Promising Practice Report

This report was produced as part of the Empower2Learn project and have largely informed the Tool guide in the Empower2learn toolkit: https://empower2learn.online/concept-map/

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Content

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Executive summary

Within the context of the rapid move to remote learning across much of Europe as a result of the global pandemic, this report sets out some of the complexities around defining 'personalised learning'. It defines and refines the meaning used by the Empower2Learn project – *"learning that empowers students to become active in their learning pathways and tailor their learning activities to meet their needs, abilities and interests"* – and considers different dimensions, including addressing inequality, personalised learning pathways and the benefits and risks of digital resources including adaptive and AI systems.

We argue that the ultimate goal is a mixed economy of confident teachers using digital tools where appropriate and operating across the different dimensions of personalised learning, as part of a community.

How does this come together in practice? Seven case studies of promising practice offer stories of very different ways in which personalised learning has been implemented in schools:

- Sweden - The educational platform Kunskapsporten
- Belgium - Tablio: adapting to different learning profiles with Classkick
- Netherlands - Snijders School and Bordfolio: co-creating a digital portfolio
- Sweden - Studi.se: opening up the multilingual classroom
- UK - ReflectED: metacognition with SeeSaw
- EU-level - I Read: fostering literacy through personalised apps
- Netherlands – Snappet!; implementation of a platform

Finally, we offer design principles for school leaders and policymakers, teachers and edtech companies. These are recommendations for the effective implementation of personalised learning strategies based on the examples of good practice for the design of such solutions derived from the case studies and our discussions with practitioners.

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1. Introduction

Adaptive tools, including AI-based software in education, are predicted by many experts, researchers and strategists to have the potential to empower learners through personalised learning, and to have a profound impact on educational practices by enabling new ways of teaching. Although the pace of technical development is very fast, teachers' use of ICT tools to support personalisation is still in its infancy and best practices and methods are yet to be explored and defined.

This report addresses one of the specific project goals in the Erasmus+ funded KA2 project Empower2learn (2019-2022): *to explore and analyse existing studies and best practices, effective digital tools and pedagogical models in primary schools EU-countries related to personalised learning,* which means that it explores, rather than maps an emerging field of practices and technologies. Taking its departing point in the first project output, a curated online collection of research, studies, reports, briefings and presentations and the summary of its key findings, this 'Promising practice report' has set out to collect the current best, good or promising practices of personalised learning with the use of digital technologies in schools from the participating countries and beyond.

The partnership (4 local school authorities/educational centres and Universities from Sweden, Belgium, UK and the Netherlands) argues that personalised learning through ICT can empower students from an early age and affect their learning in a positive way, but that this requires that both teachers (K-12) and educators have up-to-date knowledge about how ICT tools can support personalisation, as well as practical support in how to use them effectively at all stages of an educational learning process.

More than collating and pointing at good examples, this report contextualises current practices by defining the differences between key terms, outlining learning pathways, and addressing important ethical considerations. The seven case studies presented in the report are based on interviews and discussions made with users and have been selected to display the complexity and many options for implementing technology to support personalisation in different educational settings and countries. They show signs of being able to achieve beneficial outcomes or have already been demonstrated to have achieved them; however, it is important to realise that context is key and despite success in one context no one approach can be guaranteed to work in all cases for all learners, and indeed all teachers.

The context in which this work has taken place is also reflected in the report. Several months after the beginning of this project the Covid-19 global pandemic led to the closure of schools across most countries in Europe and around the world and the need to move rapidly to remote learning using digital technologies. This digital shift in an emergency situation forced schools and education policymakers to adopt new practices and new technologies. Teacher professional development was unplanned and responsive but, of necessity, many European

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teachers learned new ways of working at speed. While the long-term implications cannot be known, we have attempted to reflect some of the short-term effects in the case studies.

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2. What do we mean by personalised learning?

Personalised learning, in the general sense of there being clear expectations that teachers will regard and teach pupils as individuals, is not a new concept in education. Equally, digital tools of various types and levels of sophistication have long been at the disposal of teachers in theory, and in some practice, as has the idea of using these tools to support personalised learning. Personalising learning was also clearly possible before digital: the notion of a one to one personal tutor can be traced back to elites in classical civilisations. Combining both personalisation and technology offers the promise of this 'elite' education to all citizens in the digital age.

One could say that the term 'personalisation' is deceptively simple and is used somewhat interchangeably with others. While educators and learners may find themselves in a wide variety of contexts where not all aspects of personalised learning are conceivable, achievable, applicable or desirable, an approach that favours one or more aspects may still be valuable. Equally, 'personalised learning' may be under consideration from the viewpoint of an individual learner, family, educator, institution or higher level organisational, administrative or governmental grouping or by a policymaker.

Some awareness of so many variations in understanding needs to be maintained at all stages. Producing a working definition across all contexts is a considerable challenge.

However, in this project we understand personalised learning as **learning that empowers students to become active in their learning pathways and tailors their learning activities to meet their needs, abilities and interests**.

Different dimensions of personalisation

Drawing on the literature and first hand and reported experience it is clear that this learning process consists of different dimensions, which give meaning to the personalisation:

1. **Objectives**

The objectives should be optimised for each learner's needs, interests and ongoing performance. These objectives refer to the specific learning goals, which the student is working towards (SRI International, 2018).

2. **Personal characteristics of the learner**

The personalisation is located at the level of personal needs, abilities and interests. These refer to the characteristics of the learner, which could be indicated by the following:

- Demographic: eg age, cultural background.
- Prior knowledge: the pre-existing knowledge, before introducing new knowledge.

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- Interests: since learners are the subject of personalised learning, it is important to steer the learning so that it matches their interests, talents and ambitions (Bartle, 2015; Bray and McClaskey, 2013).
- Preferred mode of learning: online, face-to-face, hybrid, blended or in some way mixed.
- Level of learner commitment/motivation: is the learner motivated?
- Self-regulation: the ability to handle thoughts, emotions and behaviour and to adjust them so as to further successful learning.

3. Type of learning

Personalisation could occur in different types of learning:

- Formal learning: learning in a systematic and structured way, within an environment which is designed for learning (eg a school).
- Non-formal learning: learning outside specific institutional contexts which are designed for learning, such as programmes developed by museums.
- Informal learning: learning which is directed by the learner themselves and not limited to certain environments, such as learning how to interact with others, how to refuel a car and so on.

4. What is being personalised?

This refers to the sources which are used and could be personalised:

- Content: the content of a subject could be personalised according to the learner's characteristics and needs.
- Assessment: the assessment could be personalised to a format preferred by the learner (eg presentation, video, portfolio).
- Teaching and learning strategy: this could be adapted to the needs of the learner (such as individual work, homogeneous group work, heterogeneous group work).
- Learner's choice: the learner is free to make choices about the topics they want to address, how to study them, how much time they spend on certain topics, etc.
- Teachers' choice: the teacher can also choose the ordering of the content which is predetermined in the curriculum, how they want to adjust the curriculum, etc.
  Of course, both the choices of the learner and of the teacher are important; each with their own role, they are jointly responsible for the personalised learning process (Hargreaves, 2006).

5. Who/what is doing the personalisation?

The personalisation could be carried out by different actors or agents:

- The learners themselves
- The teacher or other person with responsibility
- A peer
- A trainer
- Computer software

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6. **How is the personalisation carried out?**

This refers to how the personalisation is being realised. Personalised learning does not need to be carried out with the involvement of technology, but the rapid development of adaptive tools, AI software, etc enables personalised learning at scale. These options may or may not be available at a given time to a learner or teacher.

