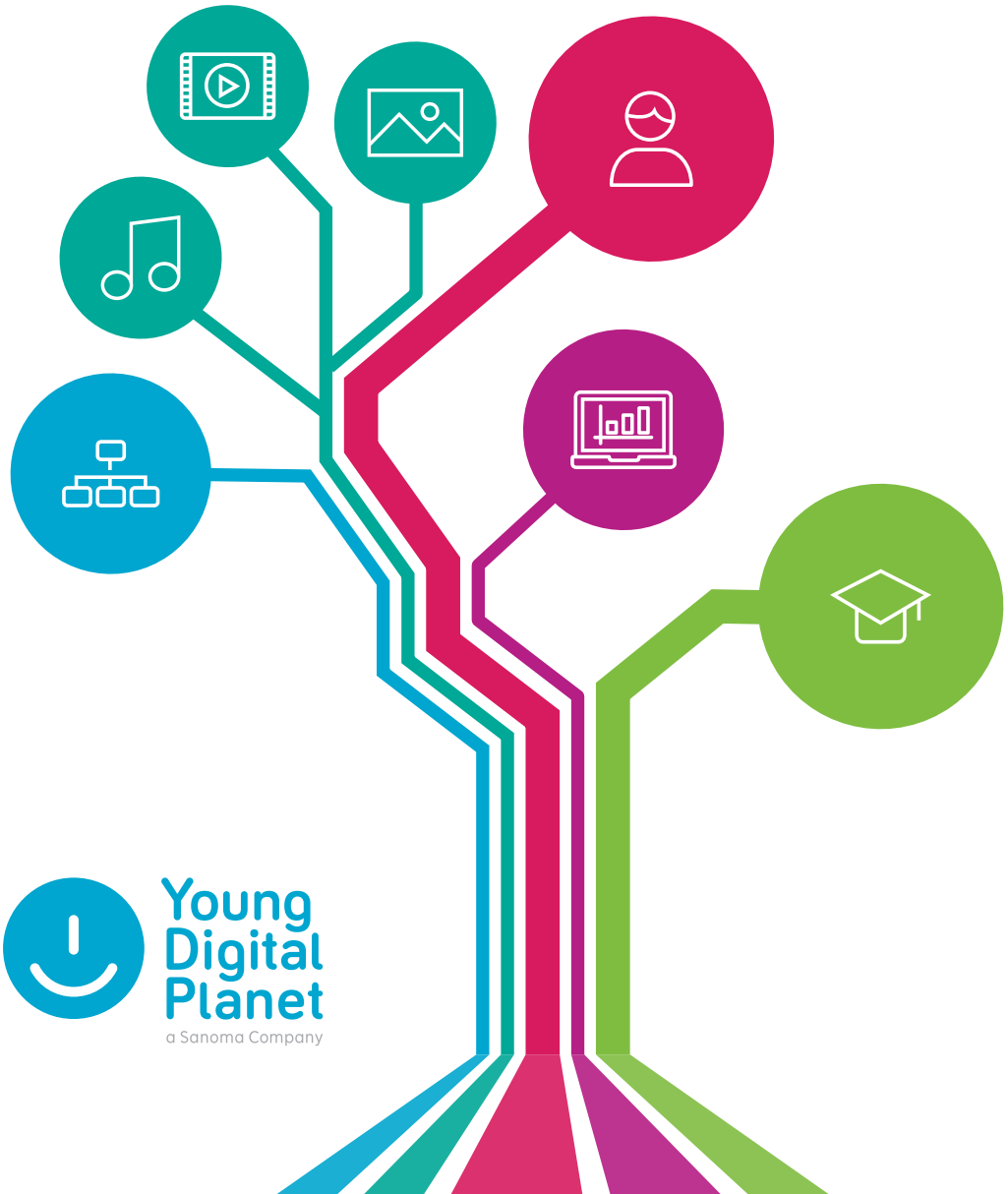
The Value of Technology in Education



Young Digital Planet

a Sanoma Company

About Young Digital Planet

We provide tailor-made digital educational solutions built around our content and delivery platforms, designed in line with the latest trends in education. We base our strong industry expertise on 25-year market presence. Our products are used in almost 45 countries by educational publishers, ministries of education, school chains and ICT companies.

We are a part of Sanoma Learning – an educational division of Sanoma – a front running consumer media and learning company in Europe. Sanoma is the market leading media company in Finland and the Netherlands, with a broad presence across multiple platforms.

Our solutions incorporate customisable and flexible products:

- educational content covering different subjects, curricula, and language courses,
- delivery platforms, e-learning, and publishing technologies,
- products that support children and adults with special educational needs at schools and medical institutions.

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The Value of Technology in Education

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Foreword

Visions, trends, and ideas for implementing technology in education are abundant. Still there are few comprehensive publications combining pedagogy with practical aspects of implementing technology.

The following report gathers what we believe are some of the most important aspects of technology implementation in education, backed with success stories, for publishers who want to go digital. We want it to serve as a guidebook and food for thought. It can be read as a story from chapter 1 to 7, or in snacks, depending on your specific area of interest.

Enjoy the read.

And let us know your story.

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Executive summary

Proliferation of technology in education has been undeniable in recent years, however the results of introducing technology to education are mixed at best. Publishers who have invested in digital technology without thoughtful consideration of the way it will be implemented and used have not been successful. Oftentimes the reality of public schools (hardware, software, Internet access, habits, attitudes, readiness) proved to lag behind the visions of policymakers and technology evangelists.

If you are reading this report, you are still probably asking yourself the question, "Is it worth to invest in digital technology in education?" We say, "Yes."

The present paper is based not only on our experience in implementing digital educational products in Poland but also on considerable research into digital educational projects by renowned researchers like Benjamin S. Bloom and Sugata Mitra, publishers like Pearson, software providers like IBM and Knewton, and reports by OECD and the World Bank.

We have found that combining technology with a new technology-based pedagogy brings effects which are not yet measured by standardized testing, but are critical as far as the development of 21st century skills is concerned. These are:

- a boost in student engagement, agency, collaboration, and organization,
- effective teacher organization, more student-time, more meaningful, individualized instruction and feedback, and higher on-the-job satisfaction.

What is more, with purposeful use of technology publishers may gather information about their content and users on a scale never seen before. This data can be used to design and target products and services with higher precision and less guesswork.

1. Technology is here

In 2015

- 72% students in OECD countries use computers at school
- market of teaching and learning solutions is worth 52,8 bn USD
- there are over 3000 e-learning companies in Europe

But still

- impact of technology on education delivery remains sub-optimal
- educational software and courseware lack quality
- there is insufficient support in the face of psychological, social, and cultural barriers

1.1 Edu-tech market

Will governemnts still invest in digitizing education in the near future or will they reduce their subsidies, and how will that affect traditional publishers who refuse to go digital?

Technology is present in many schools around the world. In some countries this means interactive whiteboards, computers, and internet access in almost every classroom. In others, where schools are not so well-equipped, students and teachers still have access to technology on a daily basis by means of their own devices.

- 72% students in OECD countries use computers at school.
- There is one school computer available per 5 students (on average).
- Students typically spend over 2 hours online every day (school days and weekends).[1]

The number of internet users has grown 870% since 2000 reaching 2.4 bn users globally. This is an unpreceded change in how people access information and interact with the world.[2]

- In 2015 the market of teaching and learning solutions was worth 52,8 bn USD.
- The value of the LMS market was estimated at 2.5 bn USD in 2013, rising to 7.8 bn USD in 2016.
- There are 2.4 bn internet users worldwide.[3]

Digital education is developing everywhere. In Europe, there are over 3000 e-learning companies, and global expenses on e-learning reached 20 bn USD in 2015 alone.

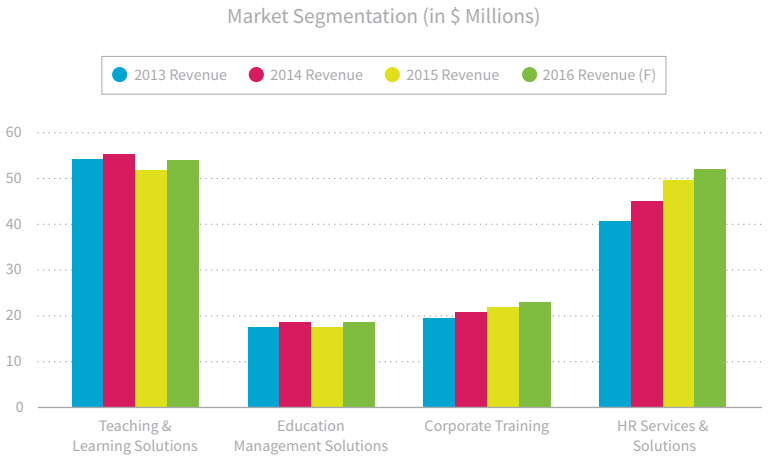

Fig. 1 Educational market segmentation 2013-2016

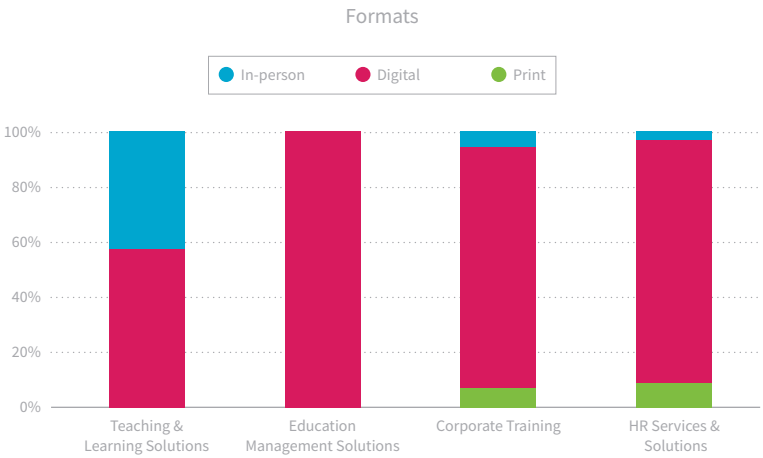

Fig. 2 Print, digital and in-person format used in education

But despite the incredible budgets spent by governments and countless initiatives proposed by technology evangelists, only a few edu-tech projects have brought measurable outcomes and tangible benefits.[4]

For instance, David Laws, the ex-Minister of State for Schools in the UK, opened the London Book Fair 2016 with the observation that in the developing world the earlier focus on expanding access has now largely been replaced by a debate on how to improve quality.

