Chapter 18
Flip the School, Forget the Classroom; How to Enable Personalised Learning with the Help of Information Technology

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Abstract In this contribution we explore how information technology can help individualized learning in schools. Rather than tweaks, schools need a complete makeover. Analysis of the results of our test school in Amsterdam shows that freedom of choice leads to responsibility, leads to motivation, leads to higher learning outcome.

Keywords Flipped classroom • Personalised learning • Digital tools • Information technology • Individualised learning • Schools • Classroom environment • And on recent difficulties • Educators • Organizational and the • Educational transformation • Educational goals

In this contribution we explore how information technology can help individualised learning in schools. This has been the Holy Grail for the education profession since Helen Parkhurst (1922) and Maria Montessori (1993) made their compelling calls to reform traditional classroom based education into individual experiences, based on individual for goal setting.

Up until now, many attempts to put this goal into practice, have failed, or faced erosion for reasons of efficiency (van Duijne, van den Tempel, & ter Welle, 2015). Our ambition is to show that by deploying digital tools schools now can (and therefore, should) transform their operations into a collection of personalised learning experiences rather than persist in a one-size-fits-all approach.

The need for this transformation is not the availability of the tools itself. Education has been functioning rather well over the past 124 years; in 1892 the Prussian model of standardised education was adopted in the USA and became a worldwide standard (Armytage, 1969–2012). Since then, each generation showed higher intelligence and higher education levels than the one before (Resing & Nijland, 2002). But while society faced the digital/information revolution, the education system did not divert

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from the goals that were set by the industrial revolution (Collins & Halverson, 2009). Education raises a workforce that is capable of performing standardised tasks in clearly defined time spans; just what the twentieth century needed. Compliance is a strong asset for blue and white collar workers, who have to complete dull tasks in a routine fashion that does not differ much from one worker to another.

Four Types of Learning

Since society faces a new phase in which robots will take over not only simple mechanical tasks but also more complex ones, and in which artificial intelligence will, at least partially, equal the human brain (IBM's Watson is about to pass the medical examination and will be a licensed medical practitioner soon) (Simonite, 2014), we do not need a workforce that is only compliant and capable of routine tasks. Instead, critical and creative thinking are qualities that will be sought for.

It is easy to acknowledge that in order to meet society's demands, we will have to say goodbye to the well-known organizational principles that "make" education today. No longer do we need to stress to "behave" in a group of peers who are basically doing the same things for the whole day. Instead, we have to empower children to complete tasks that are relevant for their learning goals, or tasks that result from their participation in "enterprises" or research projects.

Before we can focus our attention on the ways we can organise this, it is important to understand the nature of personalization in education. Personalization differs from differentiation and individualization in two dimensions: the locus of control and the social context of the work that is being done.[1]

If we cross these two dimensions, the result is four types of learning:

	Internal locus of control	*External locus of control*
Individual work	Individualised learning (Montessori)	Differentiated learning
Collaborative work	Personalised learning	Group learning

If we follow the table clockwise, we see that individualised learning is able to meet both the demands of a fixed curriculum and personal learning goals; if we add ICT to this type of learning, the danger might be that children or students don't feel connected with their peers when the usage of screens gets heavy. Not only are the children or students looking at a screen, but there is no connection in the type of activity either.

Differentiated learning is a system that works fine, since it is mainstream education and thus the benchmark.[2] But it is an organizational challenge, and a constant strain on the administrative qualities of teachers. Because children or students are

[1] This double dichotomy seems to work better than the original trichotomy that is proposed by Bray and McClaskey (2013), since group learning and drilling do not fit easily in that model.