7. **Impact/beneficiaries?**

The impact and benefits could be related to different but also multiple actors:

- The learner
- The teacher
- A peer
- A trainer
- The software developers
- The school
- A higher level organisational unit such as a municipality, school board or authority

Another model

In this way of viewing the situation, the way in which learning is personalised depends on two dimensions, namely:

- Collective interest versus individual interest
- External regulation versus self-regulation

The dimension of collective interest versus individual interest focuses on the level of differentiation. In this dimension the school has to decide how they want to balance collective interest versus individual interest with the educational offering. At one end of the dimension, the curriculum is solely based on a set of knowledge and skills that is predetermined by society and is believed to be needed to be able to function in society. At the other end of the dimension the educational offering is solely based on individual goals and learning needs. In between these two extremes there is a balance between the collective and individual interest.

The dimension of external regulation versus self-regulation focuses on the level of student autonomy. In this dimension the school decides the level of responsibility that students take for their learning and which possibilities the students get to have to influence the learning process because they can decide what, when, where, how, why, with whom or how quickly they learn. On the left side of the dimension the control is completely in the hands of the teacher of other external agent or actor, for example, an ICT program or course book. On the right side of the dimension, it is the students who have full control of their own learning processes. In between these two extremes all kinds of mixed forms are possible, whereby

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students are to a greater or lesser extent co-owners of their own learning processes. Choosing one of these dimensions can affect the roles of the teacher and student, the use of ICT and the educational organisation, such as learning resources, group formation, time and place of learning, and tasks.

Two dimensions, four quadrants

When you combine the two dimensions described above, you get four different combinations

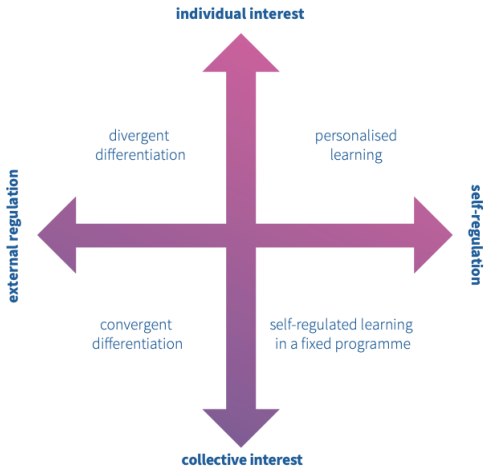

Figure 1. Dimension descriptions for personalisation of learning (Van Loon, Van der Neut, De Ries, & Kral, 2016).

or quadrants. We talk about personalised learning (the quadrant at the top right of Figure 1) when the individual needs of students are considered (individual interest) and when students regulate their own learning processes. Students not only decide how, when, where and with whom they learn, but they also influence their own learning goals (self-regulation).

When a school decides to give students a lot of control (self-regulation) and the educational offering is fixed they choose self-regulated learning in a fixed programme (the quadrant at the bottom right of Figure 1) Students need to achieve the same minimum goals but regulate how, when, where and with whom they learn. The programme is thus fixed, but they can make choices within the programme.

Schools that choose external regulation (left side of the quadrant) can cater to students' needs in two ways, namely by convergent or divergent differentiation. In divergent differentiation (the quadrant at the top left of Figure 1), the focus is on individual students who receive different levels of guidance. Students follow their own learning routes with appropriate goals and instructions. Therefore, the levels and the educational offerings are very diverse but the student has no or less freedom in the choice of learning route, goals and instructions. In convergent differentiation (the quadrant at the bottom left of Figure 1), the

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focus is on as many as possible shared goals for all students with little options for self-regulation by the students.

Personalised as distinct from individualised

Personalised learning takes place in a student-centred learning environment with coaching based on individual needs. Because of the emphasis on the individual students, personalized learning is sometimes mistakenly called individualised learning. In a personalised learning situation, learning still is a process consisting of social interactions and collaboration with fellow students, teachers, parents and the learning environment.

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3. Personalised learning in practice

Personalised learning pathways

Among the 'promising practice' examples featured in this report are ones which demonstrate good practice in making use of a variety of tools which allow a teacher to provide multiple 'learning pathways' for their learners. From a teacher's perspective these are a way in which a teacher can demonstrate 'differentiation'.

It may be that, in a given class at a particular time, learners do fall neatly into three or four groups (the typical expectation for differentiated learning in the UK context). But it is quite likely that this will be, of necessity, an approximate personalisation only: a good fit for some learners and not for others.

Possibly, too, the class will contain pupils with particular individual needs, for instance those with recognised special educational needs or disabilities with Individual Education Plans. These plans may contain further personalised and individualised adaptations and accommodations of the learning the individual's peers are undertaking through the use of a range of strategies and approaches including, potentially, support by very specific digital tools including assistive technology.

In some contexts it may be difficult for an educator to make provision in this way. But in the context of the five 'wicked challenges' facing many educators currently, this is not to blame educators (Baker, Smith and Anissa 2019).

In the report just referenced, which proposes educational AI as a possible solution, these 'wicked' challenges are characterised in a UK context. They are however shared to a lesser or greater extent across many countries worldwide:

1: Teachers burdened with excessive workload. This has a negative impact on wellbeing, retention and recruitment.

2: 'One-size-fits-all' learning, with inflexible learning pathways. Constraints in the system of various kinds limit the ability of schools to offer personalised support.

3: Narrow assessment inhibiting teaching and learning. A high-stakes focus on assessment of a narrow range of abilities distorts teaching and learning or discourages innovation and risk-taking.

4: Difficulty of sharing insights between schools and colleges. Beneficial network effects are hard to establish in many cases where only a minority of schools are able to connect to share or gain insights in what works effectively.

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5: Inconsistency of education provision and lack of social mobility. If the quality of education provision around a country and system varies significantly this is likely to limit the education system's ability to increase social mobility and tackle disadvantage.

Another factor to consider is the variation in the range of confidences and competences that individual educators will have across a number of areas where digital tools can have an impact, and this is recognised within the Digital Competence Framework for Educators (DigCompEdu) that is at the basis of this project, and personalisation is one of its key areas. Alongside differentiation and personalisation sit accessibility and inclusion and actively engaging learners.

Progression model of teachers

As a concrete way to understand what this can mean for educators let us briefly consider some of the different types of stages for educators proposed by DigCompEdu (Redecker 2017 p 75). This progression model is intended to help educators, including teachers identify and decide on the specific steps to take to boost their competence. Here we are synthesizing these into 3 hypothetical teachers (there is more detail in the competency framework):

Our first hypothetical teacher is someone who makes little use of digital technology to engage learners, differentiate or personalise, and is uncertain about the benefits or how to do so. There is a fear that this will make it difficult for already disadvantaged students to participate and keep up with others. Good practice case studies using a particular tool/sample and a professional development toolkit may help this type of educator.

The second hypothetical teacher is already, in DigCompEdu terms, an integrator who selects and uses some learning activities, such as quizzes or games, that allow learners to proceed at different speeds, select different levels of difficulty and/or repeat activities previously not solved adequately. This person is able to select from a range of tools the most appropriate tool for a given context and for a given learner to use actively, taking care that all learners have access and, where appropriate, using 'compensatory digital technologies' to provide support to some learners.