1.2 Technology is not the panacea

After the first rave about technology, we have come to realize that technology alone is not enough:

> *The reality in our schools lags considerably behind the promise of technology. (...) The results show no appreciable improvements in student achievement in reading, mathematics or science in the countries that had invested heavily in ICT for education. And perhaps the most disappointing finding of the report is that technology is of little help in bridging the skills divide between advantaged and disadvantaged students.*
>
> *"Students, Computers and Learning", 2015*

Hypotheses on the insufficient – compared to the expected – effects of introducing technology to schools, formulated by Andreas Schleicher (Director of OECD Directorate for Education and Skills), mostly point to lack of thoughtful choice of technological tools.

> *The impact of technology on education delivery remains sub-optimal, because we may overestimate the digital skills of both teachers and students, because of naive policy design and implementation strategies, because of a poor understanding of pedagogy, or because of the generally poor quality of educational software and courseware. (...) Results suggest that the connections among students, computers and learning are neither simple nor hard-wired; and the real contributions ICT can make to teaching and learning have yet to be fully realised and exploited.*
>
> *"Students, Computers and Learning", 2015*

At the same time multimedia are just beginning to be a source of revenue, and most publishers still see the digital as an investment in the future, not their core business.

What economic and political conditions should be met to make revenues from digital education exceed revenues from print for education? Is such a situation possible?

Thus, digital learning resources are offered only as an addition to the coursebook and not a standalone product.

On the other hand, revenues from the digital in more advanced economies like Denmark, France, and the USA are already as high as revenues from print. Publishers on these markets become the trendsetters, and their experience paves the way for a more thoughtful introduction of technological tools to education.

> *Now digital products are as good as paper-based products, they stand by their own feet, but five years ago it wasn't like this, they were additional and for free – like website supporting the book, you pay only for a book.*
>
> *GFK study report for YDP, 2016*

Undeniably, the role of government funding in developing a good technological infrastructure in schools and driving the need to create and make use of digital resources is crucial. However, even without such an incentive, and no plan for making them the basic source of income, multimedia may still become the leverage for publishers' marketing success.

A leading Polish publisher used high quality 3D animations as an element of their marketing campaign for a new series of high school course books. The multimedia assets explained concepts teachers found difficult to present using traditional methods. The campaign proved a success and the publisher's market share in the relevant subjects soared to over 70%.

1.3 Barriers for using technology

Benefits of using technology in education may seem obscure because of numerous obstacles, misconceptions, and habits. Taking these barriers into consideration is crucial for designing a realistic strategy for a meaningful technology implementation.

Access to technology has been a sore spot since its introduction to education. It was deemed to be the detrimental factor that would deepen the divide between the privileged and the disadvantaged. At first access was defined as “having a chance to use the devices,” later it became clear that access to the Internet is as important as the device itself.[5] Practice shows that even when students have access to the devices and the Internet but they lack technological knowledge and support, they will not benefit much from technology. What is more, if students know how to use the device but no quality content has been uploaded onto it, then learning might deteriorate into mindless clicking.[6]

How can a publisher ensure the quality of digital content and tools they offer? Should Ministries of Education be involved in quality control?

Children growing up in stimuli-rich environments where education is highly appreciated and well-scaffolded will be able to properly interact with technology even when they are given access to it at a later age. In contrast, when children with limited cultural capital and disadvantaged social background receive access to technology, they rarely use it for developmental purposes. In this respect technology may be seen as not beneficial at all. In such cases, it becomes even more important to teach kids how to interact with technology in the way that will benefit them instead of taking away their valuable developmental time.

Sugata Mitra in his initial project "Hole in the Wall" in India seemed to have discovered that children can learn completely on their own if only they are provided with Internet access. Later it transpired that his thesis had been invalid. The project took place in slums where computers were placed in kiosks and children could use them freely. The kids were so eager to try the newly planted device and had nothing better to do, so some of them spent a lot of time exploring it and then teaching others. Sugata has revised his approach several times since then providing

scaffolding, guidance, and focus (see his SOLE project and the Schools in the Clouds).[7]

How can publishers address the issue of unreliable hardware in schools? Should content be adjusted to the available devices, or should it be designed for modern/future devices? Can the BYOD trend be of service?

Another aspect worth considering is whether access is meant to be physical only or whether psychological barriers, like fear of novelty or resistance to change, should be included in this group. We need to bear in mind that some teachers are afraid to use technology in the classroom thinking that they will never be as tech-savvy as their pupils. Others use technology on top of their regular paper-based scenarios, instead of integrating it – and complain of lack of time. It is true, though, that there are schools where access to technology still means working on old, slow PCs and poor quality content, which does not allow the teacher to make the most effective use of the lesson time.

We can observe that top-down implementation of technology will seldom bring positive results. Such implementation tends to be very superficial, reduced to doing the required minimum. Without understanding and embracing technology by headmasters and teachers, it is difficult to talk about a successful implementation.

Thus, traditional pedagogical approaches devised for 19th century mainstream education need to be rethought in order to integrate technology with the learning processes. The new pedagogy cannot see technology as just another centrally-imposed, time-consuming obstacle to teachers' work.[8]

In 2013 all public schools and preschools in Turkey received a total of 620,000 smart boards, while tablet computers (with e-books) were distributed to 17 million students and approximately one million teachers and administrators.

Project Fatih gave equal access to technology in all public schools in the country. Unfortunately, apart from hardware distribution it did not entail teacher trainings, consideration for the teacher day to day work, or measuring the effects of the project on learning outcomes.

How can the fear of novelty and resistance to top-down reforms be overcome? What can a publisher do to help headmasters and teachers to embrace technology?

These barriers combined with widespread availability of technology result in an increasing digital use divide. This complex phenomenon is influenced by students' cultural capital and socio-economic background as much as it is shaped by curiosity, persistence (among other executive functions), literacy, and digital skills. Therefore, it is crucial that schools become places where comprehensive development is provided and monitored. This requires integration of technology into everyday learning activities.[9]

2. Implementing technology

- Never force feed technology
- Start with small steps
- Train and support teachers
- Engage parents
- Build student agency

2.1 Role of technology

> *It's important to never force feed technology – if it's not supplementing what's already happening in the classroom or a teacher's goals for the school year, the addition will become more of a barrier to learning than a catalyst.*
>
> *Elise Ecoff, headmaster, 2015*

What is the potential and what are the drawbacks of introducting technology to education from a publisher's perspective?

Implementation of technology has the potential to bring a change in class organization and pedagogical approach, therefore it is vital to understand where technology can alleviate problems and not be a hindrance or a gadget.

Replacing traditional materials and approaches with their digitized versions may do more harm than good. For instance, taking notes on a laptop is less efficient for the learning purposes than taking notes by hand, which forces the learner to elaborate the information, since most of us write too slow to note verbatim what is being said.

> "I felt like I'd gotten so much more out of the lecture that day," says Mueller [commenting taking notes by hand], who was working with a psychology researcher Daniel Oppenheimer at the time. "Danny said that he'd had a related experience in a faculty meeting: he was taking notes on his computer, and looked up and realized that he had no idea what the person was actually talking about."[10]

If we look at technology through its deep pedagogical and organizational benefits, and identify problems at the level of causes rather than tools (learning materials) then we are on the right way to find the place of technology in education.

In the present study we focus on five areas where technology may support headmasters, teachers, students and parents. These are:

- Technology influences organization
- Technology enhances learning resources
- Technology drives didactic approach
- Technology enables personalization
- Technology shows outcomes

The University of British Columbia's class SPAN312 contributed to Wikipedia in 2008. The teacher set his students a meaningful goal: bring a selection of articles on Latin American literature to featured article status (or as near as possible). By project's end the students had contributed three featured articles and eight good articles. During the project the students not only developed writing skills and learnt about formatting and style, they also became more tech-savvy by being immersed in technology and using it to realize the task.[11]

2.2 Small steps

Teachers familiarize themselves with technology best by taking small steps. They can start by using applications and tools which give immediate benefits and are simple to use. For example:

What other simple digital tools can a publisher encourage teachers to use so that they see immediate benefits?

Online register is very often the first digital tool introduced by schools. Although most online registers do not provide great user experience, their main advantages are: access for students and parents, and generating reports and statistics on students' progress. Using the register on a daily basis changes teacher's habits and routines giving immediate benefits.