[2] In many countries, the effectiveness of Direct Instruction Model and other forms of differentiation in the classroom is widely accepted and hardly discussed; the didactics are even actively promoted by authorities, as for instance Onderwijsinspectie in The Netherlands. Yet this is not an evidence based approach. (See for instance: Hattie, 2008; Schomker, 2006).

grouped in different level groups, that vary from subject to subject, the teacher is constantly struggling to organise a meaningful learning day for as many children as possible. A big disadvantage is of this type of learning is that the learning itself is perceived as something that has to be done rather than something that helps oneself to improve. Moreover, despite the constant focus on learning outcome, on close examination one easily sees time and attention leaks.[3]

Group learning can be very effective; see for instance the approach of whole brain learning or the drilling practice in military schools.[4] The approach has two disadvantages. Firstly, it hardly meets the demands of higher and lower cognitive skills, and it has a hidden learning effect: becoming an obedient part of a group is more important than developing one's own individuality.[5]

Personalised learning reflects the situation that children or students will encounter in their future lives and careers: combining ones individual needs and strengths within a combined team-effort. Whatever our work will be, it is never a sole operation; even self-employed workers have clients and suppliers, with whom they coproduce the outcome.

Moreover, personalised learning is efficient because the tools are adaptive; no time is wasted on tasks that are too difficult or too easy, the learning content is tailor-made and connected to individual learning goals, thus leaning on a stronger motivation. Research (Hattie, 2008) is conclusive: the more children are involved in discussing their own learning goals and paths, the more efficient they will learn. An internal locus of control calls for constant reflection upon learning activities, the goals they are serving and the manners they are executed in.

The collaborative aspect of personalised learning is interesting. It is claimed[6] that teaching is the best way of learning; setting free this energy by allowing children or students to teach each other can be a powerful tool to enhance learning efficiency. And allowing for this type of activity, sometimes called "tutor-learning," again reflects their future to the extent that in workplaces normally junior professionals pick up skills and knowledge from senior colleagues.

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[3] Although the effects on allocating autonomy to learners in terms of efficiency has no empirical basis yet, at face value we expect an efficiency gain. Empirical studies show that the mainstream approach of differentiated learning has considerable time loss. One third of the time is not spent on learning, but on classroom management, preparation and disruptions. In teacher-led activities, pupils pay attention 7 out of 10 min. Of independent work, pupils are engaged 2/3 (language) or 3/4 (math) of the learning time. In total, of every hour of school time, less than half of the learning time is spent on learning! This is a strong call for reorganizing school. See: Brown and Saks (1986).

That granting autonomy to children is effective has been shown. See for instance: Cordova and Lepper (1996).

[4] The point of Whole Brain Teaching or Whole Brain Learning is attaching gestures to content that must be memorised. Moreover, children teach is other by repeating (all at the same time) whatever the teacher has just said. While they do this, they ought to use the gestures; if they do, they earn a glad smiley, and if they fail, a sad one. See: http://www.wholebrainteaching.com/.

[5] See for a discussion of the hidden curriculum: Klaassen and Veugelers (2009). Dimensie vh Onderw/ILO, UvA/UvH. Retrieved December 11, 2015, from http://dare.uva.nl/document/2/73627.

[6] Since Seneca, this claim has been reiterated often and debunked seldomly. See for instance: Gartner, et al. (1971).

Getting Rid of Obstructing Mind-Sets: Farewell Class

Once a school introduces personalised learning, teachers have to say goodbye to many dear old mind-sets. First of all, it is important to understand that the classroom with the fixed group of inhabitants is an impediment rather than an asset. It obstructs tutor learning, does not facilitate different learning styles and cannot be optimised as a rich learning environment for one specific subject. Moreover, "locking up" children of the same age in one room for the whole day provokes bullying behavior and insubordination (Yoneyama & Naito, 2003).

So, the first step to personalization is to let go of the classroom and the concept of class. School immediately becomes a collection of learners, each and every one of them with their own schedule for the day.

One might fear that this results in chaos. We have to let go of an important organizing principle; the classroom and the class of children or students in approximately the same age. To group children or students into classes makes school much easier to organise; the group moves from one room to another, the group has an average score that indicates the level of proficiency of the teacher, organizational issues are communicated to the group.

How are we going to cope with all these organizational issues, once we forget about the group and start delivering education to individuals?

It is at this point that we can grasp the disruptive influence ICT can have on the education. ICT enables us not only to flip the classroom; we can flip the school as a whole. ICT's influence is not limited to the educational content and the way it is presented, but ICT also affects the organizational principles that define school.