The third hypothetical teacher is classed by DigCompEdu as a leader, with a well-developed set of competences. This person "comprehensively and critically implements differentiated and personalised learning and, in collaboration with learners and/or parents, designs personalised learning plans which allow all learners to follow their individual learning needs and preferences, with the aid of appropriate digital resources." The resources and digital pedagogical strategies are fitted to learners' digital technology uses, competences, expectations, attitudes, misconceptions and misuses and adapted according to effectiveness. Through monitoring, this teacher reflects on how effectively the teaching strategies employed foster differentiation and personalisation as well as active learning and adapts teaching strategies and digital activities accordingly. This includes using design principles to increase accessibility for the resources and digital environments used in

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teaching, such as font, size, colours, language, layout, structure. The obstacle that this individual will encounter sooner or later is that of capacity in terms of time, scope and ability to respond quickly to increasing amounts of data. However, these capacity limits may be overcome through the use of AI in educational technology as explained in the next section.

In the experience of the partners of Empower2learn (London Connected Learning Centre, PXL, Han university and the Department of Education of the municipality of Norrköping) we know that teachers can achieve remarkable results by employing a range of strategies and digital tools. In some cases this may be through a teacher's own individual commitment, interest or expertise. In other cases this may be through policy and practice within a school, or a wider organisational grouping, and through the effective institution-wide practices led by senior leaders, or through effective distributed leadership. Here, mechanisms such as, but not limited to, professional learning are in place to support, encourage and disseminate identifiable strategies for successful outcomes, and on the basis of regular review and refinement achieve a mature digital approach.

As well as these 'pick and mix' opportunities left to the choice of individual teachers, departments, schools or districts, over recent years publishers and providers in the edtech sector have offered school-wide systems. Educational platforms have been around for some time but what is relatively new are the capabilities within them to take on automatic functions, whether programmed conventionally or using adaptive learning technology and artificial intelligence.

These offer the promise of being able to go beyond what an individual teacher can perform in terms of collecting knowledge about individuals over a period of time, diagnosing needs and providing additional support or challenge. This might relate to the achievement of learning outcomes identified within a national, regional or local definition of a curriculum, subject area, programme of study or syllabus. Some of these tools, platforms and systems can be used ad hoc or in one-off situations, but many are predicated on a continuous provision of education through kindergarten, school and similar institutions.

Addressing inequalities

At the heart of this Erasmus + project Empower2Learn, from which this report emerges, are two goals centred on the model of learner and educator as co-authors and agents of learning.

For students, the project is ultimately expected to empower students to learn, to become co-authors of their learning pathways and take part in activities that meet their needs, abilities and interests. It addresses the diversity of students and promotes social inclusion in the learning environment, with the awareness that differentiation and personalisation can

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contribute to reducing disparities in learning outcomes, affecting learners with disadvantaged backgrounds.

For teachers and educators, the goal is to boost their competencies around personalised learning with digital technologies to empower all students.

However, during the period of this project the Covid-19 global pandemic has led to the closure of schools across most countries in Europe and around the world and the need to move rapidly to remote learning using digital technologies. This has caused disruption to education systems globally, nationally and locally and has brought to the fore inequalities in society. Across the K-12 age range, educators will have a great range of assumptions and philosophies as well as the constraints imposed by the context in which they are working, crisis situation or not. The current situation gives us a chance to consider some of the other, not always explicit, dimensions of the term ‘personalisation’.

At the same time publishers and edtech providers have opened their resources, often free of charge for a period, to the wider audience of parents and family members in their role as educators of children within the family during a period of remote learning. In this particular context, digital inequalities, teacher competences (and those of parents and family) and the need to address the diversity of learners and their needs (and the community) and promote social inclusion are critical issues. There is talk of a widening gap across the world between learners, with huge disparities exacerbating existing inequalities, but this is also true on a national, regional and local level. What role can personalised learning play in addressing inequalities and enabling those pushed even further behind to somehow ‘catch up’?

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4. New technologies and ethical considerations

Towards a Shared Vision of Ethical AI in Education, a report from the Institute for ethical AI (University of Buckingham, 2020) sets out some of the ways that AI is used in education. These range from adaptive learning platforms and predictive analytics to automated essay scoring, facial recognition systems and smart toys (which can be used in Early Years or kindergarten to support language development).

The report argues that the benefits posed by AI in education (AIEd) stem from three fundamental factors:

- AI can increase capacity within education systems and increase the productivity of educators.
- AIEd can provide valuable insights that can enhance teaching and learning, and support learners' well-rounded development.
- AIEd can deliver autonomous learning recommendations.

But there are also profound risks. As the authors acknowledge: "If artificial intelligence is used effectively, responsibly and with learners' best interests at heart then real progress could be made towards achieving a more effective, well-rounded and equitable education for all learners. But if we get this wrong, societies could become more divided, education could be used as a weapon of mass manipulation and human flourishing could suffer profoundly." They recommend that all the professionals involved in using AI will need to be empowered to make ethical decisions in the best interests of learners: "Educating people about AI in education is hence a necessary starting point."

In this report we are clear that no one tool is a magic bullet. Much is dependent on context and, despite success in one context, no single approach can be guaranteed to work in all cases for all learners and, indeed, all teachers.

The mix of approaches will include digital tools that enhance opportunities for student engagement and personalisation along with data-rich tools that assist teachers with overall just in time intervention and support where needed. These might be built on underlying ethical AI systems that assist the learner and other stakeholders – educator, leader, school – to make (benevolent) sense of patterns in the increased data supply.

The ultimate goal is a mixed economy of confident teachers using digital tools where appropriate and operating across the different dimensions of personalised learning, as part of a community. Good access to effective professional development for those teachers is fundamental.

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5. Stories of promising practice

1. The educational platform Kunskapsporten

Background

In 1991, Sweden implemented educational reforms that gave all students the right to choose between municipal schools and independent schools that were owned by parent cooperatives, foundations or companies. Kunskapsskolan started as a private initiative in 1999 and opened its first four secondary schools in the greater Stockholm area and Norrköping in August 2000.

In Norrköping, teachers Birgitta Ericson and Torbjörn Bindekrans struggled with the idea that education is structured to fit everyone in the class. Driven by the conviction that, if you want every student to be successful, it is impossible to teach in the same way at the same pace, Birgitta and Torbjörn created several new methods that put the student at the centre of the learning process and where autonomy is considered to be the key to motivation in learning. They developed a complete teaching and learning model, the KED Program, that is unique to Kunskapsskolan but can connect to different national curricula. The KED Program is currently used in six countries: Sweden, India, UK, Netherlands, Saudi Arabia and the US. Kunskapsskolan targets students from 12-18 years, and the project involves more than 100 schools, 25,000 students and 2,500 teachers. (The KED Program, n.d.)

How was technology used to support personalisation?

The KED Program is supported by the educational platform called Kunskapsporten – a learning portal that support the educational ideas, reflecting the core values and organizing the teaching and learning in all schools run by Kunskapsskolan. It combines all the digital tools into one space that is accessible to students, teachers and parents. Kunskapsporten contains the curricula, work paths, exercises, texts and other resources for all the goal oriented, step-by step courses and the interdisciplinary thematic courses. Students can follow their own development/progress and understand the course objectives and content in both a shorter and a long-term perspective.

Kunskapsporten gives students access to the entire course content from middle school and high school, as this too is expected to increase their motivation and spark their curiosity. Each course is presented with different types of learning material to support the goals. The students must demonstrate that they have achieved the goals, but they can achieve them in different ways. The course, in turn, contains different kinds of themes and topics which are based on an interdisciplinary approach.

