

WHAT IS “FLEXIBLE AND PERSONALIZED EDUCATION” ANYWAY?

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1. SUMMARY / ABSTRACT

What is “flexible and personalized education” anyway?

The current state in Dutch Higher Education

An analysis of strategic plans of 40 institutions of higher education in the Netherlands shows an overlap in ambition: a search for more flexible and personalized education. But what does that look like, customized education? And how would or should that prepare students for a career in a rapidly changing world? SURF, the collaborative ICT organisation for Dutch education and research, spoke to a large group of innovators that try to translate concepts of flexible and personalized education to classroom practices. We spoke to people who are changing the way they offer their courses, and explore, in the classroom, what works and what does not. We also spoke with visionaries who think about what we need to change to prepare students for the future. We asked them what they see as flexible and personalized education, why it is needed, what we have to change and offer to enable it, what organisational boundaries we encounter, what already is happening, and what their vision of the future is. We had them meet up and share their visions and inspire each other. We included international publications about the subject in the discussion. We looked where vision and practice seemed to connect and where it collided. During EADTU Christien Bok, program manager of SURF Technology Enhanced Education, will present the current state of flexible and personalized education in Dutch higher education, and how ICT can contribute to shape

2. WHAT IS “FLEXIBLE AND PERSONALIZED EDUCATION” ANYWAY?

1. INTRODUCTION

A large number of universities, technical colleges and university medical centres in the Netherlands harbour the ambition of offering personal and flexible education. Placing the student at the core of their teaching seems a better option than placing the curriculum at the core. Not every institution is at the same stage in achieving this ambition. In practice, it seems that it is not yet very clear what exactly personal education is, and when it provides an improvement in quality.

The terms personal and flexible are defined and interpreted in diverse ways by different institutions. In this white paper, SURF is setting out to define and describe the topic of “flexible and personal education”. We also refer to this as “customised education”. The goal of this is to provide the higher education sector with a grasp of the different options and the issues they bring with them. We will examine questions like: Why is customised education needed? What might customised education look like, and what do institutions need to take into consideration when setting it up? The white paper is intended for educational developers, policymakers and lecturers who are involved in shaping customised education.

In preparing this white paper, we have carried out a large number of interviews and held discussions with representatives from Dutch technical colleges, universities and student associations. We have gratefully made use of their insights and practical examples. The different examples allow institutions to learn from each other and show the full bandwidth of the subject. The title of this white paper is *Customised education in 2016*, because in the discussions we held, we were far from covering all the points of interest on the agenda, and because new experiments, developments and research in the next few years will undoubtedly rapidly provide new insights.

Based on our discussions we distinguish between five educational dimensions for customised education that could be helpful in developing your own vision. The crux here is that institutions and programmes define, based of their own vision on education, which dimensions they want to emphasise to a greater or lesser extent when implementing customised education. Customised education looks different not only for each student, but also for each university, college and lecturer.

Education means working with people. ICT can never replace people, but it offers lecturers options to allow them to implement customised education. Digital assessment makes it possible to hold exams more flexibly, and offers the opportunity of testing learning targets that cannot be tested in a written exam. Analyses of tests give lecturers insight into the quality of the tests and test items, which improves the reliability of the tests and the ability of the lecturer to set tests. The use of study data provides insight into personal progress with study, meaning the students can work in a more targeted way on their weak points. Students are also asking via their representatives¹ for more digitalisation of teaching. SURF helps institutions by providing ICT services that enable innovation in education and customised education. Over the next few years, we will be intensifying our research, in collaboration with the institutions, into customised education and the ICT services that are required for this.

2. WHY CUSTOMISED EDUCATION?

The knowledge economy is placing greater and greater demands on people. Mid-level jobs are disappearing, and the need for higher education is growing. A one-size-fits-all approach cannot deliver this. Education must make space for more people with different backgrounds, talents and needs. This in turn requires differentiation.

Jobs are mutating or disappearing at a rapid rate. Lifelong learning is necessary. To remain accessible and attractive to people at each stage of their (professional) lives, education must take account of differences in goals and circumstances.