UONET+ is a modern system to manage information about the pupil developed by Sanoma Learning's Polish subsidiary Vulcan. The software is fully online, and it combines e-register and a school office with teacher substitution system. Also, it gives parents and pupils online access to all the necessary information about the pupil progress either through the website or a mobile app. The system supports school-parent-pupil communication via a set of multiple functionalities, for example: internal mail module, push notifications in a mobile app, dedicated reports for the head teacher, and the home page with all the key information displayed for convenience.

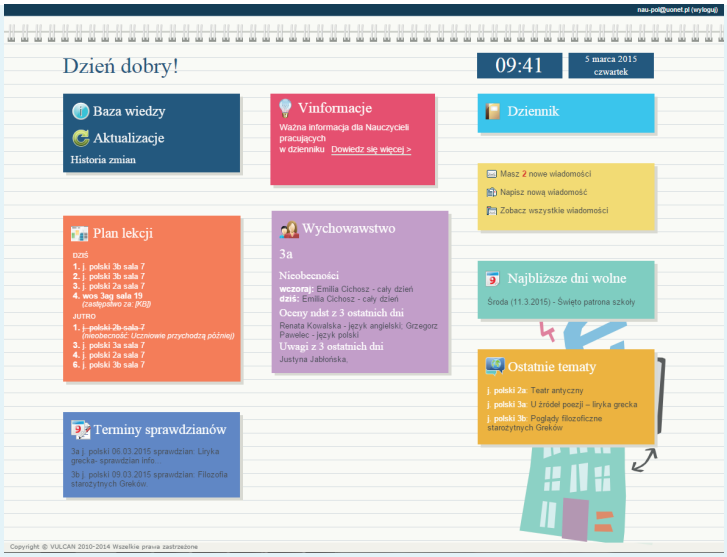

Fig. 3 Vulcan's digital register home screen

Teachers can prepare small quizzes for the whole class to engage students in a little competition – not to test them. With the aid of technology ,like Kahoot!, such quizzes can be prepared on the spot.

Another simple tool is an Excel table with filters. The table may match an external testing program with Khan Academy lessons. This way the teacher can assign activities most relevant for each student according to their grades from the last test.

How would a lesson plan need to be designed to familiarize teachers with technology as unobtrusively as possible?

A recent study[12] found that giving middle school math teachers access to inquiry-based lesson plans and online support significantly improved student achievement – benefiting weaker teachers the most. The effect on learning was about the same as moving from an average-performing teacher to one in the 80th percentile.

> *A bunch of studies that look at professional development find the effect is zero.*
>
> *[...] A 2014 review of 600 studies on math professional development for K-12 teachers found just two studies showing positive effects on students' math proficiency.*
>
> *Stephen Sawchuk, associate editor for Education Week, 2015*

Giving teachers lesson plans is also cheaper and easier to scale than other interventions aimed at improving student achievement, such as removing ineffective teachers and giving teachers incentives to put in greater effort, the study notes.[13]

Using all the above aids will not affect students' results or engagement greatly, but it will break the barrier to using technology. Once this is achieved, teachers may be more willing to use other tools.

2.3 Supporting teachers

Practice shows that disseminating the benefits of digital education requires involving teachers on several levels. Teachers should be supported in four areas:

- technology (how to use computers, whiteboards, software etc.),
- pedagogy (how to use technology for didactic purposes),
- organization (who to contact when difficulties arise),
- lesson plans (lesson scenarios and materials to use in class).

How can teacher's needs be addressed? And can they be addressed with the use of technology more effectively than by other means?

All these aspects can be tackled during teacher training sessions and with the help of school IT administrators but also through practical application – by simply following ready-made lesson plans with guidelines, tips and tricks.

Numerous studies on teachers' needs and the reports of publishers introducing digital products all conclude that without training and support for teachers there is no chance of success.

A regional platform for teachers in one of the voivodships in Poland was designed with a series of teacher trainings as part of the implementation process. YDP and the platform administrators trained over 600 leaders (teachers who would support their colleagues in using the platform; there was one leader per school) and several thousand teachers. A helpdesk line was opened. This way, after their initial reservations, teachers began using the platform. The whole project proved a hard-earned success and received numerous prizes.

As a result, didactic classrooms were created in all teacher training centres in the voivodeship and mobile didactic classrooms were created in schools. In these classrooms teachers test modern didactic methods and attend trainings to develop the skills and competences for using the platform.

Even if an e-course is well-designed and self-paced, based on a structured platform directing the student along the course, the role of the teacher is still crucial in helping the student to navigate through the material and understand the "why" of the learning process.

> *I believe the teacher is the killer app in education. A great teacher is like a great coach who can help to unlock the potential of each child.*
>
> *John Martin, Sanoma Learning CEO, in an interview with Alex Hernandez, 2015*

2.4 Engaging parents & students

Parents have different values: some care about their child's general development and happiness, others want tangible results (test scores), and still others just want their child to be kept safe. In all cases digital technology can help parents have as much influence on their child's education as they choose. Technology can facilitate teaching and learning by providing space for storing information in various formats, and offering applications which aid learning organization. It also helps to monitor achievements by showing a progress bar, providing feedback, printing reports, and suggesting next steps. And last but not least, it can be used to make a closer connection between school and home.

How strong the connection between parents and school should be? Are there any limitations?

Schoolze is a gamified platform that facilitates parental engagement with schools. It offers tools for communication between parents and teachers like instant messages, a parent conferencer, and event signup. It aims to "build vibrant school communities to support learning and student achievement".

Another tool for engaging parents are digital portfolios, which are becoming more popular as a record of student's work and achievement. They allow students to reflect on their own learning (develop meta-learning strategies) and are a channel for communication with parents.

Are there any other reasons why students do not engage with the lesson? How can they be tackled?

Even though – or maybe because – school is compulsory, student engagement is crucial for efficient learning, and at the same time difficult to achieve. Research starting from Csikszentmihalyi's concept of flow through studies on engagement in literacy[14] to specific cases like using clickers in class[15] shows that students who actively participate in their learning process have better results and a much smaller drop-out rate.

To engage students, it is necessary to understand what disengages them. Our experience shows that factors increasing disengagement and boredom are i.a.:

- lack of understanding,
- lack of context, examples of use, and application (the so called "Why do I need to learn this?"),
- lack of interest (especially when there are more attractive activities during the lesson, like chatting, games, social media, etc.).

Technology can help alleviate these problems by:

- explaining difficult aspects,
- providing context and relevancy,
- offering interactive materials, attractive design, and the possibility to change modalities (through the use of various resources).

However, one of the strongest factors building student agency is choice and social interaction. Here technology offers collaboration tools and makes learning resources available at one's preferable time and place. It also allows the student to adjust the pace and spacing of the learning activities. A good example are some of the well-developed MOOCS like those available on Coursera.

What are other ways of developing student agency that can be incorporated into the publisher's content?

3. Technology influences organization

- Change class organization to let the teacher spend quality time with each student
- Let students communicate and collaborate anytime, anywhere
- Allow teachers to store, manage and adjust digital learning resources effectively
- Boost time, task, and role management for both teachers and students
- Help the teacher monitor students without disrupting their work

3.1 Class organization

Class organization influences both the teaching and the learning process from the managerial and the didactic perspective; it also affects communication and monitoring. In a traditional classroom the teacher could control the whole class from her central place. Technology can change it by providing tools to enhance:

- Group work
  - boosting collaboration (Google Drive, MS Office),
  - aiding communication (social media),
  - helping to define roles, tasks, and schedules (Asana, Trello)
  - making it more convenient to search for, organize, modify and store information search engines, sharing apps);
- Individual work
  - adapting to individual needs (adaptive engines),
  - giving instant feedback,
  - monitoring progress (dashboards);
- General instruction (by designing instructional materials for IWB)
  - explaining issues that are difficult to explain using paper (micro- and macro-scale processes),
  - engaging the student through interactivity (simulations),
  - putting information in context, explaining why it is necessary to learn it, showing the big picture, the real-world relevancy (contextual hooks).

What are the consequences of changing class organization by means of digital tools for the publisher's content?

