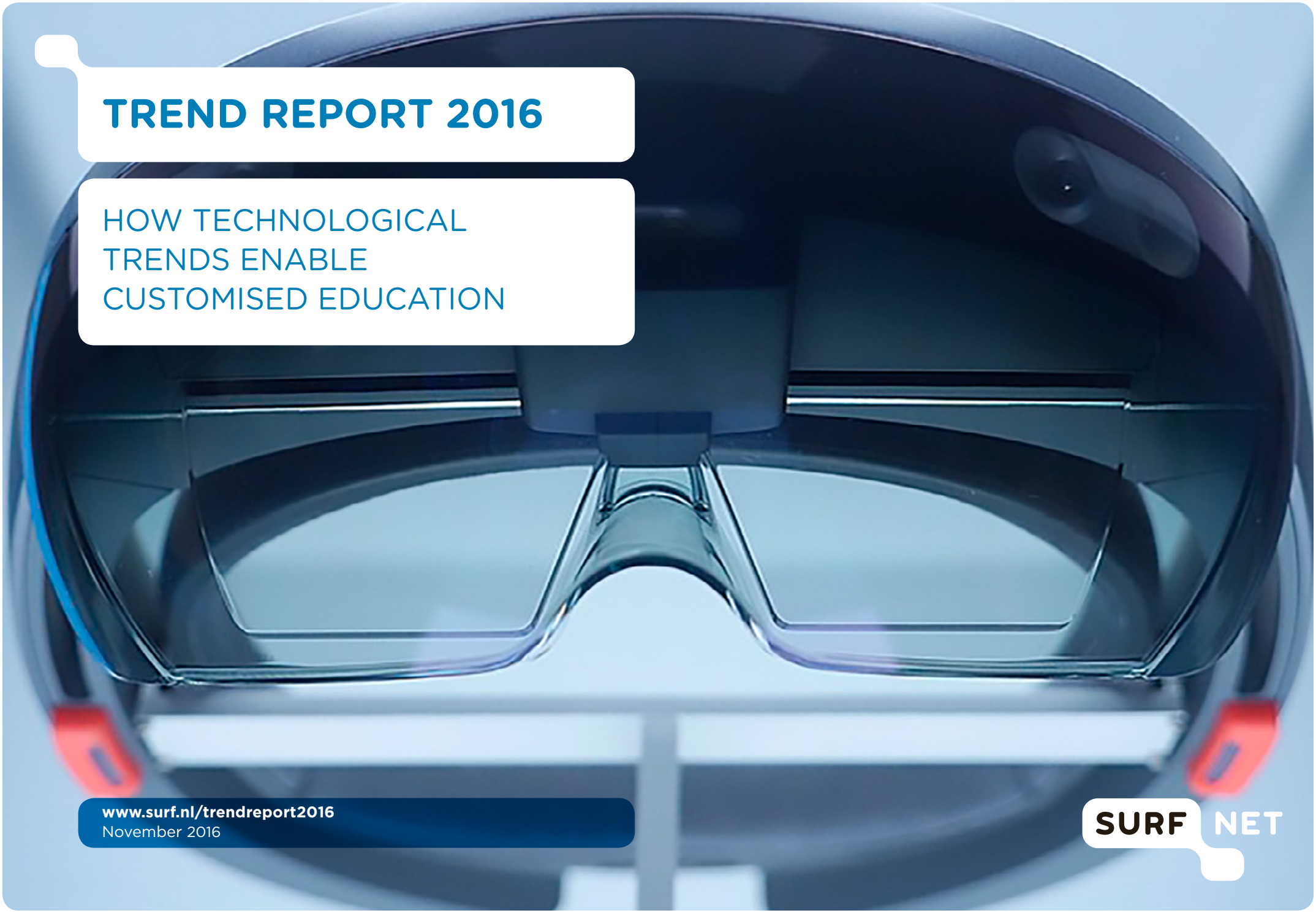

TREND REPORT 2016

HOW TECHNOLOGICAL TRENDS ENABLE CUSTOMISED EDUCATION

www.surf.nl/trendreport2016
November 2016

SURF NET

FOREWORD

Erwin Bleumink
Member of SURF's Executive Board and CEO of SURFnet

Dear Reader,

We are proud to present the latest trend report from SURFnet, which focuses on the theme of *customised education*. 44 Dutch experts in the field of education and ICT have sought out technological trends that enable customised education. This report is intended to highlight the opportunities available for Dutch education and hopefully inspire and encourage our readers.

A total of 13 individual trends are mapped out. Together, they form a picture of innovation within education, with three clearly identifiable themes. The first theme relates to *didactic enrichment*. These are innovations that make education more interesting, better and more motivating. The second theme is *organising flexibility*, i.e. creating education where the lines between different types of education, and between courses and institutions are blurred. The third theme is *adaptive learning*, meaning education is adapted to the learner. When added together, these trends give an insight into how education may look in the future.

While technology influences education, education also influences technology. SURFnet and all affiliated educational institutions are at the heart of this issue. This is why we must all work together to create an educational future that combines the best of technology and education.

This report is the result of a joint effort. SURF is the collaborative ICT organisation for education and research in the Netherlands. The report therefore had to be as wide-ranging as possible in order for it to be relevant to as many educational institutions as possible. With this in mind, we selected authors primarily from SURF's special interest groups relating to education. We also sought the involvement of edubloggers, who are used to monitor new developments and form opinions accordingly. The result is a report with a broad focus, written by experts from higher education who bring their own in-depth knowledge to each theme. Although the trends are described from the perspective of higher education, they will also be of interest to – and serve as inspiration for – the senior secondary vocational education (MBO) sector.

We hope that this trend report will inspire you. We hope that it will help you to not only define a long-term vision, but also make minor tweaks to your current activities that you can implement straightaway.

ABOUT THE REPORT

This trend report was written in close collaboration with **44 Dutch experts** in the fields of education and ICT. The compilers first created a master list of potential technological trends that are relevant to customised education. This master list was then discussed, added to and ordered according to priority by educational ICT experts in higher education, representatives from SURF's special interest groups and a few edubloggers.

Within the framework of a kick-off meeting, priorities were jointly assigned to technological trends that are relevant to customised education. The core insights from existing trend reports were also used as a basis. 13 writing teams and review teams subsequently set to work on describing the technological trends they considered to be most important. The students' unions LSVb (Landelijke Studentenvakbond), ISO (Interstedelijk Studentenoverleg) and JOB (Jongeren Organisatie Beroepsonderwijs) gave their feedback on each of the themes.

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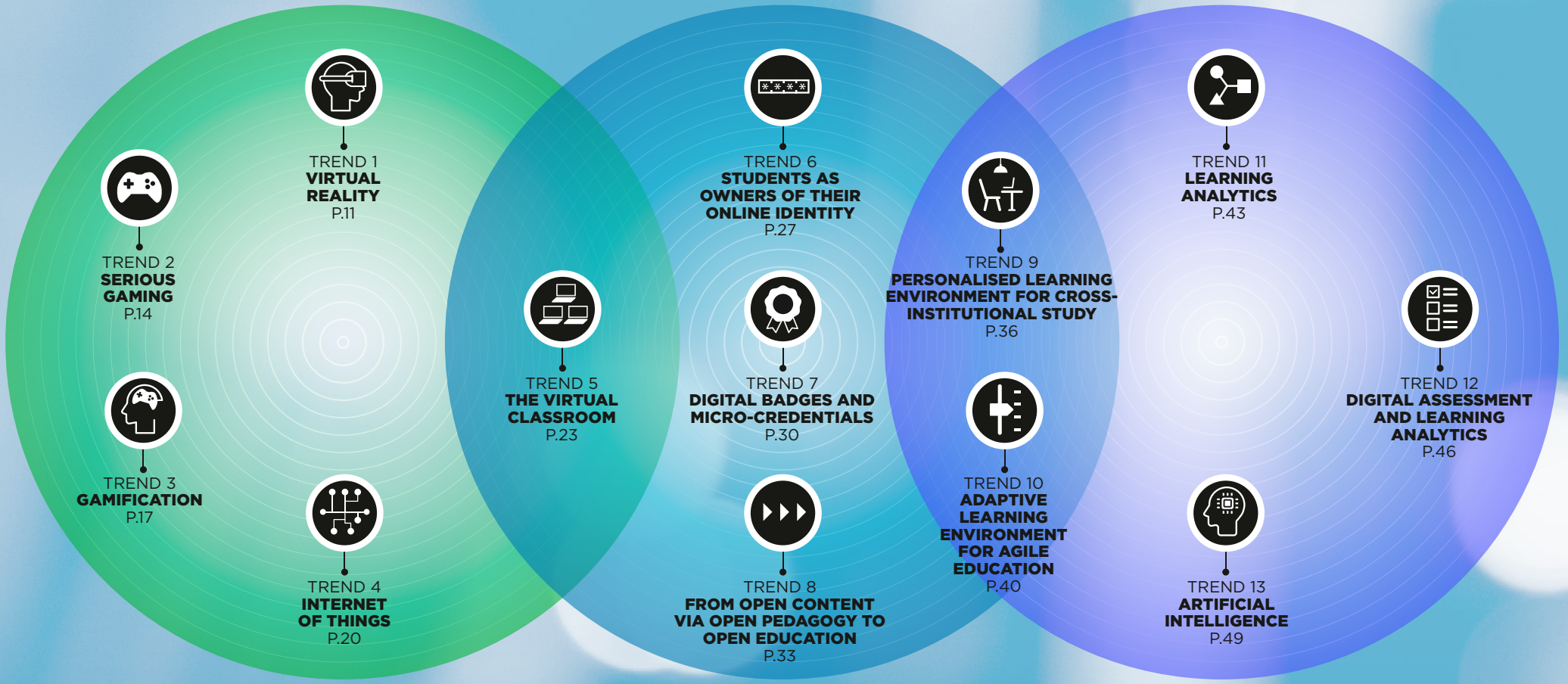

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EDITORIAL: HOW TECHNOLOGICAL TRENDS ENABLE CUSTOMISED EDUCATION

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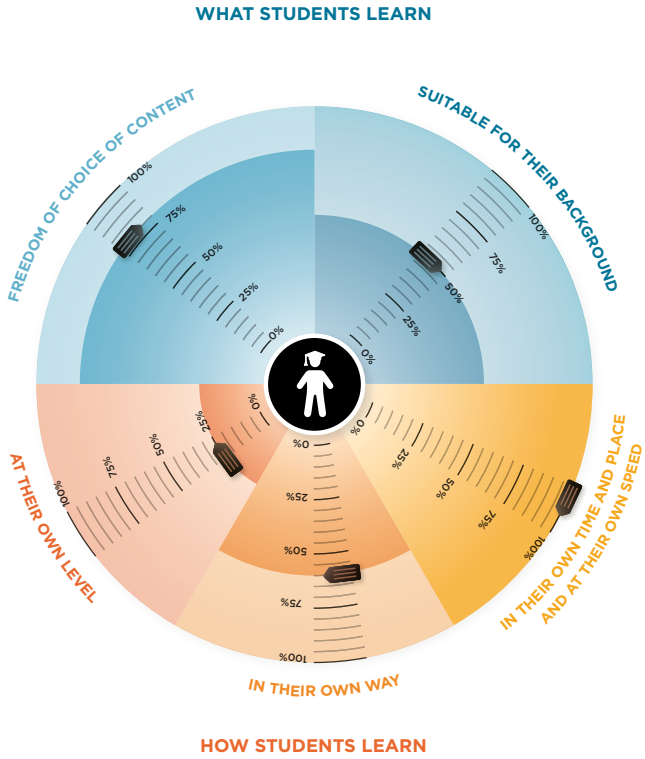
According to Professor Jan Rotmans, we are living not in an era of change, but in a change of era. Both the Netherlands Association of Universities of Applied Sciences (VH) report 'Onderzoek met Impact' [Research with Impact] and the Association of Research Universities in the Netherlands (VSNU) report 'The Digital Society' describe ostensibly contrasting trends such as globalisation, regionalisation, technologisation, informalisation and flexibilisation. These trends affect countless aspects of our society, including the way we work, learn and organise things.

In other words, we are witnessing a world in transition with a massive dynamic that is strongly influenced by technological trends. Young people and adults must learn to cope with the uncertainties, risks and opportunities that this entails. They need to be able to function within a highly digitalised society. Clearly, this also has consequences for education, both in terms of the curriculum and in terms of teaching and learning.

This trend report describes 13 technological trends that may affect the content and design of education. The focus is on how these trends enable 'customised education'.

The knowledge economy is placing ever-greater demands on people. Mid-level jobs are disappearing while the need for more highly educated personnel is growing. If we are to adequately respond to this requirement, a one-size-fits-all approach will no longer suffice. Students vary greatly in terms of their knowledge, skills, talents, requirements, ambitions and relevant backgrounds. Moreover, students are increasingly combining their studies with paid work. As a result, they need education that allows them to decide for themselves where, when and at what pace they study, within their own institution or beyond. They need more scope to define their own learning paths. ICT can play a key role in the creation of personalised, flexible education that focuses on **what** students learn (freedom to choose content, greater focus on prior knowledge, experience and existing skills) and **how** students learn (own time, location, pace, level and preference).



This trend report identifies technological trends that span education and ICT and highlights the opportunities presented to Dutch higher education, including in relation to customised education. We hope that it will inspire further debate regarding the significance of these trends for education.

We are not dealing with purely technological trends. Although technologies influence behaviour, the development of technologies is also influenced by socio-economic and socio-cultural factors. Take, for example, the need to network or the fact that people are increasingly taking responsibility for aspects of their lives such as care for themselves and lifelong learning. The focus is rarely on a single technology; rather, it is an 'ecosystem of mutually reinforcing resources' (Kennisnet, 2016).

Common theme of this report

This trend report describes thirteen technological trends that have a clear, three-pronged common theme.

1 Enrichment of teaching and learning

Firstly, a number of trends lead to the enrichment of teaching and learning. Thanks to the sensory experience it provides, virtual reality can, for example, facilitate interactive learning in authentic learning situations. The same applies to the use of serious games. Gamification offers opportunities for providing feedback and encouraging self-management in that students can earn badges that act as milestones. Digital assessment allows students to obtain feedback immediately and gives them a better idea of their progress. The virtual classroom also enhances interactive and collaborative learning without students and lecturers having to be physically present in a single location. Although many lecturers still regard a virtual classroom session as 'nothing to do with them', this learning technology, in conjunction with digital assessment, probably comes closest to the way we are used to learning within our education system. Rather than a drastic change, then, it is an improvement.

All in all, these technological trends are able to support key principles of effective education (such as applying new knowledge, solving real-life problems and giving feedback; see for example Merrill 2002). It is clear, however, that the quality of some technologies needs to be improved if they are to actually make education more effective and more attractive. For example, there is rather a large amount of variation in the quality of technology available for virtual classrooms. Meanwhile, VR applications that use 'cardboard' currently offer limited opportunities for interaction.