In this chapter we examine the importance of customised education from the perspective of the student, the lecturer, the job market and the educational establishment.

2.1 The student

Young people have greater choice in every area of their lives than they did in the past. Smartphones and tablets have become an extension of themselves; boundaries between learning, living and working are blurring. They also expect freedom of choice in education, and want to be able to use ICT applications. Beside this, the student population continues to become more diverse; students with a variety of backgrounds, levels of knowledge and different learning needs benefit from a freedom of choice. Students also need the flexibility to be able to combine work and life with an education.

Different talents, backgrounds, prior knowledge

Einstein supposedly once said of the education system: "Everybody is a genius. But if you judge a fish by its ability to climb a tree, it will live its whole life believing it is stupid." Students have different talents, backgrounds and prior knowledge. An education will not always connect with or take into account some very specific combinations of talents, knowledge, skills and interests on the part of students.

Speeding up and slowing down

Whereas in the past students could study for as long as they wanted, currently students are tied to a fixed number of study years. But for many students, their time as a student is also an important time in their development. Students want to travel or do management work or volunteer work. Registration per academic year can be restrictive.

Studying at multiple institutions

More and more students also want to take subjects outside their own course of study or institution. A minor or optional subject in another faculty or educational establishment provides a broader

¹ ISO, LSVb (spring 2016), Measures to make education more flexible. Paper on creating flexibility in higher education from ISP and LSVb

perspective of the subject. Of course with the advent of MOOCs, SPOCs² and other online courses and teaching materials, students can choose from a vast selection, including from other institutions.

2.2 The lecturer

Teachers have – just like students – different abilities and preferences. Just as students have different learning styles, they have different teaching skills. In the classroom, a lecturer who likes conventional teaching, and who prefers to use their contact hours this way, is better than someone who wants to experiment with innovative forms of education.

When students have a lot more freedom of choice in how they complete their studies, then lecturers assume a new role. They supervise the learning and selection process as coaches or mentors of the students, provide context and content, and sometimes also act as online moderators. This new role demands different teaching methods and different abilities. Above all, lecturers are professionals who are expert in their subjects, and must remain so. By creating teams made up of lecturers, ICT support staff and experts in education, each team member can contribute what they are good at. Some lecturers are pioneers and contribute innovation, while other lecturers contribute mainly their domain content.

Teachers also have a heavy workload to deal with, even without any added innovative strategies. In addition, especially in universities, lecturers are judged more on their research results than on their teaching abilities. To stimulate educational innovation and to motivate university lecturers better, there is a need for an educational career path, with an appropriate HR policy. That also needs to be aligned with the new role of lecturers as coaches and mentors.

2.3 The job market

Careers, jobs and tasks are changing ever faster. Thanks to technological advances such as digitalisation and increased use of robots, some professions and careers are disappearing and new ones are being created. The content of careers is also changing. To resolve complex problems such as the environment, ageing populations and rising health costs, creative and adaptable knowledge workers are needed who can work together across disciplines. Companies and organisations are probably looking more for flexible and adaptable employees than for domain experts. They need highly educated employees who are able to deal with change, and who know how to identify and fill in gaps in their knowledge. Higher education needs to prepare students for this and to teach them how to handle it.

Up-to-date knowledge

Employers expect graduates to enter the job market with up-to-date knowledge. That requires the institutions to keep their curricula constantly up-to-date, and to continue to keep up with new developments. They also need to teach their students that personal development does not stop when you get your certificate. They need to ensure that students are able to prepare themselves for the following stages in their career and are able to manage their own learning process.

Skills as well as knowledge

As well as factual expertise, employers are increasingly looking for soft skills such as creativity, critical thinking, problem solving ability, communication and working in a team. Leadership, self-awareness and providing feedback are also becoming more and more important. Within the current curricula these skills often receive little attention, and students have less time to acquire these skills alongside their studies, due to the shorter time spent studying. More attention should be given to this in courses of study.