Personal log book

Students track their courses in a log book in which they have a dialogue with their supervisor/mentor and design their own educational pathway. All students works at their own

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pace reaching the set goals at different time and depending on their prior knowledge, interest and motivation. Some students will need more time and support to finish the different courses while others can access additional and more challenging content. The students' log books are linked to the school's documentation system (EDS) in which all teachers can follow the students' learning and make formative assessments. Subject teachers write what the students need in each subject. This information is recorded in the EDS, which the students supervisor/mentor can then access.

Bank of strategies: metacognition

Kunskapsporten also supports students in their metacognition and learning strategies through the 'bank of strategies' (*Strategibanken*), which lists different types of study techniques and other relevant materials. These support structures have evolved and become more numerous over the years. The list of strategies helps the students to identify which strategies works well in their learning and can also offer inspirations for other ways of learning. The data collected can help both mentors and students to discover patterns of how the student learns, which strategies works well and which don't.

Individual study plans

Together with their mentors, students identify goals for each semester that are stated in a individual study plan. The challenge lay in connecting the individual plans with the students with an overall plan of teaching. Although homework does not exist as a concept, students may, based on the goals set in their plan, have to catch up with their school work after school hours.

Collaborative personalisation

While Kunskapsporten can be accessed at any time and anywhere, offering students the opportunity to work with their school content individually, the personalised schedule of each student also includes learning in groups, although this differs from the more traditional approach. Kunskapsskolan has built up a range of different group constellations that require special scheduling. This means that subject teachers need to keep track of their colleagues' plans. The scheduled activities are compulsory and can consist of:

1. Lectures: lessons where the teacher lectures to a group of about 65 students. Students can choose and agree with teachers which lectures to attend.

2. Seminars: lessons where the student prepare and present a specific assignment that is discussed and analysed in more depth in a smaller group that can vary from 5 to 20 students.

3. Workshops: lessons where students work with specific goals and where they can get individual help from the subject teacher.

4. Communication session: lessons held in groups of 20-25 students that focus on communicative aspects such as group problem solving, oral review and discussion.

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Teachers can differentiate the groups by level, difficulties and strengths and meet the needs at group level. Every 4-8 weeks groups are revised and transfers made making sure that content is based on the students need and level.

What were the training needs for implementing this practice?

All teachers at Kunskapsskolan work both as mentors/supervisors and teachers. In contrast to most schools, the mentoring parts are considered essential.As there is a shared ownership between student's planning and the teacher's planning new teachers need to undergo a training module, accessible through Kunskapsporten that prepares them for the educational concepts and their different roles. The modules focuses on:

1) Mentorship/coaching. This is where teachers will get the relevant tools and support structures to execute the tasks as mentors. For example, how to guide students through their learning, what questions to ask, etc.
2) Teaching different courses. Standards of performing a course, layouts, themes etc.
3) Kunskapsporten and its different elements – how does the platform work, how are the different tools interlinked etc

In addition the schools within the KED program collaborate in different ways, offering teachers joint meeting a couple of times per semester where experiences and good practices can be exchanged.

What impact is it having?

The web based platform Kunskapsporten is at the heart of the educational offer of all schools within the KED program providing a methodology and content that facilitates a personalised learning approach for both students and teachers. For teachers, as well as for students, the platform has facilitated the transition to remote online teaching during the Covid-19 crisis[1].

[1] In Sweden only upper secondary schools were closed.

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2. Tablio: adapting to different learning profiles with Classkick

Background

The Erasmus+ funded Tablio aimed to strengthen teachers and schools in realising classroom differentiation and inclusion by the means of tablets and other mobile devices. The project outputs were developed between 2017 and 2019 focusing on design thinking and methodology.

Classkick was one of applications used in the Tablio project. Classkick is a digital formative assessment tool that allows teachers to create lessons and assignments that students work through on their devices at their own pace. By observing student progress in real time teachers can better understand which students need more assistance and provide more personalised feedback.

In this example Classkick was used in a group second grade vocational education students (specialising in sales) in Brussels. The group was diverse both in terms of student achievements, social background and ethnicity.

How was technology used to support personalisation?

Content differentiation

The Classkick app makes it possible for the teacher to prepare different assignments for the students, and allows students to complete the assignments in preferrable order and in their own pace. In this way students can tailor their learning experience to their own abilities and preferred method of working. Assignments in the app can be set using text, audio or a combination of the two and students can choose to read or listen to the task. The app also allows supporting content to be imported from other tools, such as Mentimeter and Padlet.

Teacher supervision and process differentiation

The app facilitates teacher supervision as they are able to see which tasks students have been finished and which are being currently worked on in real time. By closely observing the quality of completed work teachers can allocate support and assistance accordingly. Students can also as ask for help in the app by raising their hand virtually.

Feedback

Classkick allows teachers to respond to student requests in-app by means of a message which then appears on the student's device. As with assignments, feedback can be offered in a variety of ways, including text, stickers and audio. The app also has a functionality for peer interaction/support. Students can ask questions anonymously and classmates can answer them. This functionality was however turned off in the Tablio case study.

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What training was needed to implement this practice?

An understanding of the functionality and capabilities of the Classkick app (the app was reported to be very user friendly) was necessary, along with knowledge about differentiated learning.

What impact is it having?

After the initial class trial, Classkick was rolled out into other classes. Feedback from teachers stated that:

- The app helped students to manage their own learning and make their own decisions.
- Students were able to work at their own pace and complete assignments in the way that best suited them.
- The mixed-media assignment options made tasks accessible to students with special or additional needs.
- Question-driven feedback and the teacher overview of student progress were seen as positive.
- The app was very user friendly.
- The threshold was lowered for introverted students (for instance through the virtual hand-raising capability).

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3. Sneijders School and Bordfolio: co-creating a digital portfolio

Background

In 2015, Snijders primary school in Rijswijk, near The Hague, decided that it needed a digital portfolio to replace its paper portfolio system that often fell apart or got lost. Teachers at Snijders school worked together with the company Bordfolio for five years developing the product to meet the needs of the school. New features and tools have been developed within the platform over that time, from the initial ability to upload photographs of children's learning to a feature enabling teachers to set assignments for children. Teachers at the school liked the way that the developers worked with them, having found that other companies making digital portfolio products didn't ask teachers about what they wanted in terms of functionality. They also reported that some other portfolios had too many options, for example, having to make 10 clicks before being able to upload a photo.

Good communication between the school and the company has been a success factor. Rather than coming up with new features that they think teachers will want, the Bordfolio team always tests the idea first with the teachers and gets feedback about what is and is not useful. The company made the product freely available to schools during the Covid pandemic and received lots of feedback which has been helpful for future development. Teachers report that the product always works during school hours, with the company scheduling development work for other times.

How was the technology used to support personalisation?

The digital portfolio is an important part of the school's approach to developing children's independent autonomous and personalised learning. Each day the child logs into the portfolio and chooses what activities they would like to do – for example, from three options such as sand, playing with blocks, doing maths with a teacher – and records these within the digital portfolio. Teachers are able to monitor the choices that children make, talk to them to find out why there are gaps in the activities that they choose and address reasons why, for example, a child may not go to a certain space in the school to do activities there. In this way they use the portfolio to have in-depth discussions with each child, for example, finding out if a child doesn't want to work in a certain classroom area because they are afraid, they don't like the teacher or their friends aren't working there.

Children ask teachers to take pictures for their portfolio and tell the teacher why – they may be proud of what they've done or want to show how they have improved what they were making. The teacher writes down the child's explanation and this is an important part of the personalisation process.