2 Incorporation of flexibility in education

Secondly, we see the incorporation of flexibility in education, which 'blurs boundaries'. Students are increasingly studying different programmes within the same institution, at different institutions (both within the Netherlands and abroad) and outside the traditional higher education system. They can follow programmes that incorporate open pedagogy and courses that are rewarded with microcredentials (such as massive open online courses). Microcredentials and digital badges allow students to utilise the knowledge and skills they have acquired in different contexts. These technologies demonstrate that students have also developed their skills beyond the traditional education system.
Students undergo a wide range of online and offline learning activities to develop an online education identity – in effect a personalised education number that they can use throughout their lives. The educational institution's monopoly over the awarding of qualifications is definitely a thing of the past.

3 Adaptive learning

Thirdly (and lastly), a number of technologies enable adaptive learning. This includes both highly advanced applications that could play a key role in the long term and technologies that enable a certain amount of 'adaptivity' in the short term. Artificial intelligence is an example of an advanced application. Here, students follow personalised learning paths based on the digital traces they leave in online learning environments. One example of a simpler application is digital assessment combined with learning analytics. Another example is the personalised learning environment that gives individual students access to the applications they use for learning purposes.

Potential impact of the trends

What is the impact of these trends? In their book 'Urban Myths about Learning and Education', Pedro de Bruyckere, Paul Kirschner and Casper Hulshof use various studies as a basis to argue that in spite of developments in technology, educational practice has thus far remained relatively stable. According to De Bruyckere et al, new technologies rarely influence the way in which teaching and learning takes place.

The technologies in this report have the potential to enable flexible, personalised education. The manner in which they are integrated within education will determine whether this potential is actually exploited or not. If these technologies are properly integrated, this may have a major impact on the education system.

Unbundling

In the first instance, this may result in the 'unbundling' of higher education. This means that key activities and services in higher education may be provided by different organisations. At present, a single institution provides teaching, support and assessment. In the future, support may, for example, be provided by online coaches working in a freelance capacity. External companies may be contracted to provide online proctoring services for exams, thereby reducing the costs involved. MOOC platforms should also be able to employ the best lecturers to create MOOCs.

The incorporation of flexibility may mean that students no longer need to follow a programme of study at a traditional higher education institution to earn a degree; instead, they will be able to demonstrate their development through a collection of universally recognised microcredentials. This would have a major impact on higher education. Students would be able to select different providers for different parts of their education. If companies are able to offer accredited low-cost education of an acceptable quality to large groups of users, this will constitute what is known as a "disruptive innovation" in the education sector. There is already growing pressure on higher education to do more with fewer resources.

These trends are currently being thwarted not only by practical obstacles, but by legislation. For example, the current Dutch Higher Education Act (WHW) stipulates that the institution that awards the degree must be the one that provides the core of the curriculum. As such, it is not yet possible to combine elements of the programmes provided by different institutions, let alone for a student to compile their own curriculum based on microcredentials. In the UK, however, there are already plans to open up the traditional education system to commercial providers (see Rubens, 2016). According to the UK's Department for Education, greater competition between higher education providers and innovative newcomers will improve quality and reduce the cost of higher education.

Students as masters of their own learning

A second potential consequence of these trends is that students will become the masters of their own learning process to a far greater extent and will be more responsible for their own learning. This do-it-yourself trend is evident in many areas of society, from health care to producing products using a 3D printer. Asking students to take more responsibility for their own learning is expecting much from them. The question is how enthusiastic students will be at the prospect of having such a vast range of options available to them. This depends, in part, on age: a young student who has just left secondary school will have a greater need for structure than an older student with work experience. Clearly, this also has major consequences for educational institutions. Enabling greater flexibility is a major ask for institutions that have been working with fixed curricula and fixed timetables for decades. Moreover, offering more learning pathways to give students more choice can be an expensive business.

Finally, the use of a personalised education number has major consequences in terms of privacy. The more data that is collected and used, the greater the need for 'privacy by design'. In this case, you take privacy into account from the outset, you only process the personal data required to deliver high-quality education, and you make it clear to students exactly what personal data you are storing and why. Students have to realise that adaptivity can lead to greater

customisation, but that their data will be required for this purpose. The higher education sector must also take this development seriously.

Scope

This report is limited to the 13 trends analysed from a 'customised education' perspective. As a result, a number of trends, such as the use of technologies that enable students to create products themselves, are not covered here. These include 3D printers, the use of FabLabs and enhanced programming options. We are also excluding systems that help students choose courses or assignments based on pattern recognition. Other technological trends include privacy by design (where the design of specific systems allows students to influence the use of their data) and affective computing, whereby software can recognise and interpret emotions. Blockchain technology is not covered either, though this is a trend that should be monitored. As far as customised education is concerned, this technology is still in its infancy.

This trend report similarly does not cover the development of 'learning spaces'. The increasing use of ICT combined with greater diversity in learning activities will have a significant impact on the layout of educational buildings and perhaps on the need for teaching rooms. For example, a reduced focus on lectures may result in empty lecture halls. Online proctoring (the remote invigilation of students taking examinations online at home) may lead to the repurposing of exam rooms.

We also do not address the need for professional development for lecturers or the implementation of prerequisites such as development time. The emergence of a technological trend does not automatically mean that it will be incorporated within the education system. Far more is required in this regard, including leadership and strategy. Professional development for lecturers is also crucial if ICT is to be used effectively in education. There is much to be done here. Recent research indicates that lecturers often have an insufficient understanding of the impact of learning technologies on teaching and learning (Voogt et al., 2016). This report, however, does not explore this issue further.

In conclusion

In the VH and VSNU publications 'Onderzoek met Impact' [Research with Impact] and 'The Digital Society', the Dutch higher education system acknowledges the significant potential impact of technology on education. To what extent, though, are Dutch educational institutions already starting to exploit these technological opportunities? The recent whitepaper 'Customised education in 2016' indicates that institutions are now taking the first steps towards the use of technology in order to provide customised education. In any event, the future promises to be exciting. We trust that the thirteen articles in this report will help educational institutions develop their vision and strategy in this field. We hope you enjoy reading the report and receive inspiration from it.

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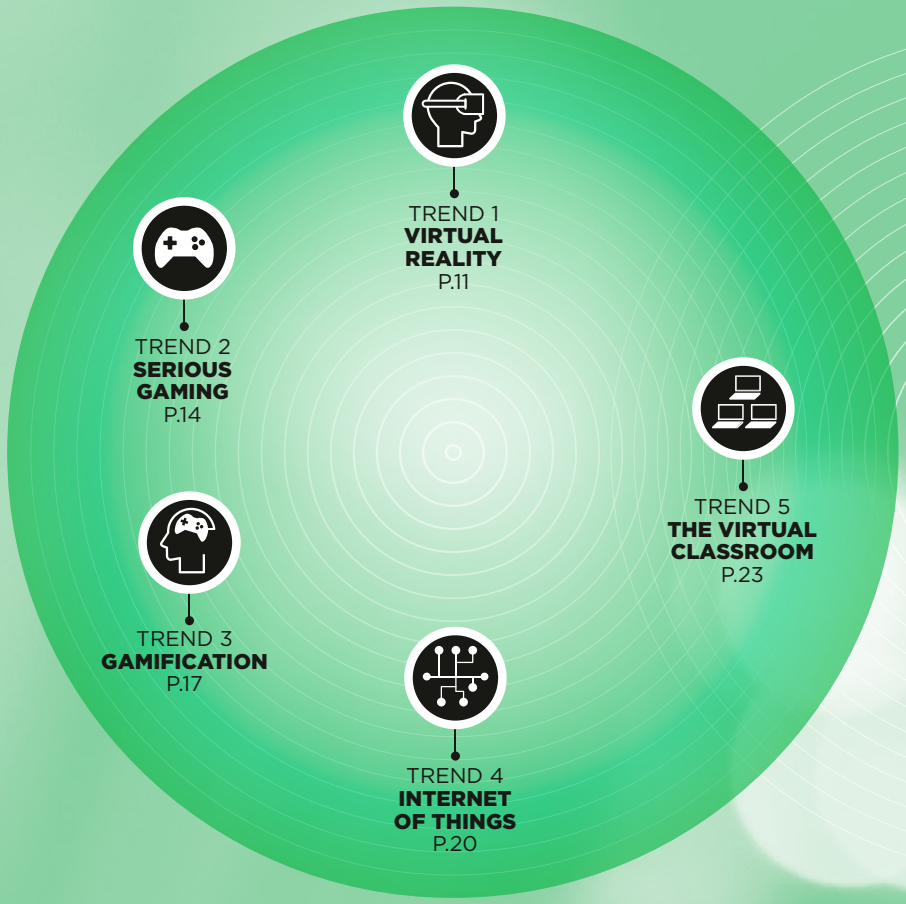
COMMON THEME 1

TECHNOLOGIES THAT CONTRIBUTE TO THE ENRICHMENT OF TEACHING AND LEARNING



1

VIRTUAL REALITY

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Robin de Lange (Leiden University, lead author)
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Jan-Paul van Staalduinen (Delft University of Technology)

FUTURE SCENARIO

Archaeology students attend a tutorial. Following an introduction by the lecturer, the students and the lecturer put on VR headsets. The students look round the virtual world. One student finds a Roman farm in the ruins of the site. The students explore the area and the excavations together: they see the remains of the building along with fragments of pottery and parts of other implements. The students can view a 3D model of the items found and zoom in on important details. They can fill in the missing pieces and walk through a 'restored' version of the farm. They have access to all kinds of scientific data about the remains and findings.

Supervised by their lecturer, the students analyse how to combine the various findings with the geography of the area. This gives them a better idea of the living conditions of the people who lived in the area. The lecturer then selects a different farm in a different location or in a different era. In other words, the lecturer travels through time and space with their students. Back at home, the students can explore the virtual world further and experience the scenarios again.

What is virtual reality?

Virtual reality (VR) simulates reality using a PC or smartphone in order to immerse the user in a sensory experience. As soon as you put your VR headset on, you are inside the 3D world. If you look left or right, the image changes. The latest systems enable you to actually walk around in the virtual world and use controllers to interact in a natural way with objects in the environment. In other words, users can influence the virtual world in various ways.

As well as headset-based virtual reality, there are CAVES. In a CAVE, 2D or 3D images are projected onto the walls of the room, enabling virtual environments to be experienced in a group. Since CAVEs are expensive, this article will focus on the rapid developments in the field of headsets (Oculus Rift, Google Cardboard, HTC Vive).

Virtual Reality is slightly different to Augmented Reality (AR), where digital information is added to the perception of the environment. Visual AR uses smartphones or headsets. Pokémon Go is an example of AR on a smartphone. Examples of AR headsets are Google Glass, Microsoft Hololens and Meta 2. The latter two headsets have potential, but are not yet available to consumers. We will not explore Augmented Reality further in this article.

Two types of content are available for virtual reality. Firstly, there are photos and videos. 360° photos and videos are created using multiple cameras whose images are linked using software. Although VR can be created relatively quickly, interaction remains limited. Secondly, there are virtual environments. Virtual environments are created using game development software, such as Unity3D or Unreal. This type of content offers plenty of scope for interaction and involves few restrictions. With this software, it is relatively easy to create a 3D environment in which you can walk around. However, creating detailed content with a high degree of interaction is a time-consuming business.

Virtual reality in practice

Healthcare and Environmental Technologies Academy, Avans University of Applied Sciences: virtual crime scene
Students participating in the Forensic Laboratory Research module learn how to accurately gather evidence from a crime scene. They do so for both a physical and a virtual crime scene. With the help of VR, students can experience different scenarios. This teaches them the importance of crime scene investigations, how to define hypotheses based on the evidence obtained and how to investigate these hypotheses further.

Healthcare and Environmental Technologies Academy, Avans University of Applied Sciences: Virtual chemical storage
Environmental Science students analyse a chemical storage facility with built-in errors that they have to identify. Not only do they visit a physical storage site, but they have the opportunity to test their knowledge in the virtual environment. This allows them to identify, log and change hazardous situations in a VR environment.

What is the potential of virtual reality for higher education?

Virtual reality can mimic our entire sensory experience of the world. It can therefore be used to help construct the learning environment offered to students, making effective learning experiences with a strong spatial, physical and interactive focus available in the lecture hall or in the student's room. Simulations make education less dependent on time and place. They help students experience important events, exotic locations or future work environments without having to leave the classroom or lecture hall.

Virtual reality makes it possible to travel through time and see what a city will look like as it develops. We can reduce ourselves to the size of a cell and view processes at cellular level. By enriching visualisations with information, we can combine different types of knowledge.

The main potential we see is in enquiry-based learning and practical exercises in virtual environments. There is also a great deal of potential for VR experiences from the professional world and for the practising of practical skills, such as operations or the assembling of machinery.

How can virtual reality contribute to customised education?

Virtual reality can enrich education. Students can decide how, where and when they use VR as part of their own learning process. Students can therefore influence their own learning. They can also use a 360° camera as a study aid, e.g. to record their performance in class.

Although a virtual environment can be experienced with others, a VR experience is essentially an individual one. This offers scope for adjusting the

environment to the preferences and level of the individual. Content can therefore be personalised.

Opportunities and challenges

Virtual reality is often regarded as intensive. It can make users feel dizzy or nauseous. Although hardware and software are continually being improved in order to alleviate this problem, some people are still susceptible to these issues. We therefore recommend working with VR for short periods of time only and alternating VR with other types of learning.

The use of virtual reality in education requires suitable ICT facilities, e.g. sufficient VR headsets. Pedagogical factors also play a role here. How long should the experience last and what form should it take? Should all students wear a headset at the same time, or can they alternate? Remember, too, that VR apps sometimes place great strain on the network.

Virtual reality is a new medium, which is why there is, as yet, little usable content available for education. Furthermore, little research has been conducted so far into the impact of VR on learning outcomes. This effectively means that if you want to use VR in education, you often have to develop your own learning resources (or have them developed for you). As a result, the use of virtual reality in education can sometimes be expensive.

Students can be involved in the creation of content in order to make the development of learning resources cheaper and more accessible. For example, students at Leiden University develop VR prototypes for education. The Healthcare and Environmental Technologies Academy at Avans University of Applied Sciences involves students of Technical IT in its experiments.

Want to know more?