2.4 Educational institutions

Institutions are faced with the challenge of making education more effective while at the same time maintaining the quality of education. Rising student numbers, less funding per student, low yields and high drop-out rates are forcing institutions to make teaching more efficient and more effective. Institutions need to shape their teaching to fit the demands of students and the job market.

² MOOC: Massive Open Online Course, SPOC: Small Private Online Course

Study switchers and drop-outs

A substantial proportion of first-year students change their subject or drop out. More freedom of choice within the curriculum offers students the option of changing direction during their education. Matching, information and insight into the professional world also remain crucial.

Part-time education

In 2014 the advisory committee on flexible higher education for employees noted that "results in the Netherlands in the area of lifelong learning [lag behind] the ambitions, while the urgency of this keeps on growing. In this area, the Netherlands is trailing well behind its own ambitions as a knowledge economy."³ With truly flexible education programmes and more opportunity for students to follow their own path at their own speed, taking their individual circumstances into account, the distinction between full-time, part-time and work-study education should disappear.

3. WHAT IS CUSTOMISED EDUCATION?

Customised education always means *personal* and *flexible* education. Personal education is not based on a fixed educational programme, but is aligned to the wishes and preferences of the student. Personalised education enables students to define their own learning paths. Flexible education offers students freedom of choice. If students are able to pursue their education when and where they want, more flexibility becomes possible and more freedom of choice can be provided. That makes learning at your own speed and on your own schedule easier.

Customised education can take a number of different forms, which can always be defined in five dimensions from the student's perspective. The selected mix of dimensions, along with the breadth of each dimension, leads to customised education for each institution. Two dimensions relate to *what* the students learn, three to *how* they learn:

What the students learn:

- freedom of choice of content
- fitting with their background

How the students learn:

- in their own time and place and at their own speed
- at their own level
- in their own way

In this chapter we briefly describe these five dimensions.

3.1 Freedom of choice of content

Freedom of choice of content enables students to match their education to their own ambitions, interests, talents and abilities. It also enables them to pursue parts of their education at a number of different institutions. By creating unique combinations, they can differentiate themselves in the job market.

Freedom of choice can apply at a number of levels. For example, lecturers can offer their students freedom of choice within a course. Within a course of study, students can be given the choice of taking or not taking specific courses, often with room for elective courses and activities. And finally, students can choose the educational institutions where they want to pursue their education.

3.2 Fitting with the background

By taking account of the (prior) knowledge, skills and experience of each student, institutions can do justice to each individual. Particularly for students with work experience who want to develop themselves further, that can be very attractive.

³ Flexible higher education for adults Consultative report dated 12 March 2014

Universities and programmes can offer students exemptions and adapted programmes, based on their experience and prior knowledge. Programmes can also continuously adapt their content, presentation and feedback to the level of the students. Learning analytics offer ways to customise this adaptation. By analysing students' learning data, students and lecturers can gain insight into learning results and learning behaviour, enabling tailored support for students.

3.3 Own time, place and speed

Institutions can offer students the opportunity to study in their own time and at their own place and speed. In this way institutions accommodate individual circumstances in the lives of their students. That makes it easier for students to combine their education with work, family, care, etc. The availability of online courses makes it possible to take courses at other institutions, including abroad.

Learning at their own speed allows students to speed up or slow down. If they have learned all the material in three weeks, then they can sit the exam after three weeks. If instead they need twenty weeks, that is not a problem. In this way, institutions can adapt to the specific talents of exceptional students. Adaptive teaching makes learning at the student's own speed possible.

3.4 At their own level

Presently most education is offered at a single level. However, this sort of education may be too difficult for some students and too easy for others. By stretching excellent students further, they are kept motivated. In addition, they can differentiate themselves for potential employers. Students who have problems with specific parts of a course should, where possible within the scope of their final qualification, be able to take some subjects at a lower level.

3.5 In their own way

Students can work more successfully if they have the opportunity to learn in the way that suits them best. Some prefer lectures or seminars on the campus, while others would rather learn at home with a book or use tutorial videos or games. Some students have a preference for problem-based learning, others really dislike it. Freedom of choice to learn in various ways enables students to choose from among the learning methods, learning materials and support that suits them best. Furthermore, the teaching methods always help to guide the approach and the way in which education is provided. This determines the degree of freedom of choice.