Each activity is tagged with a learning goal which is part of the school and national curriculum. These include objectives such as 'I like to learn, thinking in small steps, being creative, I can learn new things, I can read a story.' Having the learning goals as tags to be selected makes it much easier than a paper-based system.

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Teachers reported that ownership is a key advantage of the digital portfolio approach. The portfolio forms the basis of discussions between children and teachers and children and parents and have found that the children are more open and talk to their parents and teachers about their learning more. Photographs in the portfolio are used as prompts to help children explain their learning, for example what happened, why they liked an activity, what they want to learn next.

During the Covid pandemic home learning period, the developers made a number of changes at the request of teachers at the school, such as enabling videos of teachers explaining to children how to do the assignments. Teachers used these explanation clips to connect with pupils to explain what was involved in an assignment, which helped take some of the pressure off parents (de Heus, 2020). Another change made during this home learning period was to improve the comment functionality so that children are notified when they log in if there is a comment or feedback on their activities they can access.

What were the training needs for implementing this practice?

The developers at Bordfolio had a clear intention to make the entry level for using the technology very low and so little specific training was needed at a technological level. Teachers and children find it easy to use.

What impact is it having?

Parents have seen the benefit of the school's approach to learning through active engagement with the portfolio. While some parents find it difficult at first not having grades, they enjoy seeing the positive evidence of their children learning within the portfolio.

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4. Studi.se: opening up the multilingual classroom

Background

With around 10 million inhabitants, Sweden is a relatively small country. During 2015, Sweden received 163,000 refugees, mainly from Syria, Iraq and Afghanistan. Among them, approximately 70,000 were under the age of 18 years and around 35,000 were unaccompanied children, primarily from Afghanistan. Due to tighter border controls throughout Europe and stricter refugee admission policies in Sweden, the number plummeted to 30,000 refugees in 2016, of which 10,000 were children. Today more than 2 million inhabitants of Sweden were born abroad, and more than 600,000 are second generation immigrants, with both parents born abroad. This multiculturalism has affected everyday life in Sweden, not the least the educational system which is obliged to offer a school placement for asylum-seeking students within a month of their arrival to Sweden. Traditionally, newly arrived students were placed in introductory or separate classes (*förberedelseklass*) for a period of two or three years but, from 2016, a new set of proposals were adopted for compulsory education which means that students can be partly educated in introductory classes (although it is not mandatory) and thereafter, if needed, a school must provide the student with special educational support while they attend the regular classes. (Bunar, 2017).

In practise this means that there can be more than 20 different mother tongues spoken within one school and that one teacher has to handle classrooms where many of the students speak little or no Swedish at all. Studi.se originates in these challenges.The initiative started in 2014 when the company adapted content from three subjects (chemistry, biology and religion) into short animated videos translated into arabic. The material was then tested and evaluated in 20 schools of 12 municipalities. The results were promising, showing that it is possible to teach migrant students all subjects even before they master the language of instruction. Students learn faster and are more motivated when they can use their full cognitive capacity even though they are not fluent in Swedish.

The concept of short animated film/lessons accompanied with quizzes in different difficulty levels has been scaled up to all eleven subjects; mathematics, physics, chemistry, biology, Swedish, social studies, history, geography, religion, English and technology. Complicated contexts are explained in a humoristic and simple way. Both audio and subtitles are available in Swedish, Finnish, English, Arabic, Somali, Dari, Tigrini and more languages are to be introduced. The content targets students in year 7-9 (age 13-15) but as the videos explain complicated things in a easy way, they are used by both younger and older students. In comparison to other more traditional teaching material, Studi.se is considered among teachers to have a less Western-oriented approach.

Studi.se is also available in Germany and Canada under the name Binogi and there are plans to apply the tool in refugee camps where education is often put on hold.

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How was technology used to support personalisation?

The tool makes it possible for all students, independently of their mother tongue, to participate in ordinary teaching. By using the videos for flipped classroom settings students can prepare for class in their own language and they can also choose different subtitles. It also means that students can self-pace their engagement with the material in different subjects. Each film is accompanied with a quiz in three levels of difficulties, which makes differentiation in assessment possible. Teachers have a possibility to follow students performances and use the tool for differentiation and personalisation. .

In this example, a lower secondary school in Norrköping, Studi.se is frequently by many teachers in many different subjects. Most of them use the video content as a starting point/introduction to various subjects (such as literature, maths, chemistry, Swedish) and in flipped classroom situations (through Google Classroom) so that students can watch the videos as many times as they need to.

When used in whole class introductions (and presented through a Smartboard) the teachers discuss the content with the students, relating it to other sources and discussing key elements. Students then have different options to work with the material. Some need more time to understand the content and will review the videos in their own languages. Others will try out the quizzes that come in three levels of difficulty. The quizzes encourage students to assess their learning in a playful way, while encouraging differentiated learning based on their level of understanding. Teachers often assess the learning through the quizzes. There is a gamification aspect built into the tool, meaning that each student collects points after each test.

The tool also give students access to all material and they can see their progress and what they have done on their individual pages, following their learning path. There is additional support for students with special needs through, for example, speech synthesis and sign language video.

What were the training needs for implementing this practice?
The resource is said to be easy access and use by both teachers and students. Teachers need to understand how to share the videos and how students have been using the material and responding in the quizzes. The tool offers guidance material for teachers and there is a FAQ section that is constantly updated.

More importantly than understanding how the tool works, teachers need to change their mindsets about working with flipped classrooms, differentiated teaching, learning analytics and foremost teaching in a multilingual classroom. In Norrköping this has meant that all teachers, from preschool to upper secondary, have received training in the methods and

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approaches of ‘content and language integrated learning’ (CLIL). These approaches have been implemented in all schools in order to improve teachers' knowledge and understanding of what it means to learn Swedish as a second language and how to create equal conditions for all pupils to obtain knowledge in all school subjects.

What impact is it having?

Studi is strongly interlinked with ongoing research involving users in more than 70 Swedish municipalities and conducted by a network of research groups from different Swedish Universities. No official results have been released yet on the efficacy on students learning however many testimonials from users (teachers and students) all over Sweden indicate that the tool supports learning and motivation in different subject for many students in particular those that previously were struggling with the language.

Although the initial focus of Studi.se was to integrate newly arrived students in ordinary classes, the content has turned out to be very popular among all students, in particular students that struggle that normally have a hard time to focus in the classroom.

During the pandemic Studi.se has been available for all teachers and students free of charge.

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5. ReflectED: developing metacognition with SeeSaw

Background

Rosendale Primary school in London has been using technology to create pupil learning journals since 2013 as part of ReflectEd; the school's Education Endowment Foundation (EEF) funded research project into the impact of metacognition on learning. In the early stages of this project pupils aged 7-11 from 30 schools, including Rosendale, used Evernote to record and reflect upon their work in Maths and English, noting any challenges, misconceptions or key jumps in understanding that they were aware of. When the project moved from its initial pilot phase into a larger scale research project, Rosendale replaced Evernote with Seesaw, which had more suitable functionality for the needs of the project and was found to be more accessible and appealing to the pupils involved. They also expanded the age range to include pupils aged 5-11, and schools from across England were invited to join the project.

How was technology used to support personalisation?

The Seesaw app was used to personalise pupils' learning experiences in several ways. The first was the way in which tasks were set; teachers are able to assign tasks in Seesaw using text, images, audio, video or a combination of these. Where a combination was used, children could choose to access the task in the format with which they were most comfortable. Video and audio footage could also be played back as required so that pupils could self-pace their engagement with the materials.