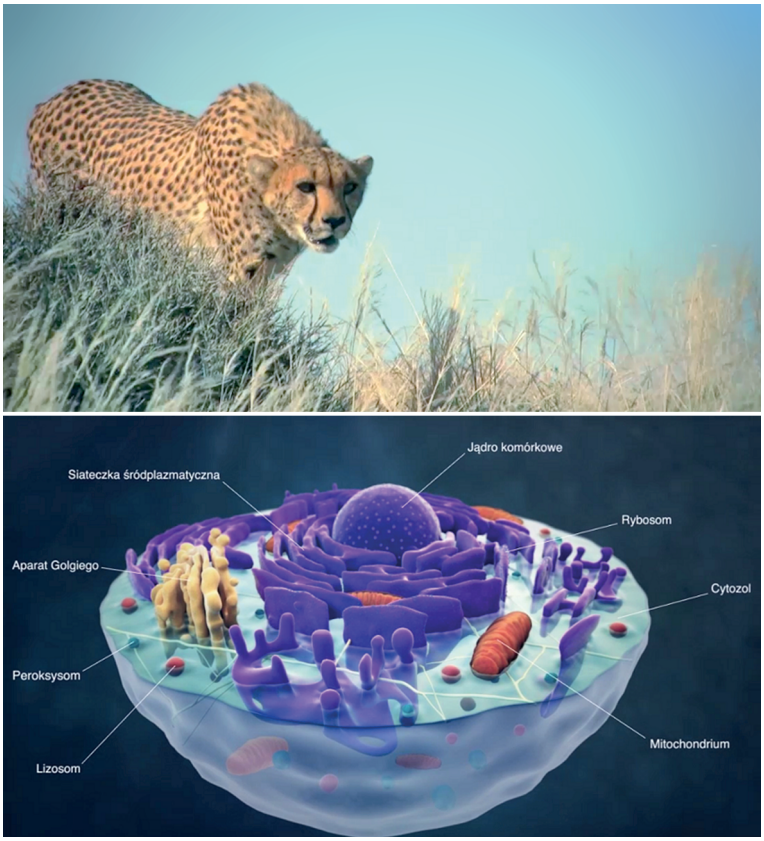

Fig. 4 Contextual hook – an animation about the structure of an animal cell opens with the footage of a leopard and then zooms into microscale

There are methods for grouping students based on numbers, colours, birthdates, preferences, etc. Grouping can be random, rotational, or designated (e.g., based on level of proficiency, where groups can be mixed either with the like ones or varying the levels to equalize opportunities), chosen by students, agreed mutually, or indicated by the teacher. Groups should be changed whenever possible not to let problem-directed discussions change into social meetings. There are applications like Team Shake which lift the burden of inventing new methods from the teacher.

At the start of the 2015/2016 school year, KIPP Bay Area began implementing the Eureka Math curriculum while adopting the Common Core standards. One teacher grouped her 5th graders into low, medium, and high groups (depending on proficiency), and each group did three rotations during a 70-minute period using a combination of Khan Academy and Eureka Math. The teacher diversified the activities in a way that allowed her to spend time with students in small groups only.[16]

Group	Rotation 1	Rotation 2	Rotation 3
Low	Small group Eureka lesson with teacher	Independent practice on Eureka	Khan academy exercises to fill skill gaps
Medium	Students try Eureka lesson on their own	Small group Eureka lesson with teacher	Independent practice on Eureka
High	Students try Eureka lesson on their own	Khan Academy extension exercises	Small group instruction with teacher to correct Eureka misperceptions or support extension activities

Fig. 5 Students grouped and assigned specific learning material depending on their maths test results

3.2 Tools for collaboration

Which specific tools for collaboration are easy to use and bring immediate benefits to the teacher and student? How can a publisher make use of them?

Technology allows the teacher to handle diverse classroom settings providing opportunities for developing student agency. Working on projects gives students the chance to tackle various aspects of group work organization, which is one of the best ways to develop agency.

Tools which enable effective collaboration include:

- search engines and virtual drives to access and manage information,
- cloud office suites for sharing documents,
- project management applications for organizing team work,
- social media applications for communication,
- presentation and social media software to share project results.

What is even more important than the tools is the reason to use them. Thus, appropriate selection of the task and a clear presentation of

rules for group work are the basis for effective collaboration. Engaging school projects with clear educational purpose and real-world application are a good collaboration exercise.

Young Digital Planet has launched a series of interactive educational project scenarios guiding teachers to run unique curriculum-based projects like “The secret life of plants” in biology or “Decipher the message” in mathematics. All scenarios include interactive multimedia (video, simulations) and step by step instruction. The material is organized according to Project Management Institute (PMI) standards.

Fig. 6 Educational project by YDP

3.3 Management tools for teachers

Management tools are a suite of office applications for teachers to organize and store folders, documents and resources. They also help teachers schedule tasks, make, and manage notes, and communicate with students and parents. Such tools may be created internally by the school or purchased from web stores. They may require downloading and installing a program which runs offline or accessing it in the cloud. Examples are many: Google Suite, MS Office, teachable.com, the-teachertoolkit.com, tes.com, and engageny.org.

In 2015 the Kuyavian-Pomeranian voivodeship in Poland backed with European funding organized a tender for s suite of IT solutions for administrative units in the voivodeship. One of the project modules was e-education, which entailed creating IT tools that would increase teaching effectivity in schools.

To deliver the goals of the module YDP designed and implemented a teacher platform with content combined with office tools (Office365). Teachers found this solution useful and valuable.

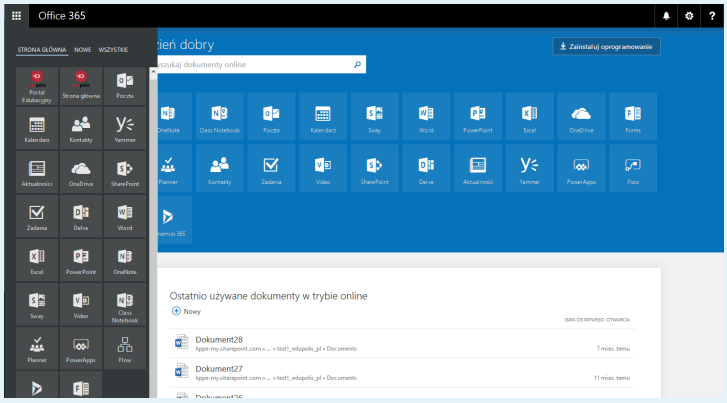

Fig. 7 KPPE screens by YDP

3.4 Learning Management Systems

What are the benefits of using an LMS by the teacher? Are there any drawbacks?

Learning Management Systems (LMS) are systems of teacher tools. They contain resource banks and authoring tools, they allow teachers to display content on a white board and assign specific activities to individual students. They may also collect students' results.

LMSes vary in their complexity but their main functionalities include:

- creating individual student and teacher accounts,
- grouping students and assigning teachers to groups,
- assigning content to pupils for classroom learning, testing, or as homework,
- generating reports on individual student's progress.

An example of a simple LMS is the Google Classroom tool, which comes on top of the Google Apps for Education Suite. An example of a complex platform designed for learning management is YDP's Deliv-

ery Platform. Other popular LMSes are: Moodle, Blackboard, D2L, and Canvas.

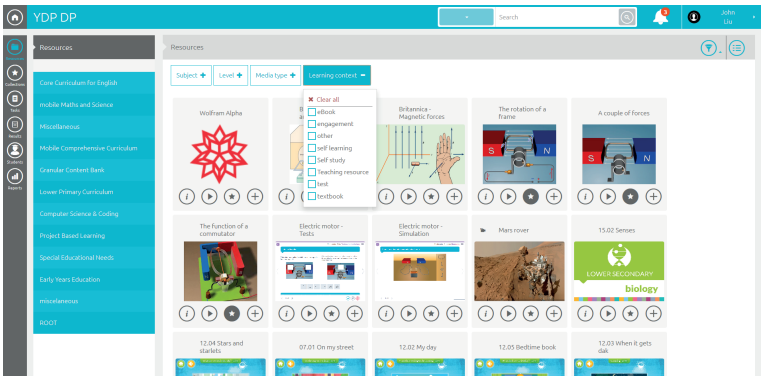

Fig. 8 YDP's Delivery Platform

Management tools let students take a more active approach to learning since the student has both control and autonomy (agency) to choose the time, the place, the pace, the learning environment, and the subject for each learning session. Research shows that choice is an immanent part of motivation.[17] [18]

What is more, an LMS helps the student keep track of things to do by organising a calendar or sending reminders. Here the line between organization and didactics of the learning process blurs.

Are there any other advantages of using LMSes for the student and their parents? What are these?

4. Technology enhances learning resources

- Assess your company's and the market's readiness to go digital
- Start with a hybrid approach: enhance printed materials with digital resources
- Try HTML-based interactive textbooks
- Create your own digital content repository

4.1 Print and digital hybrid

Technology can be implemented at various stages of the learning process (presentation, repetition, testing etc.) or in different areas of the education system (school or classroom management, instruction, monitoring, etc.). There are also different levels of integration:

- Simple addition of some digital formats into existing materials and systems without changing the approach or form, without any integration or correlation with the course book or course materials, e.g., digital assessment.
- Purposeful addition means complementing traditional materials with digital ones (adding them purposefully) e.g., a video presentation enhancing the textbook topic.
- Conversion of analog tools into digital format to accelerate the learning process or make it more efficient. This is a complex effort entailing design, preparation and application of different technologies. The most promising conversions are those utilizing student data and adaptive algorithms, e.g., a digital adaptive math course.

Which paper teaching resources could benefit from converting them into digital to better serve teachers and students?

Publishers seem to be most successful when they offer products based on the hybrid approach. The printed textbook and all the complementary materials are the basis of the product; the digital component is added in varying degree depending on the school infrastructure and the grasp of technology presented by the teachers who are to use the product.

4.2 Interactive textbooks

Digital textbooks are becoming as ubiquitous as paper course books. It is easier to distribute them, they allow the publisher to enrich static content with multimedia and interactivity. Unlike fiction books, paper course books contain various content (text, illustrations, graphs, activities etc.) which makes their layout quite complex. Therefore, it is a challenge to digitize them:

- Creating a PDF is a simplistic approach. PDF files are difficult to read on small screens, and there is no option to add active elements.
- E-reader formats like EPUB and MOBI are flexible to read but all the layout elements are lost and the textbook may lose its didactic flow.