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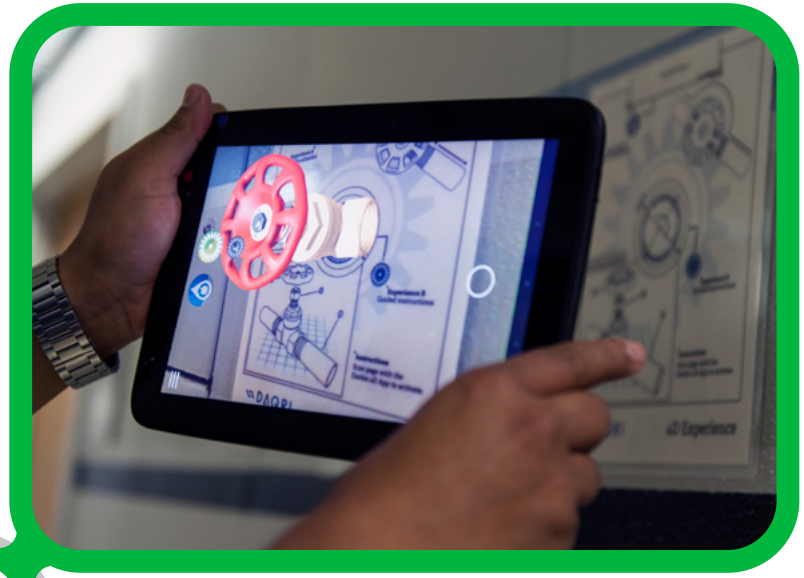
Student feedback

Virtual reality is a fascinating and, more importantly, fun innovation. I think this trend will be highly beneficial for education. Virtual reality makes things possible that are not usually possible for an institution or student. It is a matter of when, not whether it will happen.

However, virtual reality must work towards a specific learning objective. As an institution, it is tempting to invest in virtual reality in order to get ahead of the pack. While this looks good, the question is what value it adds for students. This is why it is important to consider the added value for student learning in every instance. Still, in the future there will be more and more applications for virtual reality in the education sector. As a student, I am certainly looking forward to this.

Jeroen Wienen, general board member of student union ISO (Interstedelijk Studentenoverleg)



2

SERIOUS GAMING

FUTURE SCENARIO

The Hygiene lecturer is very happy. His student Eva has learnt a great deal from the virtual hospital game that he has had developed. Eva genuinely enjoyed the experience. It was as if she was actually standing by the patient's bedside taking observations and examining them. Based on the patient's observations, symptoms and characteristics, Eva was able to make a correct diagnosis and answer her lecturer's questions correctly.

What is serious gaming?

Everyone has their own idea of what serious gaming is. Serious games are games that have been specifically developed as learning resources. Serious gaming refers to the use of games in education. It includes both specially developed serious games and entertainment games that are suitable for achieving specific learning objectives.

When attempting to make a distinction between serious gaming, gamification, simulations and virtual worlds, the terms 'virtual environment' and 'gameplay' are a good place to start. The main difference between gamification and serious gaming is the game context. **Serious gaming** takes place in a virtual environment in which the player can perform actions and see the result of these actions directly. Gaming elements ensure that players are motivated to achieve their objective. With **gamification**, gaming elements such as rewards and competition are used in isolated instances, i.e. outside a virtual environment. Although **simulations** also take place in a virtual environment, they do not usually include gaming elements. Simulations often focus, more than games, on a sequence of actions and work processes. **Virtual worlds**, on the other hand, may include gaming elements.

Authors

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Serious gaming in practice

Warfare
The armed forces have been using military games such as AmericasArmy and, in the Netherlands, Luchtmachtbase-x for many years. The army recognised the added value of games for training and education long before the first games were introduced to the world of education.

Protein folding with Foldit
A good example of the added value offered by a game in higher education is Foldit. Foldit is an online game in which players endeavour to solve one of the most difficult mathematical problems in biology: protein folding. The creators of this game wanted to use gamers' problem-solving skills to find solutions to diseases, and they were successful in their aim. Players solve puzzles involving protein structures and can play against other players or collaborate with them.

Wageningen University: destroy mankind with Plague
Students at Wageningen University are being taught with the app game Plague Inc. The player takes on the role of a pathogen intent on destroying mankind. In the meantime, different countries take steps to prevent this from happening. The player must constantly develop new strategies to stay one step ahead.

What is the potential of serious gaming for higher education?

Serious gaming adds value in particular to learning situations where it is important for students to understand the impact of their actions themselves. However, it can also help change attitudes and encourage reflection. Many entertainment games involve complex ethical issues. For example, having to decide for yourself whether or not to accept the demands being made by terrorists makes a major difference to the situation at hand.

Games can also help with skills training. In recent years, the medical education sector has made great strides in this field. Prospective surgeons often use games to practise their skills in the operating theatre. Another example is a game that has been developed to teach nurses how to lift patients correctly. The game was developed because training courses failed to adequately cover this issue, leading many health care professionals to suffer from back problems. Law students practise their skills in realistic court cases.

The use of (virtual) games/simulations for skills training is also beneficial in terms of logistics: students can practise their skills in situations that in the 'real' world would involve a great deal of time and money. The addition of gaming elements ensures that students actually want to achieve their objective. However, knowledge goals are less likely to be achieved through the use of games, with books and e-learning constituting more efficient learning resources in this instance. Nevertheless, games are often used for this purpose anyway.

How can serious gaming contribute to customised education?

As with other forms of e-learning, serious gaming can be used individually at any time and in any location. Serious gaming is therefore conducive to flexible learning and customised education.
The gaming elements that motivate students to achieve their objectives are a bonus here. Another option is to differentiate *within* the game through the use of roles. This enables students to be assigned roles that suit them within a team or roles that do not suit them so well, thereby giving them an opportunity to practise.

Opportunities and challenges

Serious gaming has significant potential for education in the case of learning objectives where learning through personal experience is important. The higher education sector is showing some interest in serious gaming, with a number of research groups and minors specifically focusing on it (see Serious Gaming Report 2016). The use of digital support and learning resources in education has increased in recent years. The use of (serious) gaming, on the other hand, appears to be lagging behind, although no systematic research in this field has been carried out.

What is restricting the development of serious gaming? One possible explanation is that lecturers are not easily convinced of the potential added value offered by games. A second factor is that innovations often focus on technological innovation rather than on what can actually be done with the technology. Finally, serious gaming has a reputation for being expensive. This is actually not the case, given that there are plenty of good games available free of charge. Systematically collecting games used by educational institutions could facilitate the identification of good practices and provide insight into the reasons why games are not yet being used to their full potential in education.

Want to know more?

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Student feedback

Serious gaming is a logical development when you see how video games are able to bring specific stories or experiences to life and communicate them to the player. Translating stories and experiences into professional practice is certainly an interesting idea and could prove to be a useful addition to our learning processes.

In my view, serious gaming is a good way of combining theory and practice in a secure classroom environment. It allows lecturers to be more hands-on and provide feedback immediately. Serious gaming allows lecturers to bring more practical aspects into the classroom.

It is crucial for the simulations used in serious gaming to actually correspond to professional practice. Otherwise, all you are doing is creating an obsolete scenario where players realise that it is 'just' a simulation.

Jasper Schöbel, secretary of student union JOB (Jongeren Organisatie Beroepsonderwijs)

3

GAMIFICATION

Authors
Jochem Goedhals (Fontys University of Applied Sciences) and
Judith Zwerver (Saxion University of Applied Sciences)

FUTURE SCENARIO

Timo has used up all his Educoins. He swipes through his personal dashboard and sees his coach's recommendation for him to complete a skills training course. This will cost him two Educoins, which he does not have. Educoins are somewhat like bonus points: students can earn them through their academic performance and use them to 'pay for' courses. Timo is working on his fourth online module, in which he attains knowledge and skills that will enable him to undertake a new role at the company where he currently works. By clicking on different parameters, he can see the development level he is currently working at (feedback) and what he needs to do to get to the level that he requires for his new role (feed up). Timo decides to schedule a meeting with his offline coach. He wants to ask what challenges or activities (feed forward) he needs to perform in order to earn new Educoins, so that he can make progress in his personal learning process.

What is gamification?

The above scenario describing gamification in education could be closer to reality than you think. Gamification is the use of gaming principles in the 'real world' and is currently part of our everyday lives. Examples include the popular game Pokémon Go, or collecting points at the supermarket to obtain a reward in the form of a discount or gadget.

Gamification may offer a solution for today's students, who are becoming disengaged with learning much more quickly and need new incentives to hold their attention. The use of gamification in education could, for example, take the form of students gaining additional presentation time or a Skype meeting with an expert when they achieve different levels (or checkpoints).

Recent research indicates that gamification has a positive impact on students' learning experience. However, this impact often decreases when the novelty wears off. People often think, incorrectly, that gamification simply means adding gaming elements, such as badges, scoreboards and levels, to the learning. This can actually have the opposite effect: it reduces motivation and engagement

because there is no link to the learning process and the gaming elements simply distract the student.

In other words, gamification does not simply entail the superficial use of gaming elements; it is more thoroughly integrated into the learning design. It is an educational concept that educational institutions can use to motivate students in their learning process and engagement. The ultimate objective is to improve the effectiveness of the learning.

Gamification in practice

Saxion: Chocolates for hydrologists
Students seem to find geohydrology extremely difficult. Lecturer Kristoff Derveaux listened to this feedback and, with the help of an instructional designer, redesigned the topic and "gamified" the course. He used a number of different gaming mechanisms: 'collection', by awarding badges when students achieve a certain number of points or levels, 'challenges', by offering quizzes, online exercises and wikis, 'ratings' in the form of a leaderboard, 'levels', by making exercises increasingly difficult, and 'rewards', by rewarding weekly winners with Belgian chocolates.

Fontys: Icebreaker game for primary schools
Students participating in the Kind Leren Media (Child Learning Media) minor go on a work placement at a primary school. During this work placement, students have to design an innovative educational concept. In a joint session, groups of students work together to design their own icebreaker game for pupils. Following the initial design session, the students adapted their prototype using 52 Playgen cards and supported it with well-known gaming elements such as: game motivation, rules of play and social mechanisms.

What is the potential of gamification for higher education?

It is clear from the examples given that gamification can be used for a number of different purposes. It helps increase students' motivation and engagement in the learning process (fun factor). Gamification can also be used to take into account differences between students (adaptive learning), increase the effectiveness of the learning, increase creativity and flexibility, and help students find out about new learning strategies.

How can gamification contribute to customised education?

The use of levels is conducive to customised education. Levels can be used to build in different degrees of difficulty and create a learning environment for every student at their own level. For example, the educational institution can offer tasks at different levels and assign different rewards to each (more points or fewer points). Learning analytics can then be used to match the learning process more closely to the level of the students, so that they can ultimately manage their own learning.

Gamification combined with smart technology allows data on students' performance to be collected. On this basis, the educational institution can provide students with customised teaching materials and tasks (adaptive learning environment). These tasks challenge the students and give them a sense of achievement. Gamification also allows for immediate feedback to be provided on the student's actions.

Opportunities and challenges

One potential problem is that if the gaming elements are not linked to the learning process and serve as a distraction to students, gamification can reduce students' motivation. Thus, it is important for gamification to become an integral part of the overall educational concept.

In addition, the use of gaming elements in education requires a customised approach. After all, what works in one situation may not work in another.

Consequently, full use must be made of lecturers' expertise if gamification is to have a lasting impact. The lecturer is most adept at deciding on the right material for their students. It can, however, be difficult for lecturers to keep track of the progress and learning achievements of their students, because so many changes and group activities take place on a daily basis.

Gamification is associated with a large number of rules of play that students and lecturers need to understand and learn to apply. This may slow the group process down.

If gamification is to be successful in the long term, the course must be designed in such a way that it includes the following elements: 1) students can make mistakes, 2) students obtain immediate feedback on their actions, 3) the progress students make is clear, 4) the gaming elements take the form of a story.

Game over!

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Student feedback

Gamification is a highly interesting development. The addition of a gaming element to a course can help and challenge students to develop skills and acquire new knowledge. Learning resources can occasionally be uninteresting and hard to understand. By adding a gaming element, you challenge students to engage with the material.

In my view, playing a 'game' and developing your talents at the same time is something that genuinely appeals to students. In other words, I think gamification has potential in education. One thing to consider is that games generate valuable data, which must be dealt with sensitively.

Thijs Tempel, general board member of student union JOB (Jongeren Organisatie Beroepsonderwijs)

4

INTERNET OF THINGS

Authors
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FUTURE SCENARIO

One autumnal Monday morning, Business Management student Michiel wasn't happy to have been woken up half an hour earlier than planned. His alarm clock had received information that his journey time to the campus would take half an hour longer than usual due to public transport problems. He now regrets ever having set up these Smart City services. Luckily, however, his coffee machine also automatically starts brewing his coffee half an hour earlier than usual.

Four hours later he wakes up with a start, this time because his mobile phone is vibrating next to his pillow. He has a new message from a missed campus beacon: "BIO2 practical 23/11 10-12: 2nd absence. Replacement assignment is ready in your portal", with a link to the recording of the practical session below it. He clicks on the link, but it doesn't work. He tries twice more without success and then goes back to sleep.

What is the Internet of Things?

Although a number of different definitions are currently being championed, the Internet of Things (IoT) can be described in a nutshell as a network of smart physical objects. We call these objects 'smart objects' because they have sensors that enable them to collect information about themselves and their environment, and link this information to the digital world '[1]. Processor capacity and memory power enable this data to be processed into useful information efficiently. This information can be shared with other objects via a network.

In this narrow definition of the Internet of Things, interaction is limited to communication between objects. It is also known as M2M (machine-to-machine) communication. In a broader definition, we talk about the Internet of Everything (IoE), which involves objects, people, data and processes interacting smartly with one other[2]. This article is based on this definition.

The technology required for the Internet of Things is becoming ever smaller and cheaper. Furthermore, the requisite connectivity is now available, including

4G and 5G networks and dedicated networks for devices with limited battery power such as LoRaWAN[3]. Another aspect is the development of cloud applications, which is set to have a significant impact on the situation. Since any object can be made smart, the potential applications are endless[4].

The Internet of Things in practice

Utrecht University: Studyspot

A number of research universities and universities of applied sciences are already using smart study space apps. One example of this is the Studyspot web app developed by Utrecht University[5]. This app helps students find an available study space on campus quickly and easily using their mobile phone. The app contains a database of buildings and work spaces, and the availability of work spaces is updated by the work spaces themselves and communicated to the central database. This information is based on the login status at PC workstations and is supplemented by information on bookings in the timetabling software.

What is the potential of the Internet of Things for higher education?

As things stand, it seems unlikely that this technology will transform the education sector in the way that it is expected to transform other sectors[6]. However, the Internet of Things has a great deal of potential, particularly when it comes to Learning Analytics. The Internet of Things offers brand new, cost-effective methods of data collection. These methods can be used to collect data about students in order to assist the lecturer. It also has potential applications for helping students organise their studies more effectively. Finally, the students themselves can proactively use sensors and smart objects to help them in their learning and research.

On campus, sensors and smart devices can be used to organise educational logistics. Managing the availability of teaching rooms is one example. However, they can actually do far more than that. Imagine classrooms or flexible work-spaces that adapt to the number of students present, their activities and their study requirements. Examples include more quiet rooms during exam periods, more collaborative spaces or social spaces at other times of the year, etc.

Another example is the use of campus beacons. Beacons are physical objects that transmit local information ('I am here') and are able to make contact with applications on mobile devices in the vicinity. For example, a beacon can be used to record the presence of students in lecture theatres.