4. WHAT IS ALREADY HAPPENING?

In the Netherlands, there is already plenty of experimentation going on with customised education. Some forms of customisation, such as freedom of choice at the master's level or development of online education, are already the norm in many institutions. Institutions are also carrying out pilots to better define the boundaries of customised education. A number of examples of how institutions have made choices to implement one or more dimensions of customised education to a greater or lesser degree are described below.

4.1 Freedom of choice

At many educational institutions students can take a minor subject elsewhere, sometimes also outside their own subject area. University colleges and liberal arts and sciences colleges offer a bachelor's programme with a lot of room for elective content. That also applies for many master's courses. At the University of Utrecht, all bachelor students can define a quarter of their curriculum themselves.⁴

Individual definition of a full course of study also occurs, but on a small scale. An example is the contract education programme at the Erasmus Academy. Part-time students here can select their own courses, and on the basis of these, create their own master's degree. Another example is the bachelor's in ICT from Fontys, where students can choose from seven study paths after the first year.

⁴ <http://www.uu.nl/bachelors/veel-keuzeruimte>

4.2 Background

Various educational institutions take account of prior knowledge, experience or skills. Higher vocational training institutions participating in pilot projects with work-study or part-time education assess case by case whether students should follow a standard course of study or qualify for a customised course of study because they have already achieved specific learning goals.

The part-time course of study in Management, Economics and Law at HZ University of Applied Sciences, started in September 2016 with education based on learning outcomes. Students can bring in projects from their job and qualify for study points if they demonstrate that they have already achieved certain learning outcomes. At the Windesheim University of Applied Sciences, part-time students in educational programmes (secondary and primary lecturer training) are eligible for exemptions based on previously acquired knowledge and skills.

The Utrecht University of Applied Sciences offers testing independent of the manner of learning: students can sit a test once they have mastered the course material, without being required to attend the classes for the course. At the Amsterdam University of Applied Sciences, study time can be reduced on the basis of skills acquired previously.

4.3 Time, place and speed

Windesheim University of Applied Sciences offers part-time students in educational programmes (secondary and primary lecturer training) the option of distance learning to develop theoretical knowledge. This is, however, done at a defined speed, with a tight study timetable and hard deadlines.

Despite the broad availability of MOOCs, their penetration into regular education is still very limited. Students who want to be credited or get an exemption for a successfully completed MOOC sometimes find it is a lengthy struggle. An exception to this is the programme "Wageningen X", in which Wageningen University is working towards integrating online and offline study options, including MOOCs. There are now two fully recognised master's courses available: Nutritional Epidemiology & Public Health and Plant Breeding. Starting with the 2016-2017 academic year, students at Wageningen University will be able to collect study points for MOOCs from their own university. These courses can be taken completely online, and students sit the exam at the university.

In part-time courses the students can postpone their courses. Speeding up is also possible, for example in the medical faculty of the University of Leiden. Students can use the freedom of choice in their transition year, after their basic medical training, to begin courses that fit with their specialisation. The result of this can be that students complete their specialisation six months earlier.

4.4 Level

Many institutions offer honours programmes for students who want to and can do more. These programmes have to some extent been developed as part of the Sirius Programme⁵, which since 2008 has enabled universities to challenge students who are performing well to dig deeper.

In the honours programme at HZ University of Applied Sciences, the students add an extra 420 hours to their studies in one academic year. The Utrecht University of Applied Sciences offers honours courses in all subjects, with both broader and deeper content. Around 6% of students sign up for this. At the Hague University of Applied Sciences (at the TU Delft campus), students in scientific subjects can choose between the university variant or the TU Delft variant. In the latter case, they can move directly from their bachelor's studies into a master's programme at TU Delft, without any transition programme.

Other institutions, like the University of Leiden and Maastricht University, offer online refresher courses for students, for example to improve their maths skills so that they can keep up with the bachelor's course of their choice.

The University of Amsterdam allows psychology students to do a formative test each week, with the help of the SPSS statistics programme. Through the test results, the students receive targeted

⁵ <https://www.siriusprogramma.nl/instellingen>

feedback about their weak spots. "This way, it is almost impossible not to pass the course," says one of the students.

5. SCENARIOS FOR THE FUTURE

An institution that wants to implement customised education not only has a choice of different dimensions, such as freedom of choice in content or freedom of time and place. For each dimension, an institution can choose the bandwidth that fits with its motivation for creating education that is more customised. In this chapter, we explore what the selection of the maximum variant might look like. As to the question of whether the maximum variant is desirable for improving the quality of education: we examine this in more detail in Chapter 6.

5.1 Freedom of choice

Full freedom of choice within an institution could mean that the institution no longer offers any programmes, but rather courses from which students construct their own educational programme. Full freedom of choice in education by all institutions could mean that students no longer register with a specific institution, but only for one or more educational components. That requires unbundling teaching, testing and services. Students can then pursue their education both at home and abroad, face-to-face, blended or online.

Independent accreditation bodies decide when a student has earned a degree. That is then by definition no longer a diploma from an individual educational establishment. The diploma will state for each component which institution provided the course(s). In this context, the development of micro-credentials becomes important. Micro-credentials, for example with the aid of digital badges, are a form of recognition of skills that students can earn and can use to prove their growing abilities.

5.2 Background

If we want to adapt education fully to reflect the prior knowledge and experience of students, the ultimate consequence is that all diplomas are detached from any fixed curriculum. The link between study points and nominal study hours is cut; instead, education is defined in terms of learning outcomes. The outcomes state what a student knows and is able to do on completion of a learning process, without defining a specific teaching path. Students can take exams at any time, whether or not they have followed a teaching unit.

At the start of their studies, students can take a test to rate them against the final level to be reached of the course to be followed. Based on the result, the student can choose where to acquire the missing knowledge: at an institution or in the work environment. Exams can be taken at any time, and as often as the student wants. Students pay separately for attending the courses and taking the exams.

5.3 Time, place and speed

Full freedom of time, place and speed in education implies that the full curriculum is also offered online. Students then no longer have an obligation to attend, but instead an obligation to deliver results. Students have (online) study support available 24/7. Students can make appointments with lecturers for times that suit them both. Students have the teaching materials available online. And they can take a test wherever it suits them: at home, at the institution or at a regional test centre.

Studying at your own speed means that there is no longer any nominal study duration. Students can take two years to get a bachelor's degree, or they can take six. Registering for a course means signing a contract with an institution that helps the student reach the end goal, at their own speed.

5.4 Own level and own way

For good matching to the level of the students, it is necessary to define a clear baseline for all courses at the middle vocational, upper vocational and university levels. Students can then take any course at any level they want. Their diploma will show the highest level they achieved. For all courses, educational establishments will organise extra challenges for the students who ask for them. Those can be honours courses, but also customised approaches per course. A student does not need to achieve a specific diploma level; a combination is also possible.

Studying in your own way implies that, for each course, students are able to choose from different methods of teaching, different kinds of teaching materials, and different forms of support.

6. ISSUES

Customised education is not a goal in its own right; it can equip students better for their future. To define the bandwidth of each dimension of customised education that best suits an institution, the institution needs to make choices. The scenarios in Chapter 5 are extensive. To determine whether an institution wants to opt for an extensive variant or a less extensive variant for each of the different dimensions, questions need to be asked about the desirability and feasibility of the outlined options, and about the necessary (legal) framework. In this chapter we examine a number of issues.

6.1 Legal framework

The Dutch *Wet op het hoger onderwijs* (WHS) [Higher Education Act] places limits on the freedom of choice. This act enshrines the principle that a formal education needs to be consistent and coherent. All study units must combine to achieve the final objectives of the course of study. In addition, the WHS states that the core of the curriculum must be provided by the institution that issues the diploma. This restricts the freedom to combine educational components from different institutions.

Students in higher education are given an "explicit right" to continue with their best subjects at a higher level. For example, students at a vocational school with a talent for English can take this subject at a more academic level. This was stated by Secretary of State Sander Dekker in a letter to the Second Chamber. Dekker: "Not every child fits exactly into one of the slots of the different types of school. At present, it is too often your worst subject that decides how good you are allowed to be in your best subject. This is demotivating for students and a waste of talent." In higher education this is not yet the case.

The Dutch Social Economic Council (SER) states that a clearly discernible difference is necessary between higher vocational education and academic education. This is necessary both for the recognition of courses of study and for the link between education and the job market. However, the Council believes that this difference should not be allowed to create a barrier to collaboration, coordination and transfer between vocational and academic education.

Any experiments that represent an exception to the statutory requirements normally require a General Administrative Measure arising from a political decision process. This generally hampers the launch of innovations..

6.2 Sense and nonsense of freedom of choice

Freedom of choice in creating the curriculum raises a number of questions. What is the quality of a self-constructed curriculum? How do you guarantee its coherence, and how do you define the objectives? Institutions generally opt for a limited form of freedom of choice. In doing so, they seek a balance between the degree of freedom of choice that students can cope with, a coherent curriculum and fixed objectives.

Structured freedom

Not everybody wants freedom of choice. A fixed programme can also be a valid form of customised education. However, freedom of choice also demands structure - for example, a structure that provides room and support to students who do not yet really know what they want, as well as students who know exactly what they want, within the scope of their wishes and circumstances. How much freedom a student can handle depends on the person concerned and their age. Generally speaking, 17 and 18 year olds need more direction and guidance than a 22 year old. Research by the Amsterdam University of Applied Sciences shows that students mainly need guidance and structure in their first 18 months. After that, they want more space, but without being completely left to their own devices.

Guaranteeing professional skills

Legal professions such as judge or lawyer, or controlled professions such as doctor or registered psychologist, require certain defined levels of knowledge in order to ensure the ability to practise. In these courses of study it is not easy to offer freedom of choice for the content of the curriculum. It would, however, be possible to take some courses at another institution.

Examinations

If diplomas are completely detached from the educational curriculum, the question arises whether an educational institution is the most suitable party to set the exams. The exams could then probably be better set by independent examination boards. However, the question is whether testing and setting exams are indissolubly bound to teaching.

6.3 Other points for discussion

Preserving the educational community

Teaching is more than knowledge transfer. The interaction between students and lecturers is a crucial part of education. Studying at an institution means being part of an educational community. If students are able to study totally in their own time and at their own place, this interaction is at risk. There are, of course, ever more options for online interaction between students and lecturers, but education is a relationship, and face-to-face interaction remains important for the discussion of crucial matters and sharing of (complex) knowledge.

Different speeds without detachment

The big question with speed differentiation is how the institution can organise the teaching. This includes interactions with fellow students and monitoring tasks and assignments. Teachability is also a contentious issue. In addition, there is the question of whether the lack of a deadline will kill motivation to complete a course.

The freedom associated with different speeds is not always a benefit. International research has shown that a high level of choice of speed leads to dropouts. Some students specifically need a strict framework. For these reasons, the Erasmus University Rotterdam offers more structure than previously in the part-time Law course of study: every Friday afternoon there is a lecture. For this reason, the Open University and Windesheim University of Applied Sciences have restored more structure in part-time courses of study. Working with fixed groups led to a spectacular rise in the number of completed diplomas at the Open University. The National Student Survey also shows that it has a positive effect on student satisfaction.

Do differentiated levels leads to dumbing down?

The question is whether equivalent courses can actually be organised at three levels (middle vocational, higher vocational and university) for all courses. This demands a lot of mutual coordination, which may come at the cost of the quality of education. The value of a differentiated diploma is questionable if crucial elements are achieved at a lower level. Another question is whether the job market can assess the value of a scaled down diploma when several different levels are involved.

Is it feasible?

Customised education demands choices: choices of the dimensions where an institution provides customised learning, and choices as to how far it should go. When assessing potential changes to education, the following criteria may be useful:

- Does the change lead to the desired change (students who are better prepared for the job market and better equipped for lifelong learning)?
- Is the change feasible in terms of studying?
- Is the change feasible in terms of teaching?
- Is the change feasible in terms of organisation?
- Is the change affordable?

The redesign of education costs time and therefore money. Experiments require a long-term effort and investments that do not always deliver the expected results. Differentiated education, which therefore many also be smaller scale, is also likely to be more expensive, with no additional funding to cover it. The WHW has stipulated that educational institutions may not ask students for additional contributions over and above their fees. The only exceptions are the University Colleges. If they have been designated as small-scale and intensive educational institutions by the NVAO, then they can ask for higher fees.

In the Ministry's experiments with voucher financing, the effects of other forms of financing are being studied, such as payment per module. Another experiment is that of the University of Amsterdam/Amsterdam University of Applied Sciences. These institutions are carrying out a pilot in

the 2016-2017 academic year with one thousand students who are not paying annual fees, but instead are paying per course.⁶ This can be financially beneficial for part-time students and for full-time students who also have to work a lot alongside their studies. The question is, of course, how financing affects the educational institutions.

7. SUPPORTING CUSTOMISED EDUCATION WITH ICT

In this chapter we offer a number of examples of how ICT can play a role in shaping customised education. The question of how ICT can enable customised education was addressed by the authors of the SURFnet trend report. We summarise their answers below.

7.1 Virtual reality

Using virtual reality you can construct the entire learning environment for a student. By using simulations in VR, students are less tied to time and place, and can experience important events, exotic locations or future work environments without leaving the teaching location or the college lecture hall. Students can decide how, where and when they use it as part of their own learning process, provided that the education/institution offers high quality content. A student can therefore influence their own learning process. Although a virtual environment can be experienced jointly with others, a virtual reality experience is essentially individual. It offers options to adjust the environment to the person, both in terms of level and of the way in which information is presented. Content can therefore be personalised.

7.2 Serious gaming

Serious gaming adds value particularly in learning situations where it is important to experience for yourself the effects of your actions. But it can also contribute to changing attitudes and reflection. Games can also be used to good effect for skill training. The use of (virtual) games/simulations for skill training offers logistical benefits: students can practice in situations that would cost a great deal of time and money in the "real" world. Serious gaming, just like other forms of e-learning, can be used individually, where and when you want. The game elements here are a bonus that motivates students to achieve their goals. Another possibility is to differentiate within the game using roles. This means students can be assigned a role within a team that suits them, or indeed a role that does not suit them so well, so that they can practice it.

7.3 The virtual classroom

It is often difficult to bring students, lecturers and (online) sources together, while direct interaction is indeed important. A virtual classroom can offer a solution. In a virtual classroom, students from different countries can follow the same lesson together, and learn about each other's cultures. The power of a virtual classroom lies in its direct interaction and the group dynamic it generates. In a virtual classroom, students work in groups. Learning to collaborate is one of the skills required for the 21st century. Here students learn that other people have other cultures and a different way of solving problems and thinking. This helps to create your own range of learning and problem-solving strategies.

7.4 Internet of things

The IoT offers wholly new and cost-effective methods of data collection. These methods can be applied to collecting data about students to support both the student and the lecturer. On campus, sensors and smart devices can be used to organise educational logistics. Managing the occupancy of teaching rooms is one example. Using data about the attendance, activities and study needs of students, you can create dynamic learning hot-spots that stimulate interaction between students. The IoT can enrich student analytics in many ways. An Internet of Everything can offer a learning experience that is much more authentic and personal than is currently possible. Reflection is based on both real data and on data enriched by the environment, and is embedded in an authentic learning environment with physical interaction options.

⁶ <http://www.folia.nl/actueel/98236/uva-en-hva-proeftuin-voor-collegegeld-betalen-per-studiepunt>

7.5 Digital testing and learning analytics

Each student leaves a digital trace from the moment they seek out the website of the educational institution until the time they are registered as an alumnus. Link all the systems together and you gain insight into students' learning behaviour, the quality and effectiveness of the teaching. Learning analytics allows targeted feedback to students and lecturers about the progress of studies, and provides insight into how the material is being mastered. Learning analytics can also provide insight into the quality of the (online) teaching materials which can then be improved as a result. By analysing the test data from formative testing, students and lecturers rapidly receive insights into which parts of the subject matter the student has absorbed. In addition, the lecturers can see which exercises and sections of their teaching could be improved. Digital testing combined with learning analytics make it possible to integrate exercises in the student's learning and development process. Students get feedback on their development, success and any stumbling blocks. And the lecturer can also form a view: he/she sees not only the results, but also the students' efforts. Based on this, he/she can offer them customised work during a seminar or a personal meeting.

7.6 Adaptive learning environment

Based on current information about the learning process and their progress, a student may choose a further learning activity and the correct learning content for a learning path. There is a constant action and reaction, supervision, assistance and reflection back and forth between the student, the lecturer, supervisor and workplace. Every interaction generates data (analytics) that form the basis for a student profile. In an adaptive learning environment it is possible to give just-in-time information. Based on the data analysis we can provide digital learning content (for example digital tests) just-in-time for a student. We can also construct non-linear learning paths. We can render material adaptive by chopping up (large) blocks of teaching material into small chunks. This way we can vary the learning path in order to match the level, speed, interest and other characteristics of the student. Digital teaching resources can be flexible in their form, content and methodology.

7.7 Digital badges and micro-credentials

Badges make it possible to assign a discrete value to smaller teaching units. This increases the flexibility of the education that can be provided: students have more freedom of choice in constructing their curriculum. Students can go looking for educational units, for which they can earn badges, that suit their own background and learning path. Especially professionals who want to continue with lifelong learning, often do not want to follow a complete degree course, but just specific parts of it. They then want to be able to provide proof that they have completed this additional training. Badges can help in recognising previously acquired skills. For employers, badges make it more transparent what education someone has completed: they make unusual skills more visible. And badges can enable clearer differentiation between formal and informal education.

7.8 The student as owner of his online identity

A good and reliable online identity is an absolute precondition for customised education. An educational identity for each student offers access to worldwide educational options without complicated and time-consuming registration procedures and difficult transfers and re-registrations. A student may specialise by taking extra subjects and additional courses at other educational institutions and simply combine study at Tokyo University with an intensive online refresher course at Munich University. A reliable identity is also important for collecting micro-credentials. Certificates and badges awarded can be linked to a single identity: that makes it simpler for a student to prove that he/she has successfully completed a course.

8 CONCLUSION

Education is due for some drastic changes in order to be better able to meet the ever-changing demands of the job market and to offer students more customised services. Institutions are moving in this direction, and revising their teaching in some wide-ranging innovative programs. But there is still

much to be uncovered about the way in which education can more closely meet the demands from the job market and from students.

Where we want and need to get to with education is a difficult but important question. Insights will emerge as we work on it, and will not follow a straight line. In this paper, we have described five dimensions of customised education, we have reflected on the extreme consequences of customised education and we have asked some questions about its desirability. We also drew an outline of the way in which ICT can play a role in achieving customised education. With this, we hope we have made a contribution to the discussion of innovation in education.

We invite educational institutions to continue to share their experiences in innovation in education and to refine their own vision of education. SURFnet wants to provide an environment for using the technological options that are necessary to achieve these ambitions.

3. AUTHORS' BIOGRAPHIES



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SURFnet's objective is to improve the quality of higher education and research in the Netherlands through breakthrough innovations in ICT. SURF's policy requires it to closely monitor international trends and openly share knowledge with international partners. As

programmanager Technology Enhanced Learning, Christien's field of interest and work is to support cooperation between institutions of higher education in the area of IT innovation for improving study success and the quality of education. She has a strong interest in Open Education, Learning Analytics, the Next Generation Digital Learning Environment and Testing and Assessments.

Christien Studied Dutch Literature at Utrecht University. She worked for the Dutch Foundation for Literature and was at the The Netherlands Organisation for Scientific Research responsible for a Research program in which IT researchers and heritage managers work together on making heritage available digitally.