However, since Seesaw was initially used in the classroom most task setting took place outside of the app itself, which was primarily used as a platform for pupils to record their work, reflect upon it and share their thoughts with their teacher. Again, Seesaw enabled the children to do this in multiple ways; some children would hand write a reflection on paper, then photograph it in Seesaw. Some would type directly into the app, or even record their voice or a video. In this way they were able to personalise their own verbalisation of their learning processes, using a means of expression that gave them the best fluency of communication.

Part of the ReflectEd approach involves the children learning to assess their own level of confidence or understanding when they reflect upon a piece of learning. This was supported by Seesaw through the use of folders. Folders were used as a kind of tagging system to help organise posts so that pupils could filter the contents of their own journal. For example, they could look specifically at work they felt they needed further help with, or they could look back over their own explanations of concepts with which they had rated their confidence highly enough that they could help a peer to understand it. Folders were also used to organise posts by subject, so a teacher could look at all posts that were submitted into, for example, maths in a given week to get a sense of which children felt confident with the concepts covered and which pupils might need further support. Essentially, the personalisation used in

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this project enabled a kind of formative assessment in which the pupils as well as the teachers were actively involved.

What training was needed to implement this practice?

In order for pupils' reflections to be effective the school implemented a series of training sessions for staff to develop an understanding of the principles of metacognition and growth mindset. This was supported by a programme of lesson plans exploring these ideas through age appropriate activities, which the teachers delivered to classes throughout the school. This meant that the whole school community developed a vocabulary and culture in which conversations about learning and progress were as useful as possible for the children.

In addition it was crucial that all staff were confident in the use of Seesaw and its utility for supporting the reflection process. To this end, London Connected Learning Centre supported Rosendale school with a whole school staff training session, during which every teacher had the opportunity to test the various functions of the app on both the teacher and pupil side of its interface. They were also invited to contribute to discussions about how the app would support the project, and offered ongoing support when further technical queries emerged. This helped to achieve a high level of engagement from staff in the technical implementation of the project as well as the broader cultural changes.

What impact is it having?

The results of the small scale research project were mixed, but broadly positive:

"The findings from this evaluation are mixed, but overall they suggest that the ReflectED approach is promising. The impact on maths was positive: children who received the ReflectED programme made four months of additional progress in maths compared to children who did not. However, there was an unexpected negative impact on reading: children who received ReflectED made two months less progress compared to other children. It is important to remember that this was a small project which indicates the impact of ReflectED in the schools involved in the study. Further research is required before we can be confident that similar impacts would be found in other schools. The positive maths result is promising enough that the EEF, the National Education Trust and Rosendale Primary School will explore the potential for developing the approach further and testing it in a larger number of schools."

Anecdotally, though, teachers and pupils at Rosendale have reported an overwhelmingly positive impact on the pupils in terms of their self esteem, problem solving and culture of peer support. The development of a shared vocabulary that describes pupils' feelings about their learning has enabled a more refined way of communicating the needs of individual learners and adapting subsequent teaching accordingly. A growth mindset culture has

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helped children feel comfortable identifying what help they need and asking for it, and has made them less likely to hide their feelings of uncertainty or lack of confidence.

One unexpected benefit of this project has been its impact on the school's adaptation to facilitating teacher-pupil communication in a remote context during school closures in 2020. Because pupils and teachers across the school were already familiar with the platform and technical setup decisions had already been made at a senior level in the school, teachers were able to quickly establish a dialogue with their classes. They could send regular morning messages, broadcast whole school assemblies, set home learning tasks, receive responses from pupils and provide tailored feedback on pupil posts. This context made Seesaw's capacity for personalisation even more important; teachers could send messages and set tasks using the most appropriate combination of media for their specific pupils, and pupils could engage at their own pace and respond in the way they were most comfortable, drawing on parental support when needed. Teachers were able to get a sense of which pupils were struggling to adjust to this new virtual classroom environment by noticing which pupils responded least frequently or fully. Analytics were used to monitor engagement; the number of posts made per week regularly reached as many as 10,000. Families were contacted in order to establish whether any lack of engagement was due to accessibility issues with the platform itself or due to other factors, such as limited access to technology or internet connection.

As such, in this instance the personalisation necessary to ensure the best learning experience for every pupil was not just about the pupils' learning needs and preferences, but also involved social and cultural factors. Teachers had to cater to a broad range of needs, many of which could be met within the limitations of the technology, but some of which required further intervention. The crisis clearly presented a huge challenge for educators across the world, but stories like Rosendale's may help us learn lessons we can apply in traditional contexts as well as in times of crisis.

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6. iRead - fostering literacy through personalised apps

Background

Literacy is a critical foundational skill that shapes educational attainment, integration in social life and future employment opportunities. Illiteracy is not just a problem for developing countries. In England, 25% of young adults have poor literacy compared with an average of only 9% in the top performing countries in Europe. Within compulsory education, about 1 in 10 children are struggling readers who are unable to master decoding as it is traditionally taught, as a result gradually being left behind in the classroom despite their potential. According to the International Dyslexia Association 74% of 8-year old students who are poor readers will remain so when they reach the age of 14, prompting policy makers to argue for early intervention.

iRead is a large scale 4-year (2017-2020) research project funded by EU H2020. The project involves interaction and game designers, educational researchers and industry partners from across industry and education in 8 European countries working together to develop tailored technology that supports primary school children in becoming confident and skilled readers including children with dyslexia. The work is organised into three strands:

1) *innovation* - to fast track the development of technology for new industry players in the arena of literacy and language learning through an open, scalable, cloud-based software infrastructure, consisting of open interoperable components, which features user modelling and incorporates reading-skills related domain knowledge and resources, to personalise technology for children learning to read.

2) *design* - targeting schools, IT pedagogues, elementary/primary school teachers, language teachers, special education teachers, remedial teachers, parents and researchers this strand includes the creation of personalised and adaptive literacy games, interactive e-books and a e-Reader app.

3) *evaluation* - evaluation is done in mainstream settings, inclusive classrooms, urban and rural schools, special education provision and foreign language schools, each of which respond to different educational problems, conditions and learners. The project looks at aspect of differentiated implementations and at how the implementation works across different cultural and educational contexts.

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How was technology used to support personalisation?

In iRead, personalised learning is supported by two teaching tools: the NAVIGO literacy game and the AMIGO eReader application.

NAVIGO literacy game

Navigo is a game designed for supervised use in the classroom and home learning. It covers the first three to four years of learning to read across the primary curriculum, while it is designed to cater to older struggling readers. The game is available in English, Spanish, German and Greek. It is also developed to teach children learning English as a foreign language. The game is based on a personalised approach that adapts to different learners in accordance to a structured and systematic progression through the games.

There are 16 game mechanics and more than 900 games available, which means the child can practice a language feature through different game activities; promoting transferability and consolidation of learning. In addition to the breadth of material, the game design is based on research that shows there is a gradual learning journey that starts from children (i) recognising and applying the correct linguistic rule, (ii) moving to using and combining different linguistic rules to bring together smaller units of words such as graphemes or morphemes to build a correct word (blending and segmenting) or rearrange/build meaningful sentences and (iii) ending with automatising this knowledge. This progressive view of learning to read accurately and fluently is reflected in the design of the game mechanics and how they are sequenced.