This was our first concern when we started the Steve JobsSchool in Holland: how can we organise personalised education in a way that children or students are still working together and develop their co-working and social skills, while profiting from the efficiency gains that digital learning can offer?

To easily understand what this is all about, imagine a music festival. On various stages artists are performing, not knowing in advance how many visitors they will attract and who these people are. Visitors construct their own schedule from the various acts, free to pick any act they may like. In Steve JobsSchools we do exactly the same; we schedule lessons and other activities, for children to pick from. What activities they select is based on their learning goals that can of course vary from one child or student to another. Software[7] records the choices, translates them into a schedule for the child and shows the teachers who will attend their lessons or activities.

If the scale of the school is large enough, children or students will be able to base their choices not only on the content or subject that they want to cover, but also on the learning style they prefer. [8] That is why it is important that teachers offer a variety

[7] See sCoolTool.eu.

[8] If the concepts of Multiple Intelligences (Gartner) and different learning styles (Kolb) have found no empirical base to the extent that no studies show that applying the concepts is beneficiary to learning outcome, it goes without saying that once education is personalised, it's a good thing to allow for different learning styles. Why wouldn't one? Obviously, children or students that are allowed to follow their own preferences thrive better. Even if sandwiches are no healthier than muesli, it is silly to eliminate the choice.

of didactics, from working together without teacher supervision in an enterprise, to following a frontal lesson delivered without any active involvement of the pupils (other than listening and taking notes). This is because children and students differ in learning style, and personalised education takes these differences seriously. In fact, we see that in our schools, pupils actually get to know their preferred learning style and base their choices upon it. Some pupils have motivational problems and need external reinforcement to increase their motivation. Also for them, a school must have a good offering.

Didactics	**Internal locus of control (producing)**	**External locus of control (consuming)**
Intrinsic reward	*Own area of interest*	*Inspiration by the teacher*
	Enterprises, Real products	Instruction and tasks
	Talent workshops, Research projects	
Extrinsic reward	*Task readiness*	*Reinforcement Strategies*
	Silent work	Exam preparation
	Work in studios	Remedial teaching

Obviously, all human beings will prefer activities that have an intrinsic reward ("fun to do," "it shows how good I am at it") and an internal locus of control ("I want to have it done", "this work suits me") and avoid if at all possible the work that has an external locus of control and an extrinsic reward (Someone tells me I have to do it now, If I don't do this, I will fail my test.)

Learning, especially formal and explicit learning, is very often not very rewarding in itself; the reward is to master the skill, rather than experiencing that you are not yet very good at it.

So it is important to make room for all learning activities that have an internal locus of control, and/or an intrinsic reward, but also organise learning activities based on reinforcement strategies. The latter activities can be obligatory for certain children or students; but only after the necessity of this approach is evident.

Empirical study has shown[9] that intrinsic reward and internal locus of control will enhance learning outcome. Children who feel autonomous in their learning, develop self-confidence while learning, get better in reflecting upon their learning goals and results, appreciate learning more and feel more motivated to fulfill learning activities. This approach is named Self Determination Theory (Ryan & Deci, 2000).

So, the activities must be designed to cover all fields of the curriculum and additional skills, such as the skills that are known as "twenty-first century skills," and at the same time cover the four didactical types of work. Also, the activities must be repetitive, in order to allow for children or students to time their learning activities individually. For instance, if a specific content area is only offered in spring, children or students who want to study this area in autumn, will not be able to do so. Therefore, the offering of lessons should be year round and if possible also repetitive in 1 week.

[9] See: De Brabander and Martens (2014). Winner of the biannual EARLI outstanding publication award 2015.

