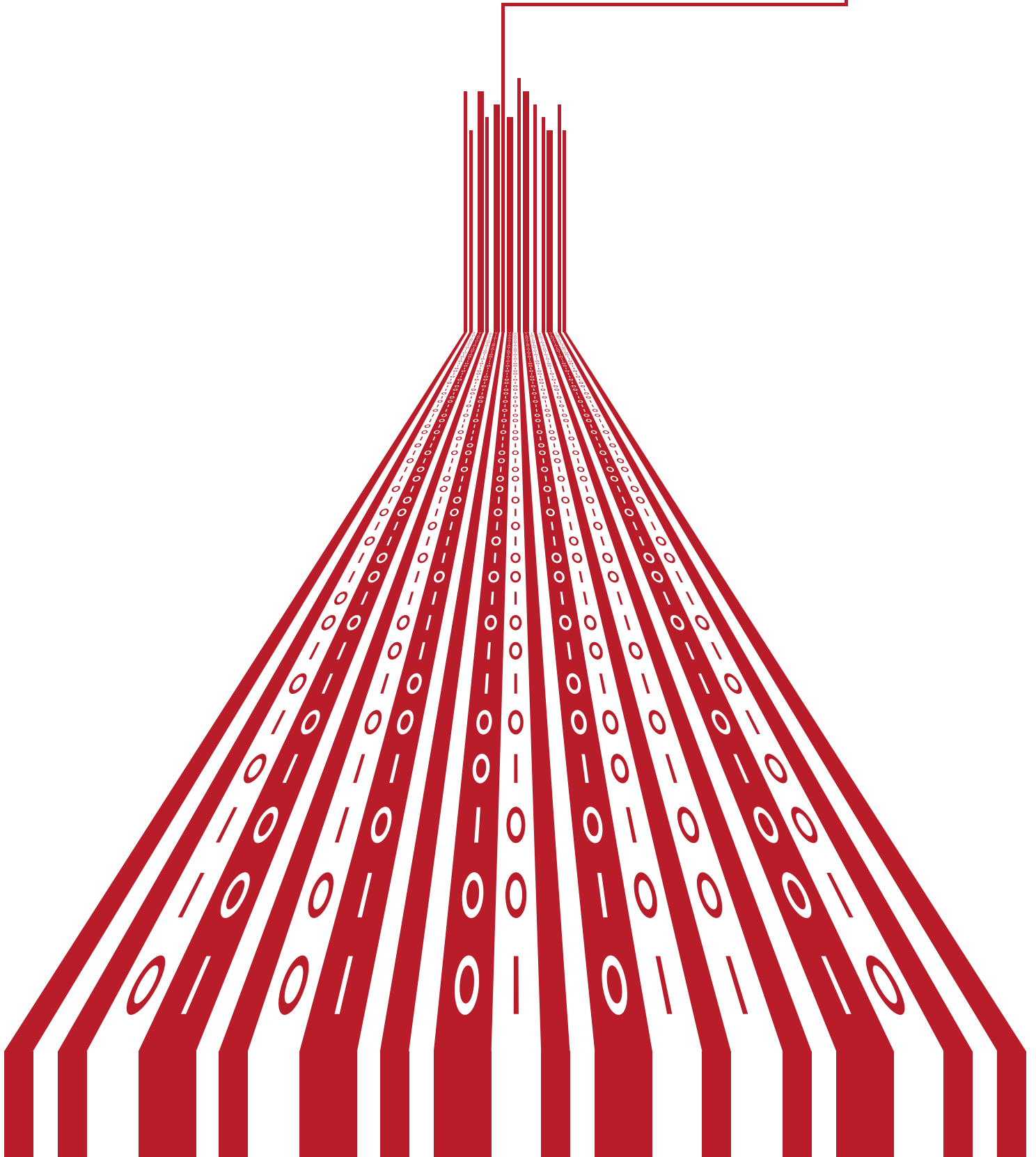
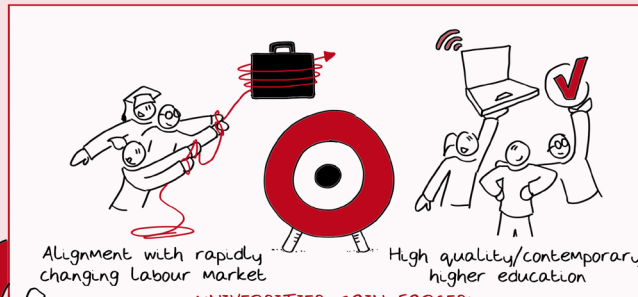