The Internet of Things and the Internet of Everything can also be used to stimulate (social) learning experiences in a physical space. Using data about the attendance, activities and study requirements of students, it is possible to create dynamic learning hotspots that stimulate interaction between students. What if the table at which you have lunch in the cafeteria could help you network? What if you were directed to a flexible workspace where you would sit next to students who are wrestling with the same method as you or who wrote a thesis under the same professor last year?

How can the Internet of Things contribute to customised education?

The Internet of Things is expected to result in an improved learning experience for the individual student. The Internet of Things facilitates individual experiences and feedback and supports new forms of learning. It can also enrich student analytics[7] in many different ways. The Internet of Everything can offer learning experiences that are far more authentic and personal than are currently possible. Reflection is based on both real data and data enriched by the environment, and is embedded in an authentic learning environment with physical interaction options.

Opportunities and challenges

The main advantages of the Internet of Things are the intuitive interaction that it provides, the high level of personalisation and the cost-effectiveness of the

process. The Internet of Things makes mass tracking and tracing extremely easy, which may simplify the acquisition of big data for learning analytics and educational logistics.

The primary disadvantage of the Internet of Things is privacy and security issues. The Internet of Things involves the transmission and storage of large quantities of personal data, which makes tracking and tracing relatively easy and accessible. This raises the question of who has access to this data and for what purposes this data can be used. The use of the word 'can' in particular is rather vague.

As well as data storage, the reliability of the data itself is an issue. With the Internet of Things, large quantities of data are automatically collected and processed. The quality of the data depends on the quality of the sensors and the software used.

The success of the Internet of Things also depends on the extent to which the 'industry' manages to develop workable standards. These standards must ensure that the user experience is so intuitive that Internet of Things applications will be accepted and purchased by the general public. Finally, there is a risk of organisational resistance and a lack of willingness to adapt to new technologies[8].

Footnotes

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4 Timmer, J.W, Vermeent, W. (2015), *Internet of Things*
5 Universiteit Utrecht, *Studyspot*
6 Timmer, J.W, Vermeent, W. (2015), *Internet of Things*
7 Also see the article concerning Learning Analytics on page 43 in this trend report.
8 Gartner Predicts 2016: *Unexpected Implications Arising From the Internet of Things*

Student feedback

In my view, the Internet of Things could make education more accessible to students. If my timetable is linked to my phone, it is easier and quicker for me to find out about timetable changes, which saves me a train journey. It is also easier for me to make an appointment with my mentor, because I can schedule the meeting myself in his diary. At the moment, I often have to wait for a reply, which can sometimes take weeks.

I think the Internet of Things will definitely be a good thing for education. Not only will this trend totally transform the education system, it may make a number of aspects easier for students. I do believe, however, that it is important to ensure that students' privacy is not adversely affected as a result.

Rick de Wijk, chairman of student union JOB (Jongeren Organisatie Beroepsonderwijs)

5

THE VIRTUAL CLASSROOM

FUTURE SCENARIO

With research universities and universities of applied sciences using virtual classrooms in all of their programmes, students are able to participate in interactive learning activities from home or their workplace. For example, Ralph is on a work placement at a media company and regularly takes part in supervised feedback sessions with his peers and his mentor through a virtual classroom. During these sessions, Ralph can ask questions and hear about the experiences of his peers. The sessions do not usually last very long and prevent the student from having to go to the campus.

Francien is doing a Master's degree in Experimental Physics. Her lecturer organises virtual classrooms in preparation for face-to-face meetings. The lecturer introduces the topics and the students can discuss them with each other. Last month the programme organised a virtual excursion to CERN's Large Hadron Collider in Geneva. The lecturer used the latest virtual glasses, so the students could see the lecturer's observations directly. In effect, the classroom was relocated to Switzerland for a one-off visit.

What is a virtual classroom?

A virtual classroom enables simultaneous communication and interaction between the lecturer and students and among the students themselves. A virtual classroom endeavours to mimic the dynamic of a 'real' classroom, challenging students to actively engage in the learning process. The lecturer organises tutorials for a group of students using video, audio, voice chats, text and additional tools. A virtual classroom therefore offers far more opportunities for interaction than a webinar, for example.

Virtual classrooms come in many different forms. In this article, we focus on the 2D virtual classroom. Well-known applications include Elluminate / BlackBoard Collaborative, Adobe Connect, WizIQ and Vitero.

Author

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When participants log in to a virtual classroom, often the first thing they see is the lecturer who will deliver the material. The presentation will also be visible. During discussions, the display can be adjusted so that the students are clearly visible. Often the students can share the contents of their screens with other students. They can put their hands up virtually and talk to each other through headsets. The lecturer can gauge opinions quickly using a poll. Virtual breakout rooms enable smaller group activities to take place.

A virtual classroom has the following features:

1 Direct interaction

In a virtual classroom, direct interaction is essential between students and the lecturer, among the students themselves and between the students and the (online) resources. This requires a specific design that enables students to actively engage with the learning materials and to be supported in this process.

2 Synchronous

Virtual classrooms are primarily used for synchronous (simultaneous) learning activities. The virtual classroom connects participants in different locations at the same time. Furthermore, it is often possible to record a session, so that it can be reviewed at a later date.

3 Learning community

As in a real classroom, learning activities in a virtual classroom take place within a learning community. The extent to which the student actively engages with the learning is determined by the design of the learning activity and the extent to which the participant feels involved in the learning community.

The virtual classroom in practice

Open Universiity: uses Blackboard Collaborate

The Open University uses Blackboard Collaborate, which enables tutors to organise online meetings with students, which can take the form of online lectures, supervision meetings or even oral exams. Working with a virtual classroom fits well with the Open University's learning model, which focuses on self-managed learning where students study in their own time and at their own pace. Face-to-face meetings are organised, and students appreciate the direct contact with tutors and feedback from tutors that these meetings provide. However, it is difficult to coordinate these meetings with the pace at which students are working. With a virtual classroom, the advantages of direct contact between students and the tutor are retained, and students do not have to travel to a physical location for their studies.

What is the potential of the virtual classroom for higher education?

Although direct interaction is important, it is often difficult to bring students, lecturers and (online) resources together. A virtual classroom may offer a solution to this problem. It may also be relevant to professionals who are studying part time or undertaking refresher training. Another advantage is that in a virtual classroom, students from different countries can follow the same course together online.

A virtual classroom can be used in fully online and blended learning. In the latter instance, the virtual classroom can be designed as a "flipped classroom". In other words, the lecturer can deliver instructional material through a virtual classroom prior to a face-to-face meeting. The face-to-face meeting can then be used to delve further into the learning.

The strength of the virtual classroom lies in the direct interaction provided and the resulting group dynamic. The expectation is that students will be less inclined to disengage from the learning than would be the case for asynchronous forms of distance learning. Other advantages of this direct interaction include the ability to provide immediate feedback and exchange different points of view.

In a virtual classroom, participants can also ask questions and issue comments through text messages (sometimes also via Twitter) without interrupting the lecturer or their peers. This means that the contributions of all of the students involved are visible and can be used at a later stage. Moreover, formulating these questions and comments also helps students with their learning.

How can the virtual classroom contribute to customised education?

The higher education sector is increasingly encountering the demand from students for personalised, flexible learning paths. The target group is becoming more diverse and comprises students at the start of their careers and professionals looking to further develop themselves. They have different learning requirements and different needs in terms of content, learning activities and the timing and location of the learning. A virtual classroom can play a useful role in this context. It enables students to study in a location that is convenient for them. It engages students remotely in the learning content. A virtual classroom also allows students to be brought together and work in groups in a location that suits them.

Opportunities and challenges

A virtual classroom enables location-independent learning: students can participate from home or from their workplace. Virtual classrooms offer more interaction and a better group dynamic than conventional (asynchronous) online learning and enable feedback to be provided immediately. A virtual classroom also offers extensive opportunities for collaboration, not least between students from different countries. Finally, there are also opportunities for 3D applications. The use of 3D applications such as VirBELA (see video), Second Life, Active Worlds and Kaneva goes one step further in the direction of virtual worlds: they simulate a 3D learning environment. They use a game engine that enables students to enter the 3D Classroom, a sound engine for effective oral communication between participants and, for example, VR glasses that make students feel as though they are actually in the virtual world.

A possible disadvantage is that the lecturer is unable to see the students as they would be able to in a standard classroom. It is difficult to gauge when students disengage with the learning or experience other problems with the content. Part of this problem can, for example, be solved by using emoticons. If a virtual classroom setup is to be successful, students must have a good Internet connection and a laptop or desktop. If one of the participants has a slow connection, this may affect the experience of the other participants. However, in recent years the technology has improved significantly: the first virtual classrooms for tablets and smartphones are now on the market.

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Student feedback

I think virtual classrooms are a positive innovation. Using virtual classrooms makes learning more fun for students. Another positive aspect is that students can take part in the classes from anywhere in the world. This makes it easier to follow different classes. Using virtual classrooms also means that you can review the class at a later stage. This is extremely useful for students. In my view, virtual classrooms have a great deal of potential in senior secondary vocational education (MBO) institutions.

For me, though, a virtual classroom is an add-on and should not replace face-to-face instruction. Personal contact is important for students' learning. The cost of the classes has to be taken into consideration too. Education costs simply cannot increase any further.

Roosmarijn Dam, treasurer of student union JOB (Jongeren Organisatie Beroepsonderwijs)

COMMON THEME 2

TECHNOLOGIES THAT FACILITATE THE INCORPORATION OF FLEXIBILITY IN EDUCATION

6

STUDENTS AS OWNERS OF THEIR ONLINE IDENTITY

Authors
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Pieter van der Meulen (SURFnet) and
Arnout Terpstra (SURFnet)

FUTURE SCENARIO

Laura believes that it is important for her to develop different skills and acquire specific knowledge during her studies in order to build up an attractive portfolio. She has just returned from Berlin, where she has been studying for the last six months. She really enjoyed studying abroad. As she has had a single unique educational identity since she first enrolled at her university in the Netherlands, she was able to log in easily using her own personal Education ID while she was studying at the educational institution in Berlin. This gave her access to a range of different digital tools and applications that she herself selected. Furthermore, the marks she obtained are linked to her Education ID. This means that once she is back in the Netherlands, she can prove that she successfully completed these modules. In addition to her usual lectures, Laura plans to take a couple of short online courses in the evenings at a different university in the new academic year. She was able to arrange this quickly and easily using her unique Education ID.

What is online identity?

Identity and identity management involves identification and authentication. Identification focuses on establishing a student's identity. At present, this is done on the basis of a registration form, copies of educational certificates and proof of identity, a passport photo and a visit to the institution itself. Once the identification process is complete, the student receives a digital identity, i.e. a user account that they can use for authentication purposes. This user account, which is generally protected by a password, gives the student access to the institution's online service portfolio. This includes, for example, the student portal, details of timetables and marks and educational content (courses). A strong(er) form of authentication, e.g. an SMS, provides an additional check when logging in. This is, of course, not necessary if a student is registering for the faculty BBQ, but makes sense if they are registering for an exam, taking an online assessment or wanting to consult their marks. A good balance needs to be struck between identification and authentication. An institution can only decide what a student is able to do in an application once the student's identity has been properly established. We call this authorisation.

If the student owns their identity, this can, for example, be derived from a digital base identity. This can then be supplemented by a unique education number that the student can use throughout their life. With this unique identity, all of the student's academic results can be retrieved and checked, irrespective of where in the world these results were attained. The student benefits from this identity and is responsible for it. Consequently, students must always ensure that their results and portfolio are as complete and up to date as possible.

An online identity gives students a greater degree of freedom and helps make education more flexible. With an identity, every student can move freely within the digital learning environments of different institutions: they can register and apply, consult their marks and give feedback.

Online identity in practice

SURFconext

SURFconext is a good example of collaboration beyond (national) institutional boundaries. It allows institutions to integrate services and applications from the cloud into their own processes and systems according to their requirements. In addition, students from a number of different institutions can collaborate in EDUgroepen or SURFdrive or via services provided by the institution itself. With SURFconext, identification and authentication are simple, and management, licences, contract arrangements and technical connections to services are straightforward. A centralised solution like SURFconext can act as a link between the identity of the student and the characteristics that must be assigned to this identity.

What is the potential of students' ownership of their own online identity for higher education?

Educational institutions are keen to foster and protect their students' identities, both as part of their statutory duty of care and for marketing reasons. If they no longer manage students' identities, there will undoubtedly be more movement and competition on the education market. This will help make education more flexible: students will have more choice and will 'shop around' to a greater extent. This freedom of choice for students will enrich the education sector and encourage institutions to improve the quality of their programmes, their range of digital options and their services.

Students will likely find this innovation rather straightforward, especially if the roles and responsibilities of the student and the institution are clear and the identity system is secure and easy to use. Furthermore, the current generation is already quite comfortable with using a wide range of more personalised concepts and applications in their digital world. Examples include social media, initiatives such as Airbnb and Uber and educational trends such as blended learning and flipped classrooms. It is crucial, however, that institutions mutually agree from the outset what is and what is not permissible and how information should be shared. Standardisation is essential.

How can online identity contribute to customised education?

A good, reliable online identity is an essential prerequisite for flexible learning and customised education. If students own their own identities, a whole new world opens up to them. They have far greater scope to study where and when suits them and far greater access to all kinds of online courses and tools. For example, a student can combine a course at the University of Tokyo with an intensive online refresher course at the University of Munich. A single unique identity allows the student to access a wide range of study programmes all over the world without the need for convoluted and time-consuming registration procedures and awkward changes and transfers.

A reliable identity is also important for obtaining micro-credentials. The certificates and badges acquired by a student can be linked to an identity, which makes it easier for them to prove that they have successfully completed a particular course. The high degree of accessibility and freedom of choice also enables students to collaborate securely and confidently with their peers. They can specialise by taking extra modules and additional courses at other

educational institutions. This enables them to learn according to their own requirements and in a customised way.

Opportunities and challenges

Changing ownership of a person's online identity is a long and complex process. Significant investments are required in order to develop a (new) technical infrastructure, as are agreements between the government, institutions, service providers and users with regard to policy, technical interfaces and costs. If students are to own their own identities, the system enabling this must strike a good balance between user friendliness, security and privacy. This is a huge challenge that will require intensive collaboration between the various educational institutions involved both within the Netherlands and abroad, i.e. between users such as students, lecturers, researchers and employees, and between management, ICT, internationa-lisa-tion and communication. The process involved is too expensive, time-consuming and complex for institutions to tackle it alone. Collaboration with other institutions under the umbrella of SURF, for example, will produce results and provide opportunities. It allows institutions to benefit from each other's knowledge and experience. The resulting economy of scale speeds up the process, allowing institutions to focus more on direction and far less on management.

Meer weten?

- Erik Huizer (2016), *Who are you in cyberspace?*
- SURFconext (z.j.), *Website SURFconext*

Student feedback

Argument for ownership of your own online identity: it will probably make education more flexible because it will give students more choice, allowing them to 'shop around' to a greater extent. But is this a good thing for education? Do we want it to be more like a supermarket? Does the quality of education improve through greater competition? I very much doubt it. For example, making the funding of educational institutions even more flexible could be disastrous for the continuity of knowledge and research, as we saw at the University of Amsterdam where an entire faculty almost disappeared. This gave rise to some extremely high-profile protests. Having control over your online identity is a good thing, but it must not be used as yet another pill in a system that always wrongly assumes that competition is the cure for all ills.

Jarmo Berkhout, chairman of student union LSVb (Landelijke Studentenvakbond)

7

DIGITAL BADGES AND MICRO-CREDENTIALS

Authors
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FUTURE SCENARIO

"Yes! I've got a gold badge for my '17th century history' module!" shouts Leah. "I missed the class on 'seafaring' but thanks to my video blog of our visit to the National Maritime Museum I've completed the badge. I'm going to put it on LinkedIn straight away. Maybe I'll get that internship at Christie's after all!"

Leah's mother Marianne is also on the computer. She has been looking for a job as translator for a few months now. But Marianne has not been idle in the meantime: she has completed the English for Doing Business in Asia MOOC on EdX and been awarded a badge by Hong Kong University. Today, she is preparing for an interview with an Asian investment bank that contacted her as a result of this badge.

Wat zijn badges en microcredentials?

A badge is a digital icon that indicates the knowledge or skills a person has acquired in a particular field. A badge contains links to information on acquired knowledge or skills as well as the underlying evidence and details of the body that issues the badge. Employers, educational institutions, professional organisations and other stakeholders can verify the claim online. They can therefore be sure that the claim made by the badgeholder (the student or professional who is undertaking further learning) is genuine. The student owns the badge and decides how and where on the web they want to display it.

Open badges make it possible to combine badges from different institutions. By using an open framework, students can collect their badges in a 'backpack' (similar to an e-portfolio). They can then make their badges available to third parties.

Badges pave the way for a potentially radical change in education: the introduction of micro-credentials. At present, students who follow accredited higher education programmes obtain only a single formal confirmation of the knowledge and skills that they have acquired during the course of their studies, i.e. a Bachelor's or Master's degree. With micro-credentials, however, educational institutions break their programmes down into smaller units to which they link an assessment or

recognition. They can offer these individual units not only to their own students, but to other new target groups such as schoolchildren or professionals. The institutions can then issue digital badges to anyone who successfully completes such a unit. As a result, these units have a value in themselves. The fact that an educational institution awards badges for particular achievements does not automatically mean that it will award credits for them within the standard curriculum. An institution or study programme can also use badges for other purposes, e.g. as gaming elements within a course.

Badges and micro-credentials in practice

Concordia University Wisconsin: Master's in Educational Technology
The 125-year-old Concordia University Wisconsin has an online variant, Concordia University Online, which currently provides education for 2,400 students. Since August 2014, this university has offered an online masteropleiding in Educational Technology, which is aimed at educational innovators. This master's programme, to which students are admitted every eight weeks, comprises more than 50 modules. Each module is associated with a badge. Students can display these badges on their profile or on the Internet. Depending on the pace at which they work, students can complete the Master's in one to two years.

Micro-credentials and MOOCs
MOOCs demonstrate how educational institutions can offer non-formal education in the form of courses. A student who successfully completes a MOOC or a series of MOOCs can be awarded a certificate. The various platforms refer to the latter as nanodegrees (Udacity), specialization (Coursera) and programs (Futurelearn). EdX also offers a number of MOOCs that allow students to transfer their achievements as credits to a standard programme provided by a number of (US) educational institutions. Students can display their achievements through badges or (digital) certificates. They may be 'verified', which means that the student's identity has been verified and, where applicable, an examination has taken place under controlled conditions.

What is the potential of badges and micro-credentials for higher education?

The use of badges and micro-credentials will allow the higher education sector to reach new target groups, particularly professionals. People in this target group often do not want to follow an entire degree programme, but only specific parts of it. They then want to be able to demonstrate that they have completed this additional learning.

Badges can also play a role in accessing Master's programmes, for example, where they provide a new tool for the recognition of prior learning (RPL). For (potential) employers, badges help clarify the courses a person has completed: badges make the individual skills more transparent.

Finally, micro-credentials and badges help align formal and non-formal learning (see second case study above). The recent publication *European guidelines for validating non-formal and informal learning* offers guidance on this. The publication calls for greater recognition of informal and non-formal learning, in which it maintains that micro-credentials should play a key role.

How can badges and micro-credentials contribute to customised education?

Badges allow a discrete value to be assigned to individual modules. This makes the available education more flexible, because students have greater freedom of choice when building their curriculum. Students can look for modules (for which they can earn badges) that suit their own background and learning pathway.

Opportunities and challenges

Students and professionals can choose from a wide range of flexible programmes anywhere in the world. They are no longer dependent on the programmes offered by a single educational institution. Educational institutions benefit in the sense that they can reach new target groups with their

programmes. The downside of this is the potential fragmentation of education. This may jeopardise the goal of 'Bildung', or rather students' all-round personal development. Can this be adequately guaranteed if everyone follows their own learning pathway? Who will monitor the consistency and level of a curriculum created in this way?

Another potential challenge is that students may, in the initial phase of their studies, be less inclined to complete a full Bachelor's or Master's degree if an employer is happy for them to take a shorter learning pathway whose completion results in a badge. The volume of administrative work will probably increase, because there are far more results to be recorded in the case of micro-credentials. On the other hand, recognition of prior learning (RPL) will be more straightforward and may make transfers easier.

If educational institutions want to use badges, they have to make a number of choices. They must decide which learning achievements they want to award badges for (accredited or non-accredited courses). They must also define the scope of the units they want to award badges for and decide whether they want to use the badges internally only or display them externally as well.

In summary, badges, used as micro-credentials, are an ideal way of making education more flexible and combining non-formal and formal learning. Clearly, however, this entails risks, because the diploma system that currently guarantees the value and cohesion of the education provided will be put under pressure. The education sector's job is to now experiment with a range of options and mutually decide on exactly how it wants the sector to evolve. The aforementioned EU publication *European guidelines for validating non-formal and informal learning* may offer guidance on this.

Want to know more?

- Cedefop (2015), *European guidelines for validating non-formal and informal learning*
- Educause (2014), *7 things you should know about Badging for Professional Development*
- ELI Brief (2015), *Developing a Higher Education Badging Initiative*
- European Commission (2016), *Validation of non-formal MOOC-based learning*
- SURFnet is also due to publish a white paper on this topic in December 2016

Student feedback

I think badges are an interesting idea. They give students a lot of scope to decide for themselves which areas they want to focus on. Badges definitely have potential for education. They give students more control over their own curriculum. This allows them to differentiate themselves from other students and to gain recognition for this.

Obtaining a degree is important for students, but the 'Bildung' (personal development) aspect should not be ignored. It is important to ask yourself, 'What am I actually learning from my studies?' In this context, this trend has two sides to it: the first is that it makes specific skills transparent, which is a good thing. The second is that it is important for students to be offered a loosely related collection of topics rather than a complete set of skills. As things stand, then, I see badges primarily as a useful addition to standard programmes.

Jeroen Wienen, general board member of student union ISO (Interstedelijk Studentenoverleg)

8

FROM OPEN CONTENT VIA OPEN PEDAGOGY TO OPEN EDUCATION

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FUTURE SCENARIO

On her way home, Anne, a lecturer in psychology at a university of applied sciences, reflects on her day. It started well with a group of students proudly showing her some feedback on a draft essay from a peer group from Brazil. Another group had independently learnt the basic principles of developmental psychology through an MOOC and was busy writing a digital summary. Their first draft was so good that Anne is keen to share the end result as an open learning resource with colleagues on other programmes. Tonight, she will check on a forum where she wants to give some feedback before she goes to her weekly orchestra practice.

What is open pedagogy?

The opportunities for sharing and reusing learning resources are growing all the time. This is demonstrated by the growing number of repositories, the open platforms that offer open courses (massive or otherwise) and the many open tools that can be used in the education process. The focus is moving from the potential of open content to its application in everyday educational practice. The key question now is: how can open education be used to improve teaching and learning? A greater focus on the use of open features in educational practice will ultimately lead to greater flexibility across all aspects of education. Students will, for example, have far more influence over their own learning process, which will be fuelled by personal motivation, interest and talent. In other words, we will see customised education (Dumont, Instance & Benavides, 2010).

A number of different terms are important in this context:

- **Open content** is creative work (such as text, images, audio or video) published with an open licence (such as Creative Commons) that explicitly permits it to be copied, edited and distributed (SURF, 2015). Open content for educational purposes is also known as Open Educational Resources (OER).
- **Open education** refers to practices and activities that aim to make education more open (Open Education Handbook). In their 5COE model, Mulder & Janssen (2014) set out five components of open education:

content, services, teaching efforts, learners' needs and the requirements of society in general. Institutions can use this model to determine the degree of openness of education.

- The definition of **open pedagogy** is not yet set in stone. We have opted to use a slightly revised version of Hegarty's definition (2015), since it is the most practical and therefore offers useful points of departure for lecturers who want to make a start in this field.

Open pedagogy is a method of teaching and learning containing one or more of the features outlined in the diagram below:

Hegarty, 2015

Open pedagogy in practice

Fontys University of Applied Sciences ICT: Human Centered Design
At Fontys University of Applied Sciences School of ICT, the Media Design module is a mandatory part of the course. In the second year of their studies, students work for an extended period on project assignments provided by IDEO.org. This organisation designs products and services that aim to improve the lives of people in poor and vulnerable communities. They take what they refer to as a Human Centered Design approach, part of which involves organising challenges. The students worked on a challenge called "How can we supply people in need with healthier food?". They used the OER available on IDEO.org to find out about the organisation's approach. They also used the online platform on this website to share their knowledge and receive peer feedback on their design. The group obtained the best score for achievement of the learning objectives for the module. The students said that they found the connection with the 'real world' extremely rewarding and educational.

This case study illustrates the following features from the diagram on this page:

- Learners are connected via social media and share their ideas, knowledge and resources (a);
- Shares ideas freely for knowledge development (d);
- Part of a community of professionals (e);
- Uses reflective practices such as peer feedback (g);
- Contributes to peer review (h);

What is the potential of open pedagogy for higher education?

Open pedagogy broadens the range of teaching and learning methods that lecturers have at their disposal. This may improve the quality of higher education.

The broader range of teaching and learning methods facilitates the creation of richer learning opportunities. This gives rise to an educational setup that trains students to become skilled knowledge workers. While lecturer-centred lectures

will still be appropriate for some topics and students, this does not preclude the use of open pedagogy.

A more widespread use of open pedagogy will also bring with it other advantages associated with an open (or at least more open than at present) approach to education, such as greater accessibility of education and efficiency through the sharing of learning resources.

How can open pedagogy contribute to customised education?

Open pedagogy offers lecturers more opportunities to create customised education, because resources and people (community) are more accessible. If they consider the features offered by open education, lecturers will have more scope to deliver customised education to their students. Open pedagogy helps lecturers select appropriate methods of teaching and learning based on their approach to education.

Opportunities and challenges

Professional development initiatives will be required in order to make stakeholders at all levels of the institution aware of the opportunities offered by, and the need for, open pedagogy. Attention must also be paid to other factors that will speed up adoption, such as support for lecturers or a strong figurehead within the institution. Moreover, open pedagogy is a concept that is still in its infancy: examples of good practice must be shared and institutions must experiment with different ideas.

Open education is a broad term and offers many opportunities. Nevertheless, it is not enough to focus on open content alone. Open education offers a great deal of scope, e.g. using the best learning resources and improving them through sharing. It is high time for these advantages to be embraced by higher education institutions at all levels of the organisation. If full advantage is to be taken of the opportunities offered by open education, both lecturers and managers must play their part. Lecturers can incorporate open pedagogy into everyday practice (bottom-up), while managers can take strategic and policy-related measures to enable open education and define a vision (top-down).

Want to know more?

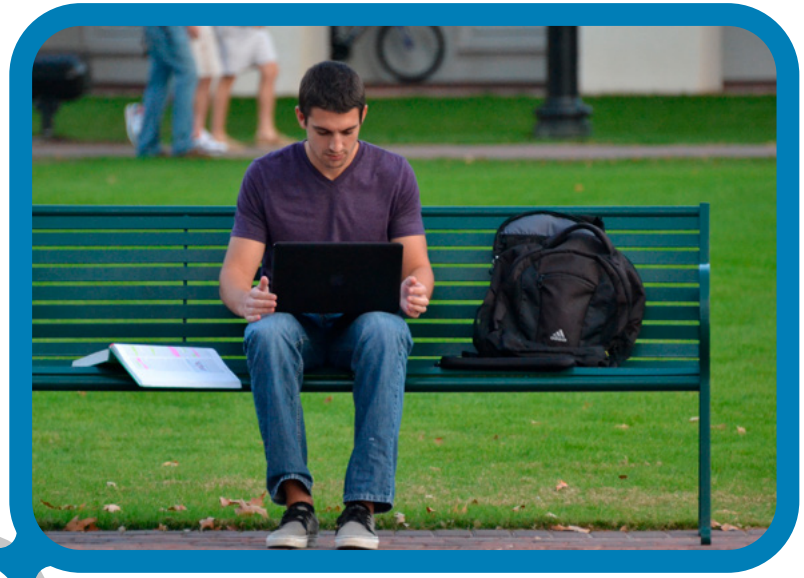
- Dumont, H., D. Instance and F. Benavides (eds.) (2010), The Nature of Learning: Using research to inspire Practice
- Hegarty, B. (2015). Attributes of Open Pedagogy: A Model for Using Open Educational Resources
- Mulder, F. & Janssen, B. (2014). Naar OER-onderwijs voor iedereen *Open Education Handbook* (Wikibooks)
- SURF (2015), *Begrippenkader online onderwijs*
- Wiley, D. (2015), *Open Pedagogy: The Importance of Getting In the Air*

Student feedback

I think open pedagogy has a great deal of potential. This trend will be good for education because it has the potential to offer students better education and better information, assuming that students are clear what it is all about, of course.

It is also important that lecturers are given support, so that they can explore these forms of learning. If open pedagogy is offered simply as an option without active support and encouragement, only the most motivated or digitalised students will make use of it. In that case, I fear that the purpose of open pedagogy will not be achieved. It must also be clear to students what is expected of them. This requires good knowledge of the resources that are being offered.

Jeroen Wienen, general board member of student union ISO (Interstedelijk Studentenoverleg)



9

PERSONALISED LEARNING ENVIRONMENT FOR CROSS-INSTITUTIONAL STUDY

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Bert van Zomeren (SURFnet)

FUTURE SCENARIO

Tim has many study-related issues to deal with today. He has a couple of things to sort out for his Communications programme, he has to prepare for an interview for a work placement and he has to start working on a marketing plan that he is writing with four other students. He logs into his own personalised learning environment, which contains useful digital tools and applications that he uses for his course.

Tim starts by checking his portfolio. His self-selected portfolio contains the results of the modules he has taken over the last two years. These are supplemented with the results of the additional modules that he has taken at various Dutch institutions and through the Open University of Catalonia. He selected these modules himself in the online prospectus. His portfolio also includes the micro-credentials that he has achieved and a description of his work for the board of the students' union.

In preparation for his interview, Tim sends the supervisor at the work placement company a link to his extensive portfolio. After that, he checks the mark he received for his assessment last week and schedules a meeting with a lecturer. He then goes to an app where he is working on the marketing plan with his peers. Everybody is already online, so they can get to work immediately.

What is a personalised learning environment?

A personalised learning environment is a student's digital home. It is a combination of tools and applications in which students can address all their study-related issues.

Using a personalised, unique online identity, the student can access information and the components of the learning environment offered by the institutions. Within the learning environment, the student has access, through a prospectus, to a wide range of modules and educational options. As well as subject-specific information, the prospectus contains information on the module level, entry requirements, skills, language, method of delivery, length of course, registration process and so on.

In the future, students may also have access to reviews and recommendations: 'if you have taken module A, module B would be ideal for you.' Students who plan to take a particular module will be granted access to everything associated with that module through their online identity: study materials, support, assessments, communities and tools.

A personalised learning environment for cross-institutional study is enabled through the use of common standards by institutions and suppliers. The institutions provide access to educational data such as marks, credits and timetabling information through the Open Education API (a set of definitions that allows software programmes to communicate with each other). Institutions are already working with SURFnet on a standard that makes sharing much more straightforward. This standard makes key educational data accessible in all applications and tools, meaning that it is less important which tools students actually use. The various digital tools and applications can also be connected to one other.

Personalised learning environments in practice

All educational institutions offer their students a digital learning environment. The functionality offered by this environment and how advanced it is varies from one institution to the next. In a basic environment, students can view their results, consult and manage their timetable and diary, register for modules and examinations, consult the institution's prospectus and communicate and collaborate with their peers and lecturers.

The educational institutions themselves decide on the design of the digital learning environment and therefore the opportunities offered. The student is given few choices. In practice, students and lecturers also use a wide range of other applications and tools. As yet, there are no cross-institutional personalised learning environments, so we are unable to give any examples of such environments. If students have completed modules at other institutions and wish to transfer the results from these modules into their own learning environment, it is often a laborious business. If institutions standardised their data and processes to a greater extent (e.g. by using the Open Education API or the E-portfolio standard), this would make things far easier and more user friendly for students.

What is the potential of personalised learning environments for higher education?

Within higher education, there is ever more scope for and focus on student diversity and the ability of each individual student to develop themselves in their own particular way. Institutions offer students greater freedom of choice, e.g. in terms of modules and teaching methods. This is good for their motivation and the quality of the learning process, and every student can reach their full potential.

Students are therefore receiving more and more opportunities for internationalisation, excellence and differentiation, and add-ons in the form of honours programmes, master classes and exclusive summer schools. This increasing diversity has been initiated by the educational institutions themselves in response to society's and the labour market's demand for highly-educated young adults who stand out from the crowd.

A cross-institutional personalised learning environment, in which students select their applications and tools themselves, plays to these trends and gives students more scope, insight and opportunities. Institutions are becoming increasingly aware that providing this flexibility to students calls for collaboration and standards.

How can personalised learning environments contribute to customised education?

A personalised learning environment that offers a wide range of options and freedom of choice will certainly appeal to a large number of students. There is increasingly greater pressure, and indeed a need, for students to stand out from the crowd. A personalised learning environment gives students more freedom to follow their own direction. They can do this using tried and tested routes, or they can break new ground.

The range of modules and teaching methods on offer is increasing: a wider range improves the quality of the input, which also improves the quality of students' output. In addition, the transition between the various modules is smooth, because students have an overview of the results they have already attained and institutions use the same standards. The personalised learning environment adapts to the time constraints and desires and requirements of the student.

Opportunities and challenges

Making their offer transparent and sharing it with others will give institutions an additional incentive to further improve their offer, make it more specialised and raise their profile just as they have done in the field of research. Intensive collaboration between institutions will speed up the technical and content-related development of cross-institutional personalised learning environments. New tools and techniques developed at local level can quickly be adopted on a broader scale.

Collaborating on standards and APIs is an intensive, time-consuming and expensive business. This is a huge undertaking within the Netherlands, let alone at European or global level. Ultimately, greater collaboration at technical level will enable institutions to refine their content-specific profile.

The changes may also affect the personal relationship between the student and the institution. The question is whether the greater freedom of choice provided to students will lead to greater uncertainty and stress. Greater online freedom and independence for students must not come at the price of personal contact. At international level, work on standards to foster innovation in the digital learning environment is on the agenda, as is evident from articles by the Educause Learning Initiative and Jisc. However, this will be a lengthy process: a great deal of time and effort will be required. As such, it is more of a political and strategic issue rather than a technical issue. SURF is supporting the collaboration, which enables a higher degree of sharing and flexibility in personalised learning environments, through initiatives such as the Open Education API.

Want to know more?

- Educause Learning Initiative (2015), *The Next Generation Digital Learning Environment, A Report on Research*
- Interstedelijk Studenten Overleg (2015), *Studeren op maat. Flexibilisering in het Hoger Onderwijs*
- JISC (2016), *Technology and tools for online learning*
- SURF (2015), *A flexible and personal learning environment. From single components to an integrated digital learning environment: a survey*
- SURF (2015), *Open Education API*

Student feedback

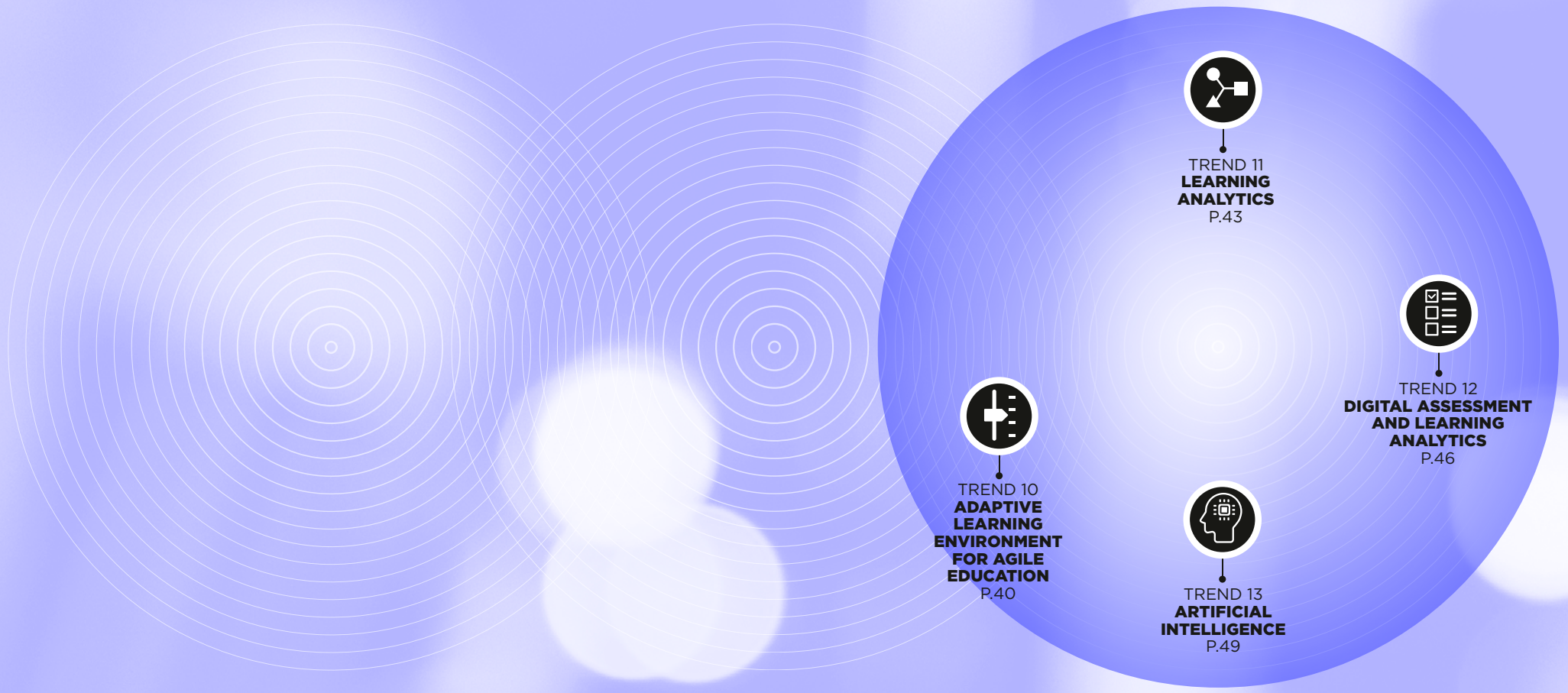
I think that a personalised learning environment for cross-institutional study offers students a wide range of opportunities. If it is properly introduced, this trend could have huge potential in education. It will allow students to have far greater control over their education. They will be able to choose from a wide range of study programmes and focus on what they find important. For example, they will be able to follow modules based on their own interests, focus on their personal development and set themselves apart from other students.

It is important to remember, however, that a great many students require security and support. We cannot afford to lose sight of the purpose of technology: to offer support to students so that they can obtain the maximum from their learning process rather than to be a goal in itself. Students who do not need extensive 'trips' or an unusual study programme need to be offered a firm foundation. They should not feel under pressure to undertake additional activities where they are not required.

Jeroen Wienen, general board member of student union ISO (Interstedelijk Studentenoverleg)

COMMON THEME 3

TECHNOLOGIES THAT FACILITATE ADAPTIVE LEARNING



10

ADAPTIVE LEARNING ENVIRONMENT FOR AGILE EDUCATION

Authors
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FUTURE SCENARIO

Nikky combines her computing studies with her own start-up company. She studies at the University for You (U4Y). The development of her business and her own personal development go hand in hand. U4Y offers a range of different (open online) courses involving problems, assignments and so on. Nikky also takes modules offered by other institutions and carries out assignments for various organisations. After completing each module or activity, she receives a certificate or badge. She can see the full details of her progress on her dashboard, 'My-Nikky', which includes her current and completed modules, her progress portfolio and the badges she has attained. She is the only one who can access this information. She writes a public blog in My-Nikky under the name of my CV. She provides access to the blog for her supervisors and the people she works with.

Nikky gains inspiration from the (online) communities she is involved in, and she can request help from other participants. The participants also meet face-to-face as peers and with the experts within the community. By talking to other students and experts in the field, Nikky acquires knowledge and insights that she otherwise would not have been able to obtain. She learns in an agile learning environment where the emphasis is on taking responsibility for your own learning, sharing and sustainability.

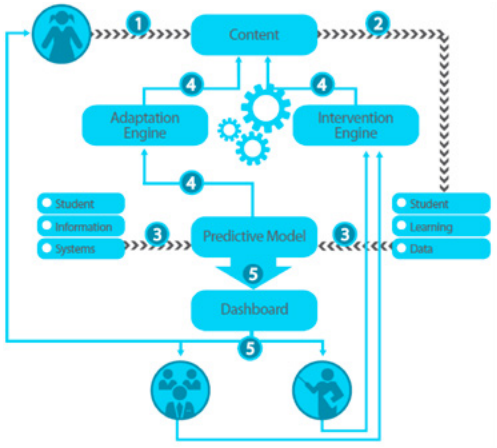
What is an adaptive learning environment?

An adaptive learning environment is a learning environment in which students can make full use of information about their learning process and progress when mana-ging their learning trajectory. The learning environment itself is not adaptive, but it does make use of adaptive learning technologies. Malcolm Brown, Director of the EDUCAUSE Learning Initiative, describes it as follows: "Adaptive learning techno-logies takes a non-linear approach to instruction and remediation, adjusting to a learner's interaction and demonstrated performance level and subsequently anti-cipating what types of content and resources learners need at a specific point in time to make progress."

The main feature of an adaptive learning environment is the up-to-date information it provides on a student's learning process and progress. On the basis of this information, the learning environment can propose a subsequent learning activity and provide the right content for a learning path. Control over the process remains with the student.

The learning technology enables just-in-time interaction between student, lecturer, mentor and workplace, all of which are always coordinated within the learning environment. It is a constant process of action and response, guidance, adjustment and reflection. Every interaction generates data (analytics) that forms the basis of a student profile. The student can view their progress through their own personal dashboard, and use this information to select appropriate and effective (follow-up) learning activities.

In an adaptive learning environment, it is also possible to provide just-in-time information. Based on data analysis, digital learning content (e.g. digital assessments) can be provided to students on a just-in-time basis. It is also possible to construct non-linear learning paths. Material can be made adaptive by breaking down large blocks of teaching material into smaller chunks. This allows the learning path to be varied in order to match the level, pace, interest and other characteristics of the student. Digital teaching resources can be flexible in their format, content and methodology. In this case, the lecturer acts as a curator, and students can add their own resources.



Source: www.dreambox.com/adaptive-learning

An adaptive learning environment requires an ecosystem of connected and disconnected learning tools, applications and systems. An ecosystem of this type needs to make basic data available in a user-friendly and transparent manner in order to give the institution a clear understanding of the data flows generated by digital footprints. This will result in a smart digital learning environment with connected learning technologies, such as assessments, (peer) reviews, (peer) feedback, collaboration, planning, discussions, gaming, portfolios, etc. The diagram on this page depicts an *adaptive learning environment*.

Adaptive learning in practice

Ohio State University: MOOCulus

Jim Fowler from Ohio State University added a 'MOOCulus' module to his Coursera MOOC on calculus. In this module, he presents students with increasingly difficult problems based on the solutions they submit.

Dreambox: Intelligent Adaptive Learning

Dreambox has expanded a Learning Management System to incorporate 'Intelligent Adaptive Learning'. This makes it possible to present a student with adapted learning content. The system uses model information on a student from the Student Information System, which is then supplemented by traces in the learning environment.

What is the potential of adaptive learning environments for higher education?

Many higher education institutions are keen to be able to design study programmes that offer scope for customisation, talent development, learning which is not spatially or temporally dependent, creativity, student engagement and contextual learning combined with a high degree of intrinsic motivation. Flexibility is the answer, and technology has a key role to play in this. A one-size-fits-all higher education system for students with different backgrounds, characteristics and learning

requirements will no longer suffice (SER (Social and Economic Council), 2015, Pijpers, R. 2015, Ministry of Education, Culture and Science, 2015). Adaptive learning environments help meet the needs of institutions, students and society as a whole.

Opportunities and challenges

Adaptive learning environments require education to be designed in a different way, with a change in emphasis, i.e. for students to be the masters of their own learning and influence the learning process accordingly. As a result, lecturers and students will constantly review their approach and their teaching/learning because they will learn from each other on an ongoing basis. This review process will involve recipro-city and mirroring. It will require an approach in which the stakeholders in higher education work together in teams and share each other's knowledge. The question is whether lecturers, support staff, managers and administrators actually want this change in emphasis to happen. Do the stakeholders in higher education actually want – and are they able – to innovate, to interact just in time, to make information available to third parties and to think and evolve based on new concepts?

Designing an adaptive learning environment is not easy. The systems and applications required are at different stages of development. It helps to visualise an architecture in which systems collaborate with each other and are able to be replaced (interoperability). Here, we can use tools such as the HORA reference architecture or the implementation of components by SURFnet (A Personal and Flexible Learning Environment, 2015). The focus is on end-to-end design and configuration of the education logistics processes involved.

As already stated, data plays a key role here. For example, we need to convert the potential of learning analytics into implementable solutions. It is not yet possible to create reliable profiles based on a student's digital footprint and make recommendations on this basis. In technological terms, adaptive learning environments are getting closer to becoming a reality. New students are already requesting them. The main challenge is to let go of existing parameters and roles: we must organise the learning process differently for the students of the future. We need to have an in-depth discussion about the significance of adaptive learning technology and its implementation. We hope that this article will trigger that debate.

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- Wissink, L. e.a. (2016), Onderwijs- en Toetsbeleid Saxion Parttime School

Student feedback

The adaptive learning environment: a new method designed to enable a higher degree of customisation and greater flexibility for the student. The student does not have to adapt to the environment, because the environment adapts itself. Clearly, however, this assumes that data (analytics once again) is collected and the student builds their own online profile. Adapting students' learning to their own individual requirements to a greater extent than before is, of course, a good idea. Still, though, it is equally important for them to share the physical environment and involve themselves in the academic community. This is a stimulating environment in which to acquire knowledge and study together with peers. It is crucial that we do not lose sight of this and end up depriving students of this shared experience.

Jarmo Berkhout, chairman of student union ISO (Interstedelijk Studentenoverleg)

11

LEARNING ANALYTICS

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FUTURE SCENARIO

As the last few students enter the lecture theatre, the lecturer takes a quick look at the dashboard on her laptop. Eighty per cent of the students have looked at the online material before the lecture and completed the online tests. The software indicates how well the students have understood the material based on their answers. The majority of the students found the material straightforward. Almost every topic on the dashboard is green. Only one topic is highlighted in red. The lecturer therefore decides to focus her workshop specifically on this topic.

During the workshop, student assistants walk round the room. A student puts his hand up and says: "I couldn't do task 14A. Where am I going wrong?" The student assistant consults an iPad displaying the student's Student Model. A definite misunderstanding is highlighted in red. "Ah, I think I see what has happened. Can you just add up the difference in weight between the passengers?" says the student assistant. "Remember...". Using the online data, the student assistant can see immediately where their help is needed and discuss the solution to the problem with the student.

What is learning analytics?

Greater insight into the learning process, targeted feedback to students and, ultimately, an improvement in student learning: these are the objectives of learning analytics. Using learning analytics, we can monitor the digital footprints of students and use the results to help them with their learning. Learning analytics offers lecturers and educational developers a new and practical source of information in addition to their own observations and evaluations. It constitutes a veritable gold mine of data on students' behaviour and learning requirements. Learning analytics processes data from the various online environments that students use during their learning. This provides lecturers with information on the quality of the learning resources and the structure of the course. Learning analytics can also provide students and lecturers with insights into online study behaviour.

Learning analytics is somewhat different to Academic Analytics. With Academic Analytics, data from Student Information Systems (SIS) is used to predict delays, drop-out rates and academic success. This provides information for programme managers, the university management team and government authorities.

When using learning analytics, it is important to carefully consider the data to be collected. In other words: what questions can we answer using the data?

Learning analytics in practice

Utrecht University: Weekly reports enrich interaction between lecturer and student

Every week, the lecturers of one of the courses at Utrecht University receive an overview of the (online) activities of the students in their project group (Van Leeuwen, 2016). This overview indicates, for example, how often the online lectures are viewed over the course of a week and whether the students are satisfied with the collaboration within their project groups. It appears that lecturers use these reports when they meet with their students. The reports provide objective information on students' activities and perceptions: this information makes it easier to discuss potential problems or questions that students may have. The reports therefore offer the lecturers an additional resource for monitoring the activities of their students *while the course is in progress.*

The Amsterdam Business School at the University of Amsterdam (UvA): Setting goals as an incentive for study

The Amsterdam Business School at UvA encourages students to set goals for themselves using a dashboard. During their course, students set objectives such as: 'This week I want to read chapters 3 to 5'. The lecturer provides feedback on the anonymised goals. Students then have the opportunity to refine their goals. As the deadline approaches, the students receive an email reminding them of their goal. If they have achieved their goal, they can mark it as completed and create a follow-up action.

SURFnet learning analytics experiment

SURFnet has launched a learning analytics-experiment to enable educational institutions to gain hands-on experience in this field. Institutions often think of learning analytics as a complex process. They often ask: how can I use learning analytics? How can I use the trails (data) left by students to provide targeted feedback? They also often ask: is learning analytics secure? What about student privacy? SURFnet is using this experiment to demonstrate what learning analytics can do, so that institutions may use it in their educational practice. All of the knowledge acquired during the experiment will be made available, e.g. knowledge regarding technical implementation and legal parameters.

What is the potential of learning analytics for higher education?

As in all sectors that make extensive use of ICT, data is found in a great many different places in the higher education sector. Every student leaves a digital trail from the moment they look for information on the educational institution's website to the time they are registered as an alumnus. Linking all the systems together provides insights into students' learning behaviour, the quality of the teaching and the effectiveness of the institution. Greater insights result in better education for the student. Learning analytics allows targeted feedback on academic progress to be provided to students and lecturers, and offers insight into how well the material has been understood. Learning analytics can also provide insight into the quality of the (online) teaching materials, which can then be improved as a result. Learning analytics also offers a way to create synergies between online and offline learning.

How can learning analytics contribute to customised education?

Many educational institutions want to offer their courses in a flexible and customised way, so that they can offer students a personalised learning pathway

that is tailored to their needs. To do so, lecturers require insight into students' progress. Students need to know how much progress they have made and what the next steps are. This is where learning analytics comes in. Learning analytics enables personalised and adaptive learning, which allows students to move on (more quickly) once they have demonstrated that they have mastered a particular topic or part thereof. Learning analytics also helps to improve the quality of teaching. Learning analytics makes it easier to evaluate learning while the course is in progress and to make amendments where necessary. All of these factors are conducive to customised education.

Opportunities and challenges

Despite the significant potential of learning analytics, there are still educational, ethical, legal and technical challenges that require further clarification. For example, it is important to establish exactly which educational questions the data can answer. Students and lecturers must know what they can and cannot do with the data, and how students can consent to (or refuse) their data being used in analyses. The technical parameters governing data collection and analysis also need to be defined. The educational institutions and SURFnet will have their work cut out tackling these challenges.

Want to know more?

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Student feedback

Learning analytics: every education manager dreams of knowing exactly what a student can and wants to do, what he or she is good or bad at, how to guide students as efficiently as possible through the material and how, as a result, to optimise the entire learning process. If you work on the basis of the NSA's motto, "the more data, the better", you will monitor all of the student's digital footprints. Is this useful? Quite possibly. Is it desirable? That is the key question. Yes, it is in the student's interests to receive help that is tailored to their needs. And yes, it would make it easier for lecturers to estimate competence levels. But it also creates a template based on 'objective' data. The ideal student emerges from the data as the optimum pattern in the digital data. Customised help also means that other students must conform to the ideal pattern wherever possible. Students' privacy is put under a great deal of pressure in order to create a sense of uniformity. Why? Because it is efficient. Education institutions would do better to fully embrace the diversity of the students that come through their doors.

Jarmo Berkhout, chairman of student union LSVb (Landelijke Studentenvakbond)

12

DIGITAL ASSESSMENT AND LEARNING ANALYTICS

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FUTURE SCENARIO

We can enrich learning analytics with assessment data obtained from digital assessments. This changes the role and nature of assessments. During their studies, students make constant and extensive use of formative assessments, which they complete at their own pace and in their own time. As a result, assessments are no longer simply assessments of a student's ability; they are learning experiences that form an integral part of the learning process as a whole. The results of these assessments (and, as a result, insights into the student's progress) are available to the student and the lecturer immediately and on a permanent basis. Students can immediately see where further action or explanation is required, and lecturers can intervene and provide guidance where necessary. This results in learning processes where learning and assessment converge to create the ideal form of self-development and self-monitoring. The amount of summative assessment involved can therefore be significantly reduced to be replaced by a personal portfolio that contains the student's assessment results.

What is digital assessment with learning analytics?

The basic principle of digital assessment combined with learning analytics is simple. The assessments can be accessed through assessment applications that use large-scale item banks. These item banks contain a digital collection of questions that can be used for assessments. A system for storing, analysing and reporting students' assessment results and study behaviour is connected to the assessment application. This is the learning analytics system. Since students increasingly study and complete assessments online, there are increasing amounts of data available pertaining to study behaviour. The software analyses this data and displays the results to the student and the lecturer on a user-friendly dashboard. This enables the student to quickly see how they are progressing. The lecturer, meanwhile, can see what individual students require and where the curriculum requires improvement.

Digital assessment in practice

Maastricht University: Rich and effective feedback for customised learning paths

As part of the 'Rich and effective feedback for customised learning paths' project, a combination of learning analytics and formative assessments yielded valuable feedback for a group of students participating in the Introductory Mathematics and Statistics module. The researchers collected data from sources such as Blackboard, digital practice environments and entrance tests. The assessment data from the formative assessments proved to be the best predictor of the students' academic results. As a result, these assessments were the best way to provide students with targeted feedback.

University of Amsterdam: The four stages of integration of learning and assessment

The Scientific and Statistical Reasoning module at the University of Amsterdam is working on the integration of learning and assessment over four stages:

- Stage one: digitalisation of the learning resources;
- Stage two: integration of practice tests and assessment;
- Stage three: diagnosis of the results;
- Stage four: establishing what the student may require in order to perform at a higher level.

Students complete a weekly formative assessment. The assessment application allows students to immediately identify the gaps in their knowledge. As well as providing insight into the students' progress, the weekly assessment serves as good incentive for the students. This type of digital assessment is the ultimate in customised education: on a weekly basis, every student has the opportunity to keep up with the course in their preferred location, in their own time and at their own level.

What is the potential of digital assessment for higher education?

Research indicates that students' results improve if they undertake formative assessments on a regular basis. If the assessment data is analysed afterwards, students and lecturers will quickly be able to ascertain which elements of the learning resources have been understood. Lecturers can also see which practice questions and aspects of their teaching could be improved.

Combining digital assessment with learning analytics allows practice tests to be fully integrated into the student's learning and development process. These practice tests offer a wide range of options in terms of question quantity, type and difficulty. Together with the insights gained from learning analytics, the practice tests will improve the quality of assessment and learning.

The entire study process will be enriched by the fact that students can develop their own specific learning requirements at their own pace, in their preferred location and in their own time. Learning analytics enables lecturers to adapt their teaching materials and contact times to suit the students. In other words, they can actually provide customised education. Moreover, the rapid pace of the digital process gives lecturers more time for teaching and support/supervision.

How can digital assessment contribute to customised education?

Digital assessment and learning analytics enable students to study without being restricted to a specific time or location. Most importantly, they can study at their own pace and according to their own learning requirements. They continually receive feedback on their progress, strengths and weaknesses and, as a result, on their options and opportunities. Students actually feel that they can influence the direction they are taking based on their results combined with their qualities, dedication, attitude and level of motivation. The lecturer, meanwhile, gains a comprehensive overview of the student. As well as having access to the student's results, they know exactly how much effort the student has put in. The lecturer can then use this data to devise a specific seminar or schedule a personal meeting for the student.

Opportunities and challenges

The education sector still has a long way to go when it comes to digital assessment and learning analytics. Lecturers, ICT staff and education and

assessment experts will need to work together closely in this field. The development of advanced assessment applications and rich item banks is time-consuming, particularly early on, and requires the specialised knowledge and expertise of lecturers and support staff. Institutions make the most progress when they take advantage of the enthusiasm and leading role of the lecturers involved. It is important to give lecturers the time to work on this.

There are also opportunities for institutions to work together, e.g. when developing digital assessments for core courses within Bachelor's programmes such as Statistics. In the field of learning analytics, new technologies must provide a single integrated, user-friendly system for input, interpretation and output. As an umbrella organisation, SURFnet can help by bringing together the innovative capabilities and knowledge of the various institutions involved.

In terms of content, the challenge is not to try to collect all types of data. Institutions must focus on data that tells the student and the lecturer where improvement is required. Assessment results are expected to be the best option here.

A digital 'assessment future' incorporating learning analytics is still a long way off, but the dot on the horizon is there to aim for. The student population of the Dutch higher education system is becoming ever more diverse and international. Students are increasingly studying online and are literally and physically crossing borders. Innovative digital applications in the field of assessment, evaluation and refinement can support and further reinforce this trend. If, in the future, the ability of learning analytics to predict outcomes does indeed become more important and more precise, education institutions will not have to rely as heavily on examinations. Ultimately, students will be able to take control of their own learning process.

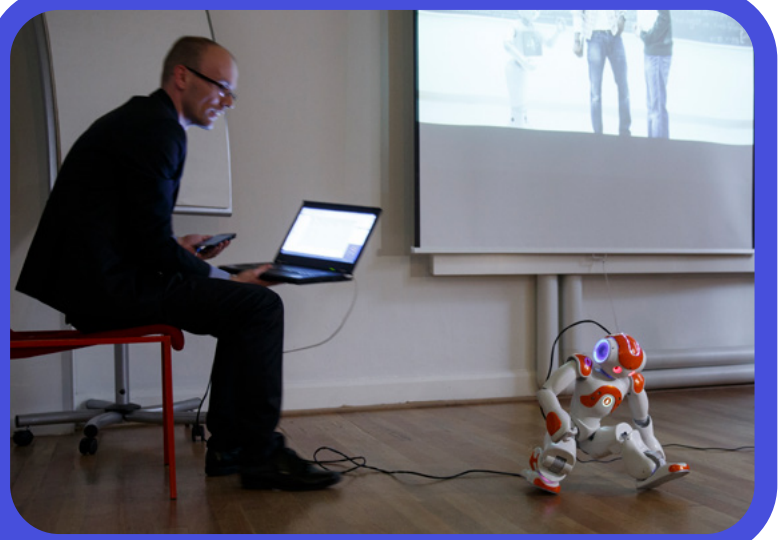
Meer weten?

- SURFnet (2016), *Thematic issue Innovations in digital assessment*

Student feedback

Do we want to be assessed as much as possible? And do we want to move from assessments to learning experiences? If so, we need to digitalise the entire curriculum. By doing so, you would be able to see the results of a student's efforts and the actual efforts themselves. Put it this way: if you want to pass your driving test, you have to put in a lot of practice. First you have to commit an entire theory book to memory. Then you have to have lessons. Finally, you have to take the test itself. If you pass, you are finished. It doesn't matter how you get there, just as long as you achieve the end result. At times this can be difficult. Still, it is the best way to ensure the maximum degree of freedom in the learning process. Clearly, research universities and universities of applied sciences work in different ways. But constant assessment offers less freedom than you think: it is a form of discipline designed to ensure that every student moves through the curriculum as efficiently as possible. But isn't it true that students also learn by making mistakes? And by finding their own way?

Jarmo Berkhout, chairman of student union LSVb (Landelijke Studentenvakbond)



13

ARTIFICIAL INTELLIGENCE

Authors
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FUTURE SCENARIO

When the lecturer wakes up on a sunny spring day in 2030, the first thing he does is look at his dashboard. He sees that 19 students have submitted their coursework. His digital assistant has already looked at it and seen that the programme has promoted them all to the next level. Their coursework is compared with that of thousands of other students all over the world. Given the huge amount of comparative material available, the programme has been able to give every individual the exact feedback, feed-up and feed-forward they needed during the writing process.

The lecturer is surprised. His students are increasingly making better use of the online feedback they receive. Some of them preferred the personal contact offered by individual writing sessions, while others opted to do everything online. The ideas are highly original: all sentences that relate to a previously published document are highlighted in blue. If a student conceives an idea that has already been used, the programme will encourage them to contact the original author. Plagiarism no longer occurs, and students are producing more and more interesting ideas.

What is artificial intelligence?

Artificial intelligence is a generic term for a broad field that includes robotics, data mining, translation, computer games and neural networks. You can take a psychological or philosophical approach to this field. This raises questions such as: what is the difference between a person and a computer? Can a computer think? You can also take a more technical perspective: how does chess software work? How does a Mars robot work (Kosters, 2016)?

Artificial intelligence allows computers to display behaviour that we refer to as intelligent in humans (Kosters, 2016). A machine imitates human intellect and is therefore able to make its own decisions.

Since 2015, artificial intelligence has been playing an increasingly significant role in our society. After years of research, it is increasingly being used for

commercial purposes (Huang and Nusca, 2016). Siri manages our diaries, email software recognises spam and computers trade our shares (Kurshan, 2016). However, artificial intelligence seems to have passed education by. Could artificial intelligence play a role in personalised learning

Artificial intelligence in practice:

ALEKS

One application of artificial intelligence in education is ALEKS, an adaptive learning environment developed in 2013. Adaptive learning environments allow every learner to learn in their own way, at their own level and at their own pace. Large numbers of learners studying the same material generate data. ALEKS is a web-based adaptive learning environment that makes use of this data. ALEKS utilises artificial intelligence to continuously monitor and evaluate a learner's performance. By doing so, all subsequent instruction is tailored to the needs of that particular learner. Every learner has to demonstrate their knowledge and skills in great detail, meaning that no two learners have the same learning outcomes. This enables ALEKS to define a unique learning pathway for each individual.

What is the potential of artificial intelligence for education?

We believe that over the next few years, education will undergo a transformation. The requirements and the talents of the learner will play a key role in this. Technology will support and accelerate this process. Education will no longer define the courses on offer, where learners obtain a final qualification (degree) at the end of their studies.

A globalising society and the challenges this entails (wicked challenges) are in need of a solution. Qualifications will do little to help find such a solution. What is far more important is who the learner is, what they are good at and what they believe in. They must take the initiative to connect with others. Technology allows the learner to make these connections and obtain the knowledge (or contact the expert) they require.

Artificial intelligence provides every opportunity to make learning personalised and engaging. It is now up to lecturers to master and carefully monitor this technology. The main focus must be the learning requirement, not the technology itself.

How can artificial intelligence contribute to customised education?

Advanced IT programmes allow an individual's learning process to be adapted in real time on the basis of performance for large groups of learners (Feldstein, 2015). The following examples demonstrate how artificial intelligence can be used to facilitate customised education (10 roles for artificial intelligence in education, 2016).

Adaptive learning programmes, games and software can adapt to the needs and levels of individual learners, enabling every learner to receive the support, feedback and instruction they need at that time.

Artificial intelligence can offer additional support to learners. Some programmes, for example, can now assist with maths or writing. Programmes based on artificial intelligence can provide learners and lecturers with useful feedback. For example, they can monitor a learner's progress and issue a warning if they fail to achieve specific learning outcomes or goals.

Artificial intelligence allows lecturers to act more like coaches who facilitate the learning process. Systems like ALEKS give lecturers the scope to take on the role of coach or mentor. In other words, they no longer simply have to convey knowledge to recipients.

Making mistakes is less intimidating. Artificial intelligence can create an environment where learners can experiment without being judged immediately. Artificial intelligence changes where learning takes place, what is learnt, how it is learnt and by whom. It is able to consolidate supply and demand, regardless of where the client and provider are located.

Opportunities and challenges

Artificial intelligence has significant potential for education and for personalised learning in particular. The recognition of voice, images and patterns, self-managing systems, translation machines and question-and-answer systems in particular can help us to create personalised learning. They can help make learning more convenient, user-friendly and efficient (Kunstmatige Intelligentie [artificial intelligence], 2015). Holodeck, an advanced form of virtual reality, demonstrates how artificial intelligence will change the face of education in the future.

A frequent criticism of artificial intelligence is that it is unable to embrace concepts such as care, understanding and belonging. Artificial systems lack the human touch, so to speak. Nevertheless, developments in the field of artificial intelligence are progressing so rapidly that it may not be long before this human touch is replicated as well. The same applies to a lack of creativity and common sense. Hopefully, this drawback is also temporary.

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Student feedback

Artificial intelligence allows educational institutions to offer their students an education that is genuinely tailored to their requirements. Students can be challenged, because artificial intelligence is able to see what elements were able to provide a suitable challenge for other students at a comparable level. It also means that students do not have to repeat certain areas of the curriculum unnecessarily. This results in a personalised learning pathway that responds to the weaknesses, strengths and preferences of each and every student.

The use of artificial intelligence has a huge amount of potential. Still, there are risks attached. Artificial intelligence will primarily be used in digital environments and therefore above all off-campus, e.g. for online courses. It is important not to lose sight of education's other objectives, namely to prepare students to take their place in society, to work with students to acquire new insights and to provide a place where students can interact with their peers and their lecturers.

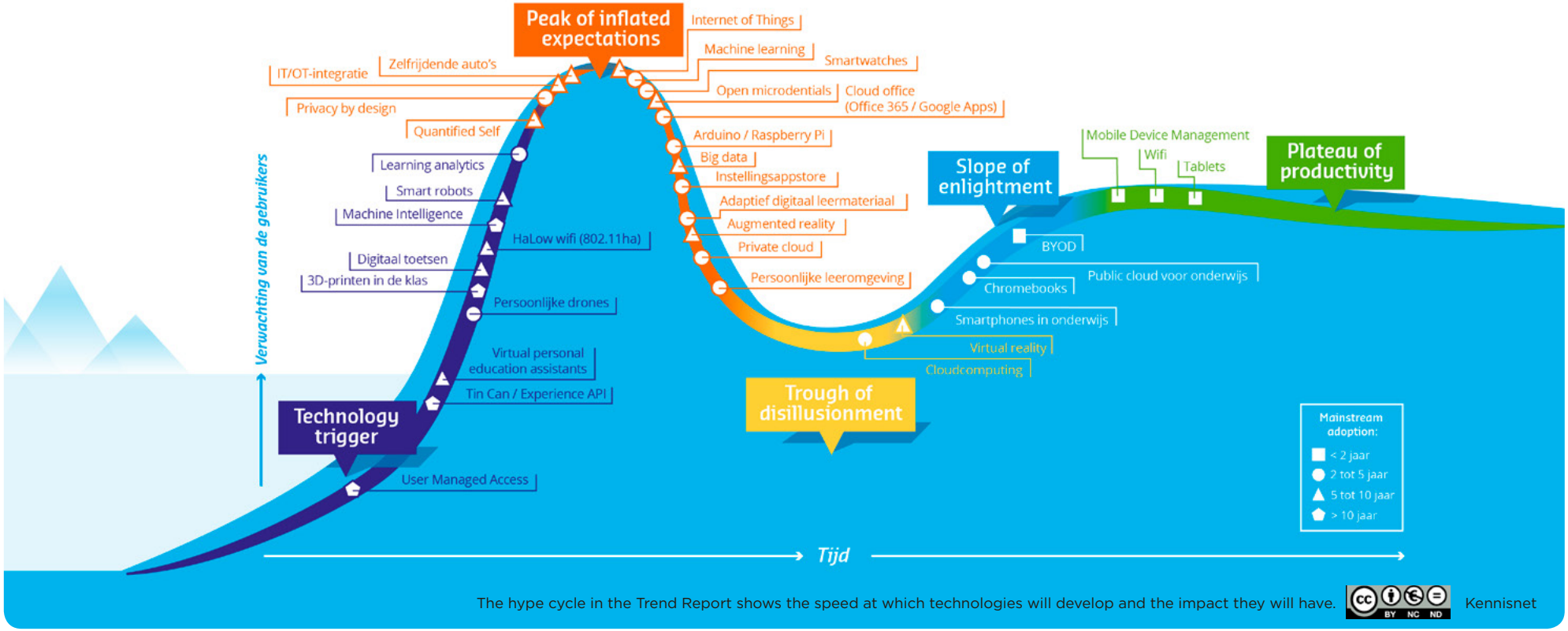
Jeroen Wienen, general board member of student union ISO (Interstedelijk Studentenoverleg)

EXISTING TREND REPORTS USED AS A BASIS

Wilfred Rubens

Every year, a number of different trend reports are published in the field of education and ICT. Our aim was not simply to add a new trend report to that list, but to use these existing trend reports to identify technological trends that could be of benefit to higher education in the Netherlands.

Earlier this year, **Kennisnet** published a report titled **'Technologie-kompas voor het onderwijs'** [Technology compass for education] (Kennisnet, 2016), in which Michael van Wetering uses Gartner's 'hypecycle of emerging technologies' to identify a number of technological trends. This report can be used as a tool to analyse risks, subject technologies to a SWOT analysis and make choices using a 'strategic technology map'. According to Van Wetering, you can adopt a technology too early, but you can also use it for too long. In this report, Kennisnet makes a distinction between the ICT foundation (the basic framework), the digital learning process and education of the future (these trends feature early on in the adoption curve).



The hype cycle in the Trend Report shows the speed at which technologies will develop and the impact they will have. Kennisnet

The main aim of the **OECD-report 'Trends shaping education'** (OECD, 2016) is to get people thinking about education, teaching and learning. It identifies five global trends, considers the challenges associated with them and asks questions about their relevance to education.

These trends are:

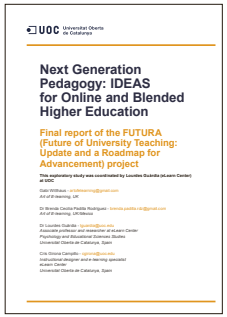
- Globalisation (e.g. migration, environment and international trade).
- The future of the nation state (e.g. an ageing working population, healthcare, security and the knowledge economy).
- The emergence of megacities. Cities are becoming the new countries (with consequences for urbanisation, governance, civic engagement and transport, etc.).
- Changes in the family (e.g. greater diversity in structures, several generations in one family, values and households).
- Brave new world as the result of technology (with risks such as cybersecurity and cybercrime, and opportunities in the field of knowledge sharing and collaboration).

These trends bring with them opportunities and challenges and may lead to changes in the curriculum (e.g. different learning objectives).

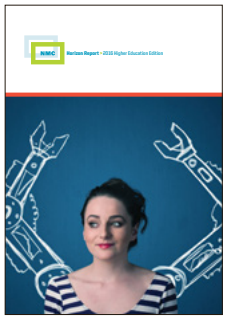
The **'Innovating pedagogy'** report published by the **UK's Open University** focuses on the impact of ICT on teaching, learning and assessment (Sharples et al, 2015). Its authors make a distinction between short, medium and long term (more than five years) and consider the impact of new technologies. Topics include computational thinking, learning by doing in remote labs, context-based learning, adaptive teaching, embodied learning (which involves both mind and body), the analytics of emotions and stealth assessment (using data rather than assessments to assess learning processes). Pedagogy must give rise to 'agile situations' that are beneficial, user-friendly and enjoyable. The use of data will become more important, as will the integration of formal and informal learning.

The report **'Next Generation Pedagogy: IDEAS for Online and Blended Higher Education'** by the **Open University Catalonia** identifies the following trends (Witthaus et al, 2015):

- Use of data and information.
- Sharing education (e.g. reusing MOOCs).
- Engaging students in their education (active learning).
- The agility of education.
- Context-based learning.



According to the authors of this report, education should be more diverse and more open and connected. Education should be more personalised, although institutions often still teach their students in a standard, inflexible way.



A well-known trend report is the **Horizon Rapport** by the US organisation **NMC**, which is based on input from experts (Johnson et al., 2016). This report considers the timescales for adoption, the challenges (solvable, difficult or 'wicked') and the technologies involved. The NMC describes trends that accelerate the adoption of learning technologies. It asks questions about the validity of existing education models. Creativity and entrepreneurship – even start-up models with ICT as a catalyst – can lead to innovation in the education system. The same applies to other forms of certification. One mid-term trend is the redesigning of learning practices via ICT (new configurations such as polysynchronous learning). There is also more emphasis on 'deep learning' with the help of ICT. The 'measurement of learning' is a short-term trend designed to facilitate customised education.

According to the NMC, the technological trends are as follows:

- Bring Your Own Device (digital learning environments must support this).
- Learning analytics and adaptive learning.
- Augmented and virtual reality.
- Makerspaces (where students create objects using 3D printers and other forms of technology).
- Affective computing (computers recognise and interpret emotions and act accordingly).
- Robotics (as a theme in itself or as part of a practice environment).

The Horizon Reports have been criticised on account of the inconsistency between the different versions and their insufficient consideration of previous predictions.

Finally, KPMG has recently published a trend report **'De toekomstbestendigheid van onderwijsinstellingen'** on future-proof education (Koorn, 2016), in which it alleges that there is a great deal of duplication in educational resources in the Netherlands. Institutions must collaborate more with each other ('smart collaboration'). Big/open data from different institutions can be used to facilitate this smart collaboration. Students will therefore no longer learn at a single institution, but will put their own learning pathway together based on the programmes from a range of different institutions. Education will also be 'unbundled': content, support, examination and certification will no longer be provided by one and the same institution. Adaptive learning technologies will use learning analytics to facilitate flexible learning. Educational institutions can act as brokers between organisations that play a role in the field of education and training. Jochem Goedhals and Peter Biekens have made a video on this report.

These trend reports differ from each other in terms of their level of abstraction, their focus and their impact on educational institutions and education systems. What they have in common, however, is that they all regard technology as a key influencing factor. They also believe that big data, advanced analytics and smart technology will allow educational institutions to take a more customised approach to education. All of these reports maintain that education must pay greater attention to a highly diverse target group that learns in a wide variety of ways.

Want to know more?

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The *Trend Report 2016 - How technological trends enable customised education* has been produced by SURFnet in partnership with 44 authors from higher education. The report is available to download at www.surf.nl/trendreport2016. This also contains a link to the Dutch version.

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