Getting Rid of Obstructing Mind-Sets: Farewell Constant Monitoring

A second important mind-set shift that teachers have to make is to let go of the reflex to monitor the process on a daily basis. Using adaptive software means that the learning progress is already monitored in real time by "machines"; no need for the human brain to duplicate this effort. In our schools, every 6 weeks, children (and their parents) discuss their personal development plan (PDP) with the coach. Every teacher serves as coach for 20–25 children, and mapping out the individual learning paths is an important aspect of this role. [10]

The other role of the teacher is the role of specialist. The specialist typically works in a subject specific studio: the math room, the language room, the creative room, etc. Since the children hop from studio to studio, their learning experiences are not monitored on a daily basis by one and the same teacher. The team of teachers is responsible for valuable learning for all children during the day; but it is too much to ask to keep in mind all the progresses of the maybe 100 children a specialist might interact with in 1 day.

Therefore, the progress of children is monitored by software, and evaluated only every 6 weeks (or any amount of weeks that seems fit). We see that this is a tough one for many education professionals. They feel they are operating in the blind; not knowing if children learn seems to equal children not learning. But this is obviously a misconception. If a school creates a culture of hard work, and if the professionals (and parents) do not allow idle chatter or nonproductive play, one must assume that learning progress takes place.

Of course, a theoretical possibility remains that a specific child manages to avoid learning activities to an extent that it threatens progress. It is important to stress that this is not very likely once we grant relatively much autonomy to children. But if it happens, a child has avoided for instance math for a period of 6 weeks, it can only mean that this child must make up for this in the next period. The coach can schedule obligatory activities, while resorting to the didactics that have an external locus of control.

Getting Rid of Obstructing Mind-Sets: Welcome Parents

The third important mind-set shift teachers have to make, concerns the ownership of the learning. Once we acknowledge that we cannot monitor the learning process on a daily basis, it is important that we transfer the responsibility for the progress largely to the child or the student. This requires trust from the teacher and leads to a sense of autonomy of the child or student. Now of course, we can easily see the boundaries of this shift in responsibility: education is asymmetrical in the sense that the teacher

[10] See: http://issuu.com/bookshelf/docs/de_gang_van_zaken_op_de_fysieke_sch_80e6f03a5bc962.

knows what there is to learn, and the pupil can be "unknowingly unknowing." So, the teacher has already climbed the top and appreciated the view, while the pupil has a certain resistance towards the act of climbing.

To grant full autonomy is counterproductive; not only does the pupil not know what the rewards will be once the skill is mastered, but also the overview of the whole competence or field of knowledge is necessarily incomplete. This being said, to return the ownership of the learning process to the child or student is a very productive intervention. If we take a close look at the metaresearch that John Hattie carried out over recent years, the conclusion is just that of all possible interventions in education, those that have to do with expectations of, reflection upon, and autonomy in learning are the most fruitful to learning effectiveness (Hattie, 2008). In other words, schools who want to improve the efficiency of their efforts, ought to start with giving back the learning process to the rightful owner: the child or student.

In primary education, ICT and especially social media have an important role where they tie parents to school and make them an integral part of a learning community. Parents are not involved in school, they *are* the school as much as children and teachers are the school. This is an important aspect of our schools, since we transfer the responsibility for the learning process from school to the owner; but if the owner is too young to live up to this responsibility, it is delegated to his or her parents. In order to take this role (almost all parents are very willing to!) parents must be enabled to be "in" school, not only in the flesh, but also through virtual presence, i.e., through social media. Children are to take a picture or make a screen dump of every meaningful learning activity, which can be shared immediately with parents in a temporary portfolio. In this way parents get a good view of the day to day school activities of their children; from the black box it usually is, school develops into a collaborative effort of parents and teachers. Also, an important aspect of Steve JobsSchools is that parents play an active role in the education itself; they deliver workshops or lessons or supervise enterprises or research projects. The disadvantage of the possible lack of didactically or pedagogical skills is relatively small compared to the enormous advantage of tapping into a huge amount of expertise in a wide variety of fields.

To sum it up, apart from the totally new way learners learn if they can use digital tools, deploying portable devices such as iPads or Chromebooks makes way for a totally new organizational model of the school. This is important to make the century-old call for personalization that Helen Parkhurst and Maria Montessori formulated come true.