Digitisation in academic education

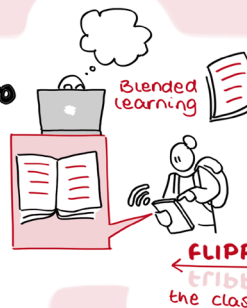
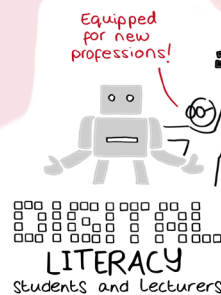
Our agenda for a future-proof
range of degree programmes



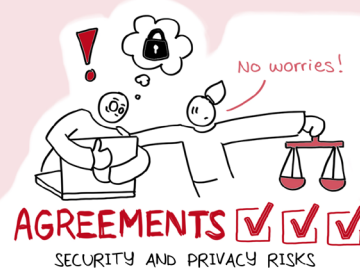


UNIVERSITIES JOIN FORCES!

WHAT WILL WE DO?



FLIPPING
the classroom



DIGITALISATION IN ACADEMIC EDUCATION

VSNU AGENDA FOR A FUTURE-PROOF RANGE OF DEGREE PROGRAMMES



Foreword

Myriad publications on the digitisation of education have appeared in recent years. The emergence of E-learning, MOOCs, blended learning and learning analytics has spawned hypes and predications on the disruption and indeed the demise of a segment of the higher education sector. Although the prophesied sea change has failed to materialise to date, digitisation has undeniably had a significant impact on higher education.

VSNU has therefore put the topic of 'technology and higher education' on the strategic agenda. Our earlier publication entitled 'The Digital Society' centred largely on research. This publication, 'Digitisation in academic education', elaborates on this topic in academic education.

I would like to thank all those who have contributed to this publication. In particular, I wish to express my gratitude to Anka Mulder, Vice-President for Education & Operations at Delft University of Technology. Her academic treatise '*Nederlandse universiteiten en technologie in onderwijs*'¹ ('Dutch universities and technology in education') served as the basis for this publication.

In 'Digitisation in academic education' the universities articulate how we aim to *jointly* unlock the potential of digitisation. We have consciously chosen an approach that allows ample scope for experimentation. After all, no one holds a blueprint of the university of the future and developments are occurring at a frantic pace. The institutions will chart their own strategy and course in an experimental environment while remaining fully committed to undertaking collaborative efforts and sharing knowledge, including with the universities of applied sciences and SURF, the collaborative ICT organisation for education and research in the Netherlands.

We are not rivals in the digitisation arena but will work side by side. We will experiment, conduct research, share knowledge and help each other utilise the opportunities afforded by digitisation across the entire sector.

As a sector we wish to design our programmes optimally to fully equip our graduates for the rapidly changing labour market, we wish to spend our funds wisely on high-quality contemporary education and we wish to respond to the need for high-value knowledge among those members of the working population who require refresher courses or further training. By joining forces we will be able to find a solution to the complex issues that lie ahead of us.

Karl Dittrich, chairman

¹ Nederlandse universiteiten en technologie in onderwijs. Anka Mulder, July 2017.



Background

Society has rapidly digitised in the past two decades. Just think of all the people in the Netherlands whose telephones are permanently connected to the Internet. Digitisation is set to accelerate even faster in the next decade. We are in the midst of a digital revolution that affects everyone. Technological advancement will see computers taking over many more jobs currently done by humans, intelligent tasks included. Smarter, more flexible, cheaper, simpler and