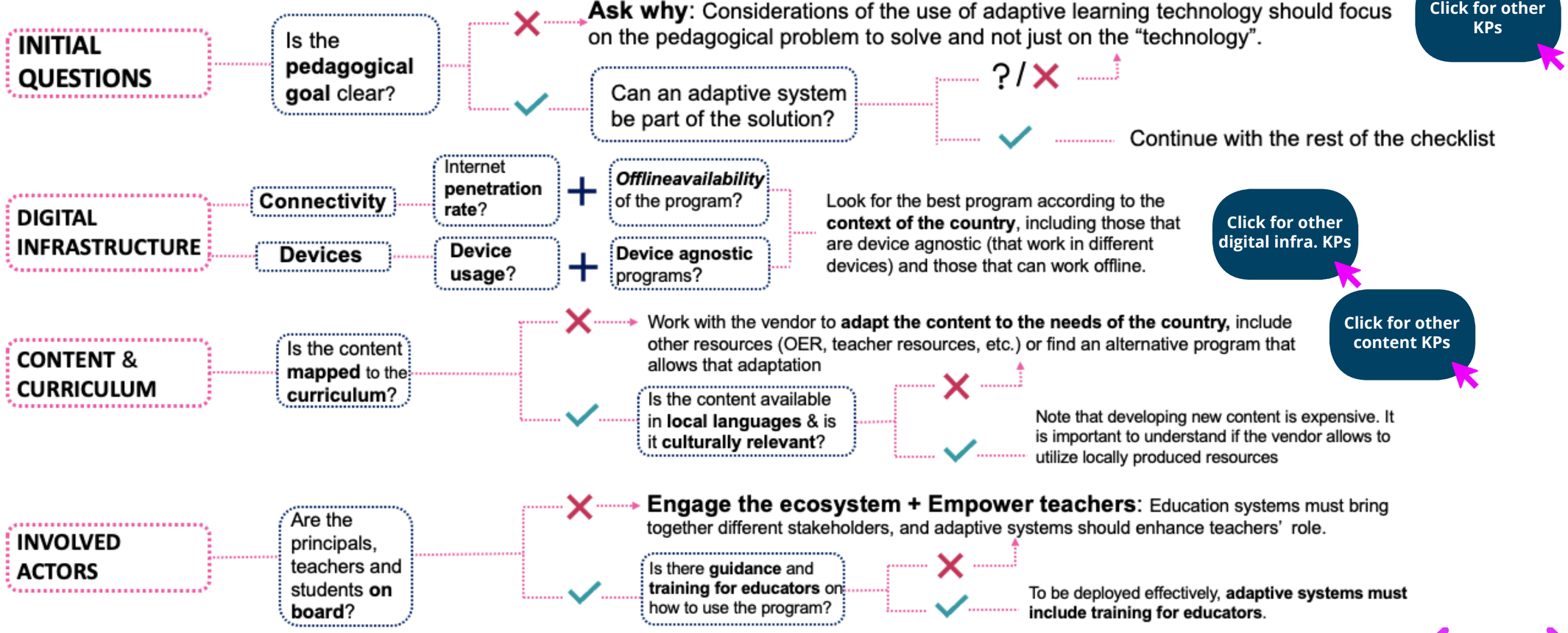
FOCUSING ON THE IMPLEMENTATION

Is there an initial checklist to analyze if personalized and adaptive programs can be part of the solution to a certain context?

Depending on the context (existing infrastructure, available content, capacity building…), adaptive technology solutions may work on the country or not.



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FOCUSING ON THE IMPLEMENTATION

Is there a checklist to select the most appropiate adaptive program for a certain context?

Adaptiveness	• Provides adaptive and individualized learning • Includes diagnostic evaluation • Offers diagnosis and mapping of knowledge per student and per course • It allows to identify and work on the topics that the student is ready to learn • Provides detailed progress & performance metrics for the knowledge acquired	☐ ☐ ☐ ☐
Content	• The content is available in the local languages, and it's contextualized • Allows the customization of the topics of a course with content from different courses/books • Includes textbook with links from the exercises	☐ ☐ ☐
Teachers	• Allows teachers to create their own exercises • Includes a teacher module	☐ ☐
Infrastructure	• It is compatible with various mobile devices • Works with internet speeds less than 1 mbps • Works offline	☐ ☐ ☐
Engagement	• Offers motivating messages when the student learns a new topic • Provides other gamification elements	☐ ☐

Check the boxes

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FOCUSING ON THE IMPLEMENTATION

What are the next steps for a deployment process?

DESIGN

- Establish Project Management Team
- Vision, Goals and Objectives
- Define Use Cases
- Evaluate Readiness and interdependencies
- Identify appropriate devices
- Adoption & Change management
- Budget (considering TCO)
- Risk & Mitigation
- Communication

DEPLOY

- Request For Information (market consultation)
- Define Technical specifications
- Define Software stack
- Request for Proposal
- Procurement
- Delivery
- Distribution
- Set-up

SUSTAIN

- Capacity Building and Skills Development
- Governance & Compliance
- Partner & Stakeholder Management
- User Support
- Maintenance
- Decommission
- Replace / update
- e-waste management

CONTINUOUS MONITORING AND EVALUATION OF PROJECT KPI'S