Navigo draws from a dictionary containing 9,000 words that are used in the games. This dictionary was created from existing children's literature and has been curated by reading experts to be age appropriate.

The majority of Navigo games offer elaborative feedback. The feedback is presented 'in the moment' and designed to support the child's understanding of their error, to scaffold further attempts in the game and encourage metacognition.

Amigo Reader

The Amigo Reader has been collaboratively designed through user centred design activities with teachers and students with the goal of supporting students to reinforce their literacy skills. For students with dyslexia and English as a foreign language, text-to-speech capabilities provide students with the much-needed exposure to age-appropriate vocabulary and pronunciation. Amigo Reader also offers on-demand access to word level strategies that support the process of decoding and comprehension, ensuring students are easily able to apply the skills they have practised in the Navigo Games to books and texts.

The iRead library contains hundreds of fiction and non-fiction books sourced from publishers in the UK, Spain, Germany and Greece, providing a wide selection of texts for students to choose from.Teachers are able to select any number of titles from the iRead library and

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assign them either to individual students or to their entire class. Once assigned, books appear in the student's book list, ready for them to open and read the next time they sign into the reader. The Amigo Reader incorporates a natural sounding text to speech voice, enabling students to tap a 'play' button to read along with the text highlighted at the same time. Students are also able to easily customise reading speed, size, space, font, colors, background in the reader so they can read in comfort. When a student identifies a word that they find difficult to decode, either the student or the teacher is able to add that word to the student's tricky words list. Once added to their tricky words list, students practice decoding the word to help them master it. To do this, Amigo Reader provides a wide range of functionalities for example having the word read back to them, display the word as syllables and assign an image to a word.

What training was needed to implement this practice?

There is a teacher manual to support the school use of the Navigo Game, Amigo Reader and the teacher tools that help assign games/texts. In addition the practices are piloted in England, Sweden, Spain, Romania, Greece and Germany and the CPD activities offered include teacher training sessions, class based demos, follow up training sessions with school teams and ongoing support. Schools were supported differently dependent of how they wanted and needed to adopt the personalised technologies.

What impact is it having?

The iRead apps are already being used by over 4 000 primary school students. The Navigo game received a Serious Games Society Award in 2018 and 2019, and the UK Department of Education awarded Navigo a quality mark for its pedagogical design.A large number of iRead evaluation pilots is currently underway across six European countries and the result of the evaluation are expected to be available in December 2020. There have already been published substantial amount of scientific papers and interrim reports in relation to principles of design, implementation and evaluation however there it is still to early to draw conclusion of how usage of the apps have affected the reading skills of the participating schools/ students.

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7. Snappet!

Background

Snappet! is a complete teaching platform or approach for Primary education. Students do their exercises with tablets or computers. The adaptive software increases in difficulty, with certain exercises, according to the level of the student. Normally students follow traditional instructions and after the instructions they work with the adaptive software that searches for the right zone of proximal development.

How was technology used to support personalisation?

Teachers have a dashboard that they use to set activities for the different courses (language, mathematics, reading, etc) and they can follow the progress of the students for those courses on different levels:

- Overall school performance by subject area
- Overall performance of the class by subject area
- Performance per student by subject area
- Performance per student per goal
- Performance on an exercise

This opens up the way for teachers to analyse the students' performance thoroughly and that way it is possible to personalise education further. In the Netherlands it is normal to create three instruction groups based on method independent tests and/ or method tests that teachers administer every 4/ 5 weeks. Because Snappet collects data for every exercise a student makes, it's possible to follow the students formatively, live for each goal you set as a teacher.

In other words, it is possible to work in micro cycles where a teacher sets a goal, students work on that goal, the teacher evaluates the goal with the students and sets another goal. Every time the instruction group can differ.

The effect of working in small cycles, is that students that are not confident overall in for example math, have the chance to be good at certain goals. That is why a higher student motivation is experienced by the teachers.

Another benefit is that teachers receive and give 'just in time' information, when it is most needed for students.

However teachers need to have extensive knowledge about the Snappet system. That way the teacher is in full control of Snappet and not the way around. Snappet is an adaptive system, and in some cases it makes choices for the teachers, if they are not mindful about their teaching. An important task for the teacher is to do data analyses every day, every week and every month, and to compare different sets of data (Snappet data, method-independent test data, observations, etc), in order to make informed decisions for the best

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student route through the curriculum. There is more data to work with, which can be a good thing, but it makes data analyses more complex.

What training was needed to implement this practice?

Multiple years of training were needed at De Kringloop (PE School). The first objective was to get to know the system better: how does the adaptive software work? How does the dashboard work? And even simpler questions for some teachers: where can I find my lessons, how do I prepare them and how do I send them to the student computers?

After that, there was more specific training about mathematics and language in combination with Snappet, and especially about analysing the data and how to work in small lesson cycles.

At this moment, individual needs are met with personal training programmes provided by Snappet. Also, every in staff meetings staff discuss Snappet (eg problems, opportunities, Snappet software updates, etc).

What impact is it having?

Snappet has became the core system for education at De Kringloop for 4th to 8th graders. The team has been brought the team together, because they needed to build and learn more about a new way of working. In some cases there is also resistance to change, as some teachers find it hard to grasp the total potential of Snappet and best utilise it as they wish.

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6. Tech roundup

This section summarizes promising digital technologies which are currently being widely used to support personalised learning as well as those with potential to support student learning in the primary and lower secondary phase of school. More now subsequently available on the

Amigo Reader and Navigo

An e-reader app for primary-aged children, designed to apply and enhance reading skills. The app offers child-friendly and adjustable large text, colourful icons and text-to-speech. Accompanying Amigo Reader is Navigo, an app offering reading skills games that adapt to learners as they go. Based on Navigo performance, Amigo Reader recommends personalised pre-reading activities. See case study six, above.

Blutick

AI-powered mathematics for ages 11-16, currently free to schools and individuals. Covering the full secondary mathematics curriculum, Blutick enables tasks to be set easily and marked automatically. Students include their working and the AI tool gives immediate, individual, line-by-line feedback, identifying mistakes as they happen and guiding students towards solving problems. There is detailed reporting for students, parents and teachers with information on progress and areas deserving focus, together with more than 500 videos featuring mathematics teachers explaining each topic in short chunks, and videos for parents that explain the mathematics and how they can support their children.

Canvas LMS

Claiming to be the world's fastest-growing learning management platform, Canvas can be integrated with other digital tools, enabling each school to build a bespoke digital learning environment. It supports the pedagogical concepts of the school and enables teachers to share each other's courses and best practices. Teachers can personalise learning in several ways, differentiating tasks at different levels for different students (only visible to that student). Learning analytics give insights into progress at individual and group levels, with the progress of each student transparent to teachers, the student and parents.

Century

A teaching and learning platform that identifies gaps and misconceptions in individual students' knowledge and uses AI to provide personalised responses. Teachers use Century to make interventions inside and outside the classroom, from flipped learning, homework and SATs revision to lessons and tasks for breakfast and after-school clubs, golden time and lesson cover. Century creates constantly adapting personal pathways and micro-lessons to address gaps, provide stretch and challenge, and promote long-term memory retention, saving teacher time through automated marking and thousands of resources that support planning across years three to 11. Dashboards offer analytics for students, teachers, school

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leadership and parents.

Classkick

Teachers can see students working and give high-quality feedback — from anywhere. See case study two, above.

Iris Connect

A video-based system and platform for CPD. At the core is lesson recording that captures audio and video from teachers and students, to be used for lesson observation, coaching, mentoring and practice sharing, taking into account safeguarding and security. Teachers and coaches can replay lessons remotely for reflection and coaching, and coaches can watch lessons remotely in real time in order to provide live, in-lesson coaching via an earpiece. Combining the video system with its professional learning platform, Iris Connect provides a range of resources to improve teacher CPD, from sharing, collaboration and community feedback to videos covering theory and best practice, together with free third party resources.

Kaligo

Described as a digital handwriting exercise book, Kaligo is an AI-based app that teaches students how to write using a stylus and tablet. It includes curriculum-aligned handwriting exercises, stroke analysis and AI-based, real-time correction, all allowing children to progress at their own speed and level of development, with data storage for future analysis. Teachers can create and customise exercise sequences and personalised lesson plans for individual students and learning groups, with the ability to save lesson plans for future use.

Kahoot!

A game- and quiz-based platform for group and distance learning, with more than 1bn players per year globally. Teachers can quickly create a learning game or trivia quiz on any topic, in any language, or choose from more than 30m public games and quizzes. These can be played in class on a big screen, or with a combination of screen and apps on students' own devices, and can also be shared with remote players, using apps or hosted videoconferencing. Slides and other content can be imported to help create interactive lessons, while Kahoot! reports assess learning outcomes and provide formative assessment. Personalised learning includes self-paced games, with real-time teacher monitoring if desired, and the ability for students to create their own games.

Learning by Questions

This multiple Bett award-winner offers hundreds of scaffolded question sets from KS2 upwards, enabling teachers to develop mixed-ability lessons that stretch every pupil. LBQ estimates that it takes a teacher five months to craft the perfectly scaffolded question set, while adapting, creating or picking from LBQ sets takes minutes. Once a session begins, a progress bar tells students how well they're doing and, if they're not challenged enough, the system automatically moves them up a level so that they are always learning.

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Lexplore

Combines AI and eye-tracking technology to analyse each individual child's reading skills and determine attainment, highlighting potential difficulties in minutes. With immediate in-depth results, teachers can determine what support is required by which students, far more quickly and often much earlier in their education than otherwise. Lexplore shows for the first time what silent reading looks like, offering insight into the complex cognitive processes and identifying minor differences in the way individuals process text. As well as helping struggling readers, it detects those who use coping strategies to present as confident readers.

Maths-Whizz

Online AI-powered maths tutor for 5-13 year olds, catering to individual needs and pace of learning, and used by more than 100,000 students worldwide. Automatically targeting learning gaps, Maths-Whizz claims to improve students' 'maths age' by 18 months in their first year. Curriculum-aligned, with real-time visual reporting and monitoring of each pupil's maths progress, Maths-Whizz offers resources for the quick planning and delivery of the 'perfect' maths lesson. For study at home, it starts with an in-depth assessment, builds a personalised learning journey matched to current ability and uses AI to constantly adapt each child's learning journey, targeting knowledge gaps and accelerating learning.

Mathspace

Adaptive learning system that brings a teacher's learning tools together in one place, from video lessons and textbooks to adaptive practice, and helps teachers encourage self-directed learning. It also supports the establishment of a remote maths classroom. Using Mathspace standards-aligned lessons, which include videos and hands-on GeoGebra applets, teachers can share lessons with students and access a range of student and class reports — including live reports that show which students are active and working — and can see their progress and tailor lessons accordingly. Students can show their work and receive personalised real-time, step-by-step feedback, including scaffolded hints and video lessons, no matter how they solve a problem.

Purple Mash

Enables schools to embed computing and digital skills in any subject across the KS1 and KS2 curriculum, with child-friendly tools, games, activities and thousands of digital resources for children and teachers. Purple Mash offers free home access for all students and works across a range of devices, from tablets to interactive whiteboards. Teachers can access ready-made, editable lesson plans, assessment framework, curriculum maps, whole school schemes, video tutorials and built-in CPD.

Seesaw

Student driven digital portfolios and simple parent communication. See case study 5.

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Binogi
Short, animated film lessons in multiple languages. See case study 4.

7. Design principles

The case studies of promising practice show a broad range of applications for personalisation in education, but they also provide some lessons on good practice for the design of such solutions. Drawing on these interviews and discussions with practitioners, students and educational researchers, this report suggests following a set of design principles for the use and effective implementation of digital technologies to support personalised learning. We have categorised these design principles according to levels of stakeholder; teachers, policy makers and school leaders and edtech companies. Although we have not included students as a group it is implicit that design principles for teachers have student outcomes at their heart.

Design principles for teachers

1. **Pedagogy not technology** comes first: a clear pedagogical approach should be the starting point for selecting the tool as the best one to do the job, along with iterating and choosing new tools as tech affordances change. Using digital technologies in the first place. Teachers need to be convinced about the benefits of using technology, how it fits with their pedagogic approach and most importantly whether there is evidence that it will lead to better outcomes for the students they teach.

2. **Engage** families to explain the pedagogical approach and how the technology supports it. Identify where there is a lack of access to any necessary software, hardware or connectivity.

3. **Support**: personalisation is something that students need to learn and master, as well as educators. Some students will need more support than others in learning how to plan their knowledge journey.

4. **Develop** a professional learning community connected by a shared commitment to improve student outcomes. Technology has the potential to connect teachers to experts who can support them in making the most of digital approaches, as well as to communities of teacher peers. Teachers need to learn from colleagues what best practices in using digital technologies for personalisation look like. A professional learning community may be online as well as within school.

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5. **Dialogue** between educators and the developers of digital tools and platforms helps to ensure that they are aligned to teacher and student needs. Where offered, teachers should grasp the opportunity to have input into the development of products.

Design principles for policymakers and school leaders

1. **Buy-in** to the school's personalisation strategy or project from the top is essential. For personalisation to be a success it needs to be at the core of your organisation.

2. **Understanding** of digital strategy and how digital technologies can support and transform learning will establish a clear direction for personalisation using digital tools.

3. **Support** from school leaders for professional development directly affects its impact on classroom practice. The encouragement and commitment of school leaders to professional development supporting the use of digital technologies is key and underpins the values and messages promoted in training.

4. **Engage** the whole school community to develop a shared vocabulary and culture around your personalisation strategy. Give every teacher the opportunity to test technology and contribute to discussions about how it will help this strategy.

5. **Accessibility** tools and features can benefit all learners, not just those with a demonstrable need for it so avoid limiting the use of adaptive or assistive technology or accommodations that could have a wider application.

Design principles for edtech companies

1. **Communication:** Establish good communication channels with teachers to understand requirements. Do teachers need the functionality you are providing? What do they need, if not? Keep the communication channels open once the product is in place so that it can evolve based on teacher requirements, experiences and feedback. Communication will often need to involve different levels and groups in a school; teachers, senior leaders and technical/admisitration.

2. **Flexibility:** Understand that schools are not homogenous. They have different needs and different processes. You will need to balance each school's need to adapt your product with your need to create a product with common features. Talk to different schools to discover the common needs.

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3. **Simplicity:** Keep it straightforward and user friendly. In general, teachers do not have time to learn or use complicated additional systems. Any child-facing interfaces need to be age appropriate and every element must comply fully with all privacy and security regulations and guidelines.

4. **Clarity:** Provide straightforward training, instructions and guidance that are as useful as possible with FAQs and examples.

5. **Patience:** Allow enough time in free trials for schools to test the product, find out about it and ask questions. Schools are busy places and this might take longer than you think. If a school's trial account expires, consider allowing more time, within reason.

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