- Fixed-ebook formats are still under development, and they have their early-stage drawbacks: lack of applicable reader-devices, formatting inconsistencies, bugs, etc.
- Flash-based interactive ebooks lose popularity since flash is no longer supported by browsers on mobile devices.
- HTML-based interactive textbooks seem to be a good solution. They are in fact small applications which allow the publisher to make the most out of interactive elements and multimedia.

What types of interactivities in HTML-based books would make the digital book attractive for the publisher?

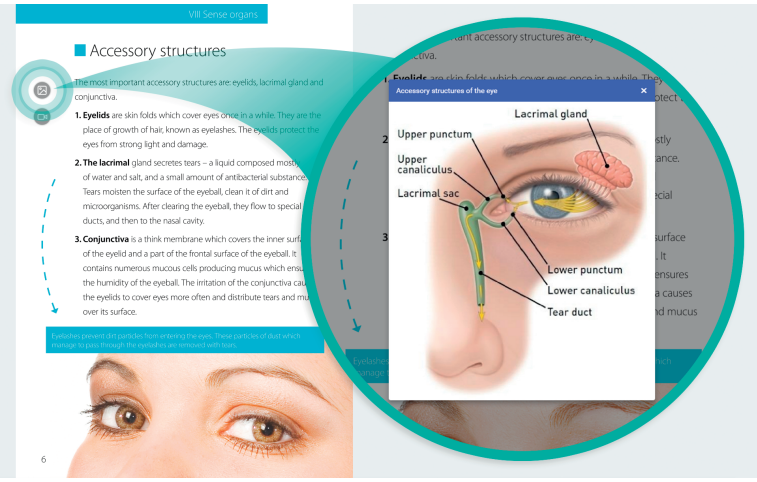

Fig. 9 YDP's Flipbook viewer

YDP designed and implemented a solution for producing and distributing HTML-based, rich-media textbooks for 76 publishers in Germany.

A government-run company implemented a system based on YDP's Digital Books and Media Solution and existing elements like SSO, reports, web shop, booking system etc. This solution enabled teachers in schools across Hong Kong to use digital course books.

4.3 Digital content repositories

Why would a publisher create a digital content repository and not an LMS?

The more digital content teachers have, the better organization and tools to use the resources in the classroom they need. One of the popular solutions are content repositories. Content repositories are usually created by:

- schools (for their own use only),
- publishers (for teachers who use this publisher's textbooks),
- education authorities (for districts, regions, or the whole country).

Common features of digital repositories are:

- storing digital resources grouped by levels, subjects, topics, learning goals, etc.,
- searching and browsing,
- creating and saving playlists,
- adjusting content settings to fit the lesson flow.

YDP created and implemented several content repositories like Scholaris in Poland, and a content bank in Kazakhstan. Another implementation was done for a US-based educational provider who uses YDP's Delivery Platform to serve thousands of content elements and ebooks to more than 50.000 users. Access is paid per content item or by subscription plans.

Granular Content Bank created by YDP is a repository of high quality K12 assets for educational publishers, supplemented with a management system and an asset customizer. GCB assets are mapped to curricula from Poland, UK, Indonesia, Qatar, China, Chile, and IBO exam standards. It is also possible to map assets to any curriculum using a dedicated tool available in GCB.

Additionally, GCB assets have been designed to be displayed on various devices: interactive whiteboards, laptops, and tablets. It will help teachers to flexibly adjust to different classroom situations. To support various publishing needs GCB assets can be exported into various formats: native mp4, png, HTML packages or SCORM and Tin Can.

Some of the more popular content repositories include: explorelearning.com, illustrativemathematics.org, unbounded.org

5. Technology drives didactic approach

- Introduce algorithms which increase effectiveness of revision
- Create resources for flipped classroom
- Implement mechanisms giving delayed feedback
- Add confidence-based marking to testing objects

5.1 Spaced repetition

Is it important for the publisher whether the students remember what they learn longer? Why?

Spaced repetition is both a method for managing one's learning process and a didactic approach to learning, as it combines the application of organizational tools and a brain-based approach to learning.

Research on how the brain works suggests that if cued to revise what we have learnt at specific time intervals (when we are just about to forget), we can strengthen our ability to retrieve the stored information. This is what spaced repetition and the Ebbinghaus forgetting curve are about. Algorithms based on these findings will help the learner substantially by reminding them when to revise – taking the burden of making all the calculations and remembering the schedule from the brain.

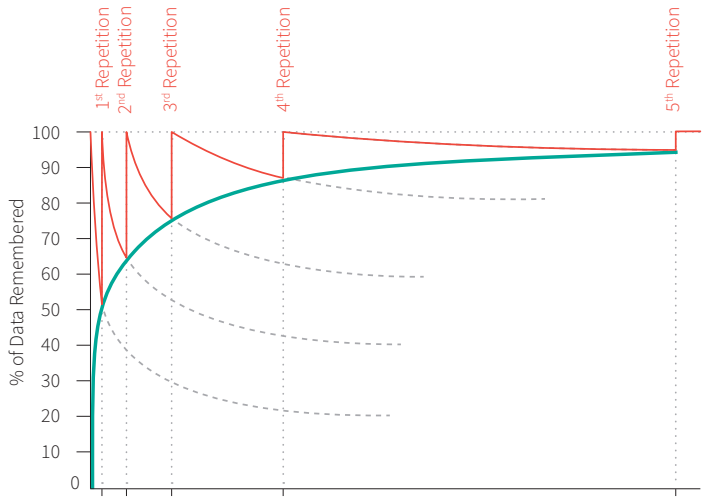

Fig. 10 Ebbinghaus' forgetting curve

Spaced repetition software uses various tools to signal the strength of learning and forgetting, e.g.:

- a vertical or horizontal bar symbolising one's knowledge, which fills up when we learn and empties when we do not revise,
- vitality points you can gain and lose,
- three piles of flashcards: 1) to learn, 2) to revise, 3) mastered,
- graphs illustrating the strength of the learnt concept over time etc.

Some online e-learning platforms which use spaced repetition algorithms like Duolingo (for learning languages) and Memrise (for various

subjects) send email notifications reminding the learner when to revise.

> Once you've completed a module, the bar underneath that module's icon shows an estimate of how well you'll remember what you've learned. Naturally, if you've only just taken the lesson, the bar will be full. Its strength will decrease as days go by, unless you revise.
>
> *Agnieszka Karch, research team leader at The Key for School Leaders, 2012*

The basis for simple algorithms of this sort is a system proposed by Sebastian Leitner in the 1970s. In his method flashcards are sorted into groups (in the Leitner's learning box) according to how well the learner knows each card. The learners try to recall the solution written on the back of the flashcard. If they succeed, they send the card to the next group. If they fail, they send it back to the first group. Time intervals between revising cards from each succeeding group are increasingly longer.[19]

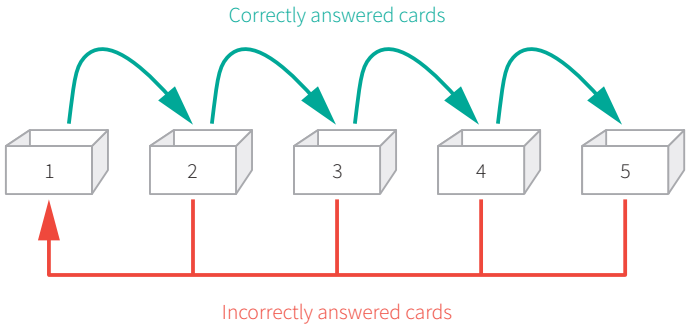

Fig. 11 Leitner's learning box

Today, technology can not only replace the Leitner's box with a computerized algorithm but also add adaptability to adjust the system to individual brain capabilities of each student. Recent studies show that the tricky part with spaced repetition is that the harder the retrieval of information is the better it will be remembered. Thus, it is crucial that the revision intervals be adjusted to individual capabilities of the student.[20]

Some of the more popular spaced repetition software is: Cerego, Mnemosyne, Anki, Memrise, and Quizlet.

5.2 Flipped classroom

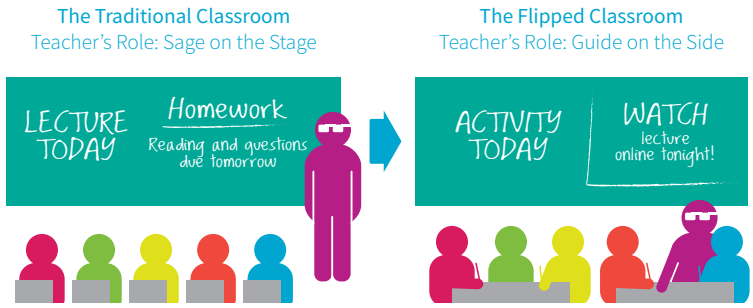

Fig. 12 Traditional classroom vs flipped classroom

Flipped classroom means that

- the teacher wants to devote in-class time to other activities than a lecture:
  - checking and deepening students' understanding of the concepts,
  - applying the acquired knowledge and developing skills,
  - peer-to-peer and collaborative learning.
- students prepare before the lesson at their own pace:
  - watch a lecture or an instruction video, read a text,
  - make notes, prepare questions about the material.

The birth of the method was driven by the need for distant teaching and helping students who skipped classes catch up. Online videos made by teachers explaining the topics to be mastered addressed the need.[21]

> *Flipped classroom teachers almost universally agree that it's not the instructional videos on their own, but how they are integrated into an overall approach, that makes the difference.*
>
> *Bill Tucker, managing director of Education Sector, 2012*

What would the publisher need to prepare for the teacher to introduce elements of flipped classroom into their teaching practice?

Preparing a flipped class entails a considerable amount of work on the teacher's side: foregoing her central position in the class, designing, creating, or finding appropriate activities and explanatory resources for students in advance. Furthermore, this model works only if all the students can use computers and have access to the learning materials (online or offline). Is this didactic approach elitist then? On the contra-

ry, taking into consideration the following comment by an American student:

> *When you live in the hood, no one will jeer at you for having a smartphone, but you will get into it with someone if caught carrying a book to study for a GED.*
>
> *Comment to Tom Barrett's article, 2011*

Among a plethora of digital resources teachers can use in their flipped classroom are Khan Academy videos and Twig Carolina videos.

Khan Academy is a set of practice exercises and instructional videos, plus a gamified, personalized learning dashboard that can be utilized in flipped classes.

Twig Carolina offers high quality films, experiments and worksheets tailored to the curriculum.

For those who want to make the effort and create their own videos, there are screen recording programs like Active Presenter. Videos can then be uploaded on YouTube, creating a channel for a specific author, theme, or group.

5.3 Delayed feedback

Feedback is extremely important for the learning process as it enables students to verify their answers and correct mistakes.

In the school environment feedback is rare and usually comes too late to make any difference, as the student has already forgotten the context, the knowledge they had, and the actual subject itself. At some point, digital technology addressed this pain with immediate feedback, and publishers and educators reacted with enthusiasm. Immediate feedback, however, provided no room for consideration. Very often the system allowed the student to submit the answer again and again, so students used it as a shortcut to finding the correct answer.

How can the publisher design activities for students and guidelines for teachers to make feedback more meaningful?

Feedback should not be understood as a chance for the student to see the correct answer, but as an opportunity to construct patterns and discover connections based on the correct answer. This may be a very powerful and pleasurable way of learning, since finding patterns and making discoveries releases dopamine in the brain.

However, when all the tasks are in the same format (which is often the case with tests or homework), and the school has a non-descriptive grading system, then providing correct answers as feedback will usually result in students skimming through the questions without any deeper understanding, clicking the answers without reflection. Additionally, feedback should allow understanding and reflection on mistakes and it should provide concrete information about how to correct them (how to achieve the desired result). For this time is required. Time for consideration.

Are there any types of activities where delayed feedback would be a hinderacne rather than an aid?

Delayed feedback may be the golden mean: it informs whether the student made a mistake, what kind of mistake it was and what the correct response should be. Additionally, it gives room for consideration – it forces the student to reflect, and it records how certain the student is about the selected answer. This way the information (the piece of knowledge) contained in the question and the correct answer is more easily retrievable later on.[22]

Delayed feedback can be implemented in a variety of ways e.g.:

- Correct answers can be viewed only after a set of tasks is completed. This gives students time to go through their answers again before clicking on the "submit" button.
- The test may also "ask" the student who clicked on the selected answer, "Are you sure?" The student can then choose either, "Yes" and submit the answer or, "No" and go back to the question.
- Another idea is to ask students to bet points on their answer to reflect how certain they are that their choice is correct. The system should then calculate all the points gained and lost by the student with each answer.

6. Technology enables personalization

- Offer software to assess and diagnose students
- Design instruction and content that adjust to the child's cognitive level
- Provide a broader context and real life application for your learning objects
- Create an adaptive course
- Add a cognitive tutor to your course

6.1 First step to personalization

"Inclusive education" for most publishers is a term reserved for children with special needs and, consequently, marginalized. But perhaps it should not be shunned when we look at the changes that mainstream education is undergoing. These centrally-driven reforms require concentrating on each student, which is now made possible with the use of technology.

How can a publisher adjust learning materials to anticipate various students' needs?

Global trends in the evolution of the SEN concept are driven by the OECD countries which see inclusive education as their priority. What follows is a gradual dissolution of special needs schools. Thus, mainstream schools and teachers take over the responsibilities of special needs schools, SEN components are incorporated to mainstream learning resources, and more and more children with SEN attend mainstream schools.[23]

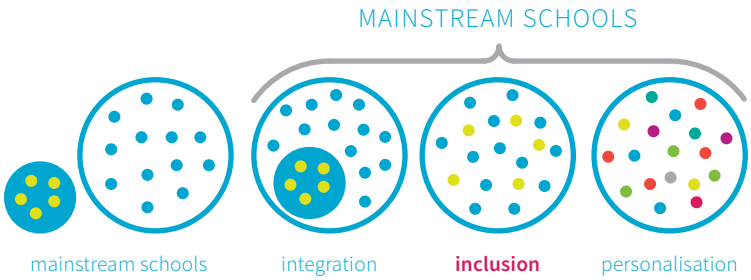

Fig. 13 Evolution of the concept of special educational needs

Inclusive education has become a solution for including children with SEN into mainstream education. This process is evolving towards personalization, when including is no longer the issue, since every child is different and every child has different needs.

On the one hand, technology is a crucial enabler for personalization on a grand scale – today personalization is possible only in 1-1 situations like individual education plans, tutoring, and sessions with a special needs teacher.

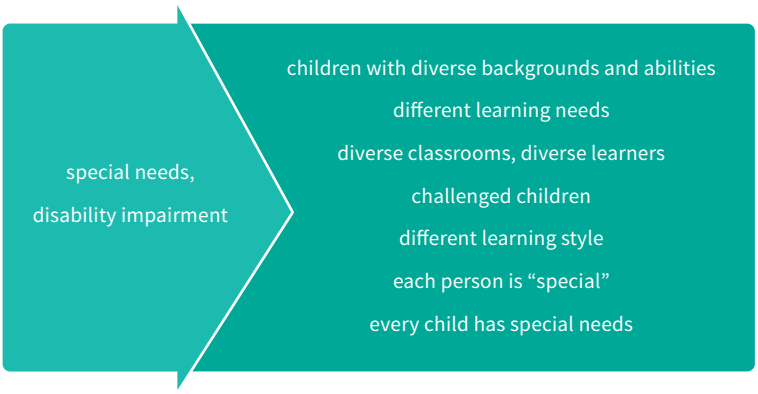

Fig. 14 Evolution of the language used to talk about special needs

On the other hand, techniques and tools created for SEN will work well for personalization, e.g.:

> *Providing education tailored to each student’s individual needs based on individual goals and informed by individual student data: personalized learning… AKA: special education. We can learn a great deal about how to personalize learning by reviewing lessons learned from the field of special education.*
>
> *Shari Butler, Director of Accessiblity Research and Efficacy in Pearson, 2016*

- SEN-rooted expertise promotes individual approach to every single learner, unlocking their potential.
- Methods and techniques developed in SEN are directly applicable to developing personalized learning solutions.
- Diagnostics and class mapping (knowing students’ strengths and challenges) at every stage of the educational process allow teachers to adjust instruction to individual needs.
- Content selection is based on cognitive capabilities and diagnosed barriers.
- Content accessibility options help to address various learning needs.

How can a publisher design a personliazed course using a paper and digital hybrid?

YDP is an expert on SEN with many years of practice. This experience shaped our knowledge about individual student's needs. Our products develop key competencies like perceptiveness, concentration, and auditory attention.

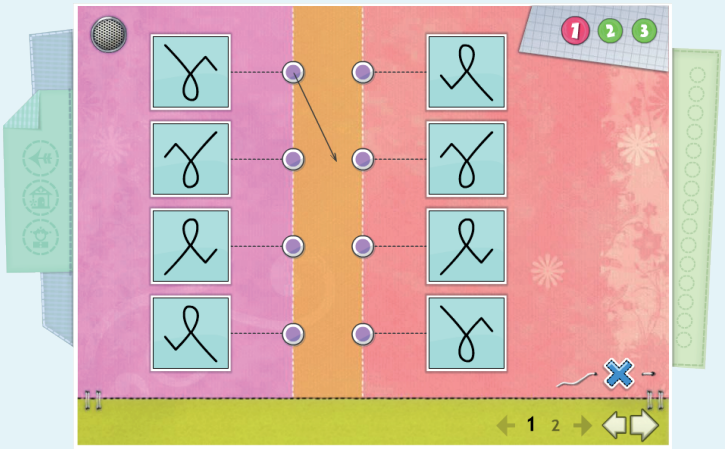

Fig. 15 Diagnosing the probability of dyslexic difficulties (differentiating between shapes)

Are there any possible drawbacks of personalization in education? What are these?

Attempts are made at applying techniques and methods from SEN to mainstream education. In the USA requirements for creating a new curriculum called Universal Design for Learning have been proposed. It is an educational framework based on research in the learning sciences, including cognitive neuroscience. It guides the development of flexible learning environments that can accommodate individual learning differences. It is a set of principles for curriculum development that give all individuals equal opportunities to learn.

YDP's ClassMapp is a tool that gives the teacher a deeper understanding of their pupils' needs. By assessing and influencing the development of executive functions it helps students to achieve educational success. The tool uses adaptive technology to adjust digital content to the cognitive level of every pupil. After testing and diagnosing the development of executive functions, it creates the pupil's profile with tips for the teacher on working with the student and assessing their learning outcomes. ClassMapp also adjusts content dedicated for specific pupils to help them reach their optimal capabilities.

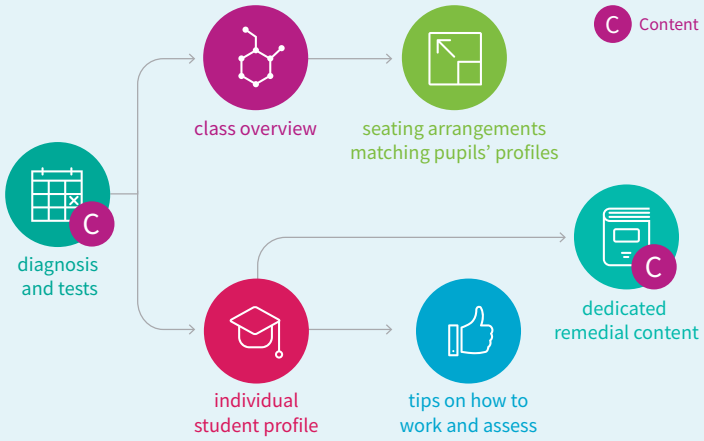

Fig. 16 Methodology behind the Classmapp solution

6.2 Adjusting to the child's cognitive level

It is said that since school is designed for an average student, it is in fact designed for no one, because the average student does not exist. "Average" is a mere medley of traits that does not appear in any individual in this combination.[24]

Each of us has a different way of learning. The very popular concept of learning styles is true in the sense that each of us has a different one. And each of us has different cognitive limitations as well, such as: different capacity of working memory, and different executive functions (switching between tasks, the ability to focus and susceptibility to stress etc.). Our emotional state can change from day to day and – depending on the environment – different factors can set us off.

For instruction to be beneficial for the student, it needs to be adjusted to the level of their cognitive limitations available to store, elaborate and retrieve information used in such instruction.

How can a publisher adjust their content to student's individual cognitive level?

How would a lesson plan need to be designed to provide a broader context, make meaningful references and recapitulate vital points?

When almost everything a student hears is news to them, then the cognitive overload will happen quite quickly disabling the absorption of any new information and the ability to elaborate on it. Cognitive backlog forms when there is a lot of new information that one does not know where to put and not enough breaks to digest it. Some people are still able to concentrate on the lecture or presentation even though they do not understand certain things but others shut off. For example, a minor instance of the cognitive backlog may form when a student encounters a new word that they might not retrieve the meaning for immediately. In such cases – research shows – the mind can pause for up to 40 seconds to search for the meaning of that word. The information presented by the teacher during these 40 seconds is usually lost on that individual.[25]

A solution for the teachers, that the publishers should have in mind when creating their resources and courses, is:

- providing a broader context of whatever is talked about in the classroom,
- making frequent references to different parts,
- recapitulating and providing time for mental digestion.

The saying goes that if students learnt exactly what their teacher was saying (and at the same pace) then students of faster speaking teachers would have much better results than others. Which, we all know, is not the case.

6.3 Adaptive learning

After much research in the 1960s and the influential study by Bloom on one-to-one tutoring, an idea emerged that with the aid of technology each student in the classroom working on an adaptive course may learn in an environment similar to one-to-one tutoring.[26] In 2013 the first adaptive learning solutions were introduced on a wider scale in the USA. Knewton produced an adaptive engine that started giving recommendations to learners suggesting which questions they should work on next, provided learning analytics for learners and instructions predicting future results.

Knewton used a knowledge graph to diagnose student understanding and misunderstanding. It powers intelligent tutoring strategies and remediates deep misconceptions. The knowledge graph was built

using adaptive ontology, a set of objects and relationships that are easy to learn, easy to express content relationships in, and powerful enough to use as a basis for analytics and adaptive tutoring.

To create an adaptive course the publisher might use the following formula:

Which subjects would be easiest to transform into an adaptive curse. Why?

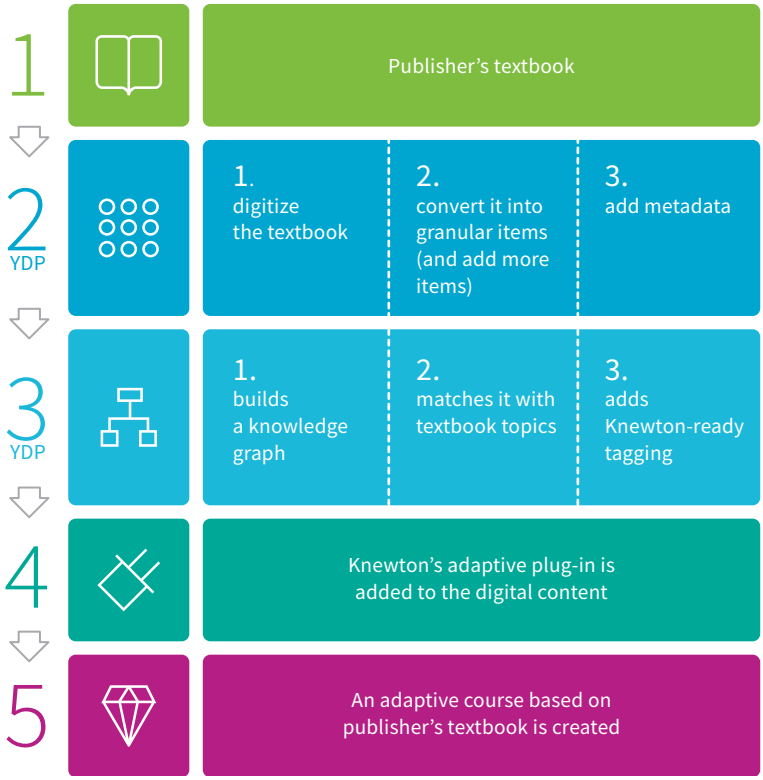

Fig. 17 Sample formula for creating an adaptive course based on a paper coursebook

6.4 Cognitive tutors

Computer-based instructional technology has been researched for decades. Scientists have evaluated students' performance, and built cognitive models that would facilitate individual problem-solving approach, step-by-step assistance, guidance, and feedback with context-specific advice.[27] This research advanced our knowledge about the way people learn, think, solve problems, accumulate knowledge,

and interact with machines. Now intelligent tutoring systems are designed to tackle different aspects of the learning process enabling deeper personalization. Take for instance the Cognitive Tutor, a type of an intelligent tutoring system produced by Carnegie Learning for high school mathematics.[28]

Recent developments in data collection and natural language processing combined with machine learning opened new ways to generate insights from large amounts of unstructured data. This is how new learning patterns are discovered and how most appropriate recipes may be offered like supporting the teacher and not substituting them with a machine. An interesting example of this approach is a complex algorithm created by IBM, called Watson.

Are teachers ready to work with a cognitive tutor? How could a publisher introduce this technology to schools?

One of the expected adaptations of IBM Watson is personalized education powered by cognitive technology where every student will be provided with a tailored curriculum optimized and profiled to the student, based on their past and current results and their knowledge gaining curve.

How does it work? The teacher logs on to management system and asks it to show information about her eighth-grade math class. She sees a visual representation of her students through several lenses, including their risk profiles for doing poorly. She selects a profile and learns that this student has reading and language challenges in other classes (something she might not know because of the departmental structure of most schools). She asks the system for suggestions about additional content and is shown very detailed analysis across several different sources (content from publishers, her own materials, or other sources) rated for applicability to the transformations but also scored for readability, density of concepts and success when historically used with similar students.

According to IBM Watson can:

- answer customers' most pressing questions,
- quickly extract key information from many documents,
- reveal insights, patterns, and relationships across data.

The questions remains whether analysis and processing done by cognitive tutors qualifies as artificial intelligence and mimics cognitive functions associated with the human mind.

7. Technology shows outcomes

- Encourage teachers to use descriptive assessment side by side with (if not instead of) grading
- Replace summative tests with tools used in formative assessment
- Implement applications which collect data, monitor student progress, and create reports
- Design customisable dashboards for teachers, students, headmasters and parents
- Collect and analyse data to improve content quality

7.1 Grading vs. description

Schools usually use numbered or lettered grades (symbols, however nice, work in the same way) out of convenience, as it is the most efficient way of comparing results across and within districts. Descriptive grading is rare at schools as it is regarded as time-consuming.

Letter-grading is ill-suited to assessing progress. Employers already notice the problem. Ernst & Young, one of the UK's biggest graduate recruiters, announced they will be removing the degree classification from their entry criteria, saying there is "no evidence" success at university correlates with achievement in later life.[29]

Research shows that, when receiving a descriptive analysis of their work, students tend to improve their skills, since descriptive feedback increases learning quality (or the willingness to learn in general and the willingness to take up challenges in particular).[30]

Healthy grading or rather healthy assessment is useful not only for evaluating the results, but most importantly for learning, improving, and verifying progress and understanding. Healthy assessment is a form of revision, it provides feedback and so students can learn on the basis of their mistakes (given that mistakes are not treated pejoratively).

What steps would a publisher need to take to promote assessment and description instead of grading among teachers?

Digital tools provide new modes of expression, many of them reserved so far for professionals, like photography, video-taking, voice recording, etc. These modes of expression can not only spark interest among students and engage them in the learning process, but they may become the means of elaboration that can strengthen knowledge assimilation and construction. This way they may serve assessment.

Assessment may also mean that data is collected during the test, and then it is used to:

- inform, adjust, and improve instruction;
- measure the progress of each student regardless of their grades;
- engage students and parents in the learning process, enabling personalized remedial approach and goal-setting;
- evaluate the curriculum, the school-designed programs, and their implementations;
- evaluate the content enabling quality improvements by the publisher;

- predict students' performance and their readiness for the next educational level and design remedies;
- compare students' performance within a school and across districts.

7.2 Formative assessment

Formative assessment (FA) is a teaching method generally believed to be successful in improving learning outcomes, as it helps the students to self-regulate their learning, and it helps teachers to develop better pedagogical practices. It is becoming increasingly prominent since technology started supporting the elements of the method which were a nuisance and blocked wider application of FA.[31]

Would the introduction of FA by a publisher to their course affect the design of teaching resources? How?

For us FA comprises model-eliciting activities (activities that encourage students to invent and test models)[32], generative activity, design methods, and collaborative learning.

The goal of formative assessment is to monitor student learning to provide ongoing feedback that can be used by instructors to improve their teaching, and by students to improve their learning. More specifically, formative assessment helps:

- students identify their strengths, weaknesses, and areas that need work;
- faculty recognize where students are struggling, and address problems immediately.

While summative assessment (SA) is still more prevalent and more commonly associated with today's classroom, formative assessment has undeniable advantages over traditional testing.

- FA stresses monitoring and adjusting teacher's methods, while SA focuses on testing student's knowledge;
- FA entails giving constructive feedback, SA means giving a grade;
- FA is a process, whereas SA is a measuring point.

FA begins with collecting data about the student. The analysed information then constitutes the basis for feedbacks for the student and recommendations on improvements for the teacher.

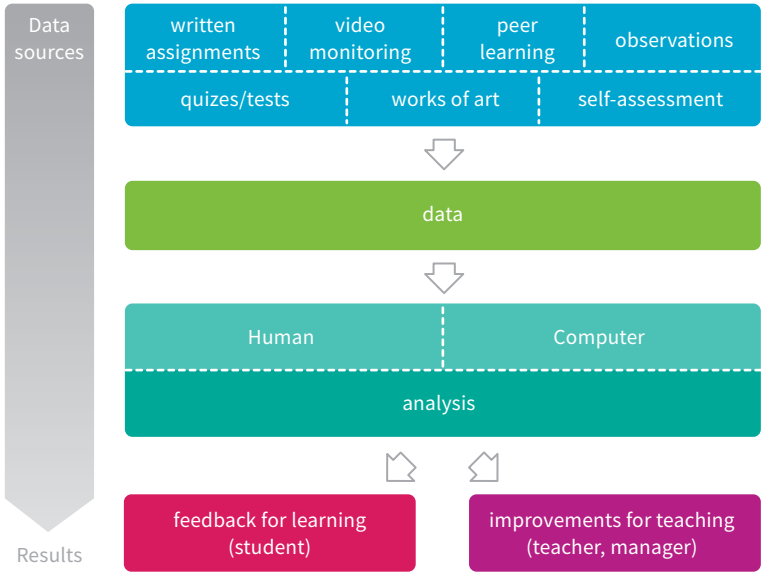

Fig. 18 General application of formative assessment

Implementing FA requires selecting sources of data about the student. These might be:

- admit-slips and exit-slips that collect student responses to the teacher's questions,
- self-assessments that ask students to think about their own learning process,
- peer assessments that allow students to use one another as learning resources (e.g., "workshopping" a piece of writing with classmates when all students follow a rubric or guidelines provided by the teacher),
- essays, worksheets, research papers, projects, ungraded quizzes, lab results, or works of art – almost all kinds of student work,
- teacher observations, video monitoring and specialized diagnostic tools.

What other sources of information about the student are there that can serve FA? What tools can the publisher develop to help teachers collect and manage this data?

Despite the variety of data sources which can be mined to help students improve their learning outcomes, technology is still used mainly to analyse test and quizzes. Some examples of more ambitious applications of FA at Sanoma and YDP include:

- Bingel, Sanoma's learning platform for primary education which provides detailed data on learning outcomes and content accuracy taking into account every learning item;
- ClassMapp, YDP's diagnostic tool for teachers which analyses the individual learning style of each student;
- an R&D project by Harimata and YDP to capture emotional aspects of the learning experience by using tablet sensors and digital content.

To formulate specific, detailed, and constructive feedback all the obtained data needs to be analysed. This is where technology comes in handy to make recommendations more accurate and free teachers to spend more quality time with students. Computers and algorithms are perfect for analysing large data sets – this is what they were designed for. Programs like the adaptive Knewton engine and IBM's Watson may support teachers in this way.

7.3 Monitoring & learning analytics

Learning Analytics, seen as the whole process of data collection, entails measuring:

- student's learning outcomes (their level of competence, areas where they require teacher's support, types of tasks that engage them most etc.)
- content quality (which tasks are most engaging, which do not play their intended role and need to be improved by the publisher).

The traditional way of measuring learning outcomes is an end-of-the-term test. Monitoring, on the other hand, requires collecting data, which is much easier (than what might be expected) with the use of digital resources and tools. Virtually every task done by the student may send results to a database. This data is then presented on graphs and record sheets (elements of a dashboard). Dashboards are designed for specific users – different data sets are presented to teachers, head masters, students, and parents.

What a teacher's dashboard should look like? What information should it contain to be useful and easy to use? Should the widgets be preselected by the publisher or should the teacher be able to choose and modify them?

Every learning object in YDP content collects student's work result. Every lesson has a final report screen which presents students' results. These results may be shared with the class system and displayed on the teacher dashboard. This way the teacher can see all his students' results, without disrupting his students at work.

Fig. 19 YDP's Lower Primary curriculum student dashboard

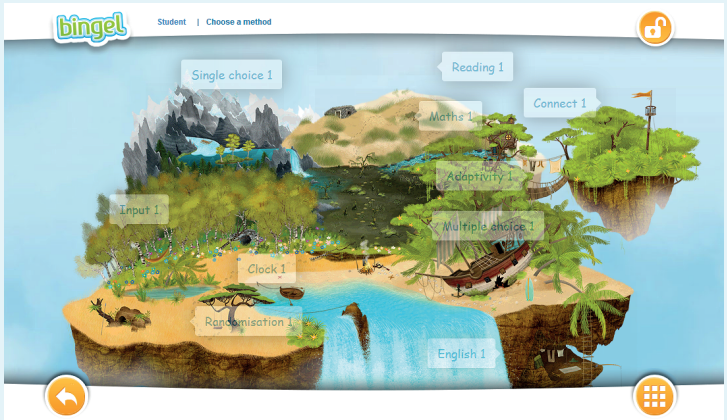

Fig. 20 Bingel island – clickable elements lead to exercises on a specific subject

Bingel is a gamified platform for learning all kinds of subjects (mathematics, foreign languages, sciences, mother tongue and much more) created by VAN IN (Sanoma group). Bingel runs on a Learning Analytics engine which generates customised dashboards for teachers and publishers.

Teachers:

- are informed about students' progress,
- can select remedial learning paths (tasks) when students are struggling and give challenges when students excel.

Publishers:

- can infer the quality of content students work on,
- may modify content which need improvement,
- receive valuable insights in on how often and how their product is used, which allows them to improve the product and the user experience.

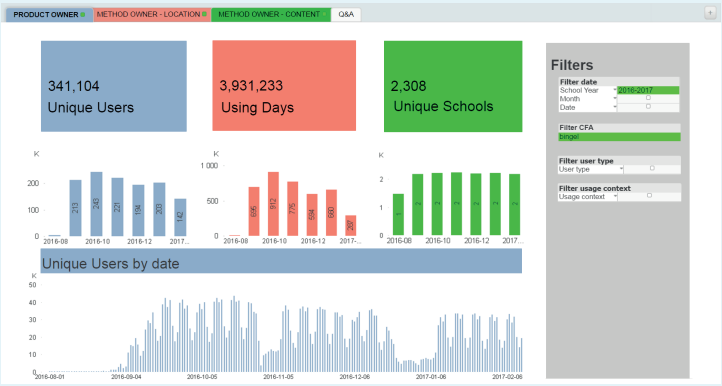

Fig. 21 Bingel dashboard for the publisher

Tests are part of the learning process. Traditional tests are enjoyed neither by students nor by teachers. Students who have weaker grasp of the subject find them stressful, those who show mastery are bored with them. Preparing and grading tests takes time.

What can a publisher do to make tests more attractive to students and easily manageable for teachers? What aspects can be improved?

Banks of digital tasks and algorithms selecting tasks matching student mastery (as opposed to a standard one version test for all the students) might alleviate the problem; plus, grading the tests is no longer a burden for the teacher.

This type of technology called Computer Adaptive Testing (CAT)[33] allows teachers to run quick tests. Thanks to CAT tests are short, and their results are reliable and comparable among students. The difficulty level of each test task is selected to match the student's abilities – the whole test should pose a little challenge, but an achievable one. Thus, regardless of each student's level of competence, they have a sense of achievement at taking the test.

CAT tests can be used to create programs monitoring student achievement throughout the year.

> *MAP assessments are based on a well-documented and established theory of measurement called Item Response Theory, under which the difficulty of test questions and each student's achievement level can be measured using the same scale.*
>
> *Introduction to a MAP Brochure, 2015*

A well designed and implemented monitoring not only measures learning outcomes but it also allows teachers to stay up to date with their students' progress, intervene early on if need arises and thus improve learning effectiveness.

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