Educational Software Personalises Learning

The second part of this contribution will be directed to the "virtual school," i.e., the school that resides in the one on one device. The 1:1 aspect is important; carrying ICT hardware in schools is far less powerful than 1:1 deployment of devices. This is shown in a comparison of PISA-scores in an OECD-study that focused on

the effectiveness of computers in education (OECD, 2015). The data in this study were derived from the field before 2012, that is, before the rather massive introduction of 1:1 iPads and Chromebooks in education. The overall conclusion of this survey was that adding hardware to a classroom has little to no positive effects. But we notice in Steve JobsSchools that the results on old-fashioned indicators are not worsening, while our children perform much better than peers in "analogue" schools in tasks that are typical for interactive digital learning. An analysis of test results of our school in Amsterdam shows that learning outcome (expressed in test results on reading skills and mathematics) is 1.4 times the benchmark. Note that the ability of children plays no role, since the measure is: months of growth, not the proficiency level itself. Also, social skills improve remarkably.[11]

So, in order to evaluate the merits of computers in education, we must rephrase this question to: what are the benefits of the one on one deployment of portable devices in education?

These are: adaptive learning, accessibility of learning sources to suit individual learning styles, and internal pacing of learning.

Adaptivity

There are two models of adaptiveness of educational software. The first is to use levels. The student is stuck at a level until he masters it. An example of this approach is Khan Academy; once the student can provide five correct answers in a row, he gets promotion to the next level. The second model is more subtle. Questions and players are seen as opponents and get a rating based on analysis of the results. The algorithms at work determine how hard a question is based on thousands of entries by players whose level is known since they have tried millions of questions. With this established, the software can offer questions at a level that suits the student; the student himself can even choose hard, medium or easy questioning, in other words, pick a percentage of wrong answers. Also, certain domains can be shut off if a student tends to neglect certain other domains; in order to work in the favorite domains, the student must complete a minimum amount of the not so popular subjects. This approach is used by the tools Math Garden and Language Sea, among others.

Abundance

If a school deploys one on one devices, the students can pick from a wealth of available resources online. This makes fine-tuning in learning possible, since every student works in the software environment he or she prefers. In a world where basic

[11] A quantitative tool for this assessment is in operation, but the longitude of this measurement prohibits us to present "hard" data. This claim is based on numerous reports of parents, both in face-to-face contacts and in blogs.

information is retrievable within 5 s, learning stuff "just in case" does not make sense; students prefer to learn "just in time," and this does make sense. Rather than concentrating on creating a common knowledge base, education should focus on information processing skills, critical thinking and creative ideas. The concept of "find, filter and apply" as the very center of our education effort is crucial in most of the pleas for redefining education.

We now have access to a great wealth of knowledge anytime, anywhere. Conrad Wolfram provided a compelling argument for this in a Ted Talk in 2010.[12] 50 years ago, there was no device that could compute the square root of 53; so we learned how to calculate this. This consumed a whole lot of learning time, time that could not be spent on learning to conceptualise and apply mathematical principles. Now that a smartphone has more calculating power than a mainframe computer 20 years ago, the educator's time is better spent if we focus on conceptualization and applying mathematical concepts. Also, education served as the phase in a person's life that prepared him or her for the future; the knowledge base that fits in one brain was sufficient to cope with life's challenges. Since our society became more complex and our careers more versatile, learning has evolved in a lifelong duty. The importance of the "what" of learning has therefore decreased, and the 'how' has become more important. If all knowledge is available, and we learn during our whole life span, it becomes futile to focus on a common knowledge base in the brains of all 18-year-old citizens. We face a shift from *just in case* learning towards learning *just in time*; I need knowledge for achieving my goals, so I gather, evaluate, and apply the knowledge (Kagan, 2015).

This does not mean that children and students are to neglect the more basic levels in Blooms taxonomy (Engelhart, Furst, Hill, & Krathwohl, 1956): knowing and understanding. But what is does mean is that these basic levels differ from one student to the next; where one student learns thousand of words in a foreign language, the next student may learn 1000 other words or 1000 words in another language; moreover, one student may learn 500 words this month, the next student may learn 5000 new words …. The common base of knowledge that is so crucial in most curricula is outdated; in the new networking society, the opposite is more desirable, namely if individuals have different bodies of knowledge. The abundance of online resources makes education a totally new gameplay.

Pacing

The third aspect of digital learning is that it allows for individual pacing. If lessons are canned on YouTube or Vimeo, and practice is scheduled in an individual schedule rather than in a group setting, students can fast forward or rewind just as they please. This might make the explicit and formal learning far more efficient for any student who is not on the exact median level. This gain of time can be invested in the more rewarding types of work, for instance, work in enterprises or own research. [13]

[12] https://www.ted.com/speakers/conrad_wolfram.

[13] This is discussed in: The Educational Technology Anthology Series (1991). There is not a whole lot of empirical evidence available.

Not Only Highly Desirable, Also Workable

We face resistance to these very desirable aspects of our educational concept, and most of it doesn't focus on the principles but rather on perceived practical impediments. People fear that students who are offered trust will abuse this trust. They will spend many idle hours instead of learning, nobody will know if education fails or succeeds, it will be an organizational nightmare. But the opposite proves to be true, once you give it a try. We had to develop planning software and we are currently working on some other software tools, but in our schools children are happy, parents are content,[14] and teachers are thriving. School in this way truly has become a learning community and a lot of social and emotional problems that we have got used to in "normal schools" are nonexistent.

An instrument called sCoolTool is what makes school happen; with it, teachers broadcast their offerings and children plan their day. If the children are too young to make sound decisions (choose activities based on their learning goals) their parents are helping them to plan their day. The portfolio that proves they are progressing is directly attached to the activities; so even very young children can keep track of their progress. As stated above, learning awareness is proven to be the single most important intervention for teachers wanting to enhance the effectiveness of education.

Children only see activities on their screen that are relevant to them. Some items are obligatory, but most often every time slot has a variety of activities that they can choose from. This enables children and students to focus on their own talents, or to put more effort in goals they find hard to achieve.

When asked what aspect of the Steve JobsSchool students liked most, almost none of them answered: the iPad. The vast majority of the children named the freedom to choose the best thing of school in comparison with previous schools. Justifiably the children do not emphasise the digital tools; they value the organizational gain that these tools enable. A survey conducted by the University of Amsterdam showed that the involvement of children in a Steve JobsSchool was considerably higher and their learning experience was more positive (Neto Gomes de Almeida, 2015).

It is important to stress that Steve JobsSchools have to meet the demands of the national curriculum. So where we might question the relevance of some parts of it, we comply with the common core of knowledge and skills that our children have to acquire to make national grades. But we do so much more: the twenty-first century skills, the work on individual talents, extracurricular areas as programming and robotics …. All of this is possible due to the efficiency gains that personalization brings about.

For schools that want to fully benefit from the organizational and educational advantages of applying digital technology, we have a precise roadmap available.

[14] On our flagship school in Amsterdam, the satisfaction levels on almost all dimensions were at least half a point (on a 5-point scale) higher than the national average. E-mail for the full report: info@o4nt.nl.

The tools that we will gladly share are not confined to the Dutch educational system; Steve JobsSchools have opened in Spain, South Africa, and will most probably open in 2016 in several other countries. Especially after the influential blog Tech Insider named the Steve JobsSchool one of the 13 most innovative schools in the entire world, we expect a further international rollout.

In conclusion, both the organizational and the educational aspects of school are turned around if schools are willing to reconsider the goals, the means and the practicalities of their core operation. In our experience innovation that is applied only gradually have a high risk of failure; in the twilight zone between applying old practices and using new tools people easily get lost. Since education is a people's business, the gradual transition model is a risky approach. Schools that want to adopt our model, are advised to prepare thoroughly and then act quickly; the transition itself should be as short and sharp as possible. In the first year that a school operates in the new concept, the team should be curious and the headmaster stubborn.

If schools are willing to reinvent themselves, they are doing their children a huge favor—they prepare them for the future, not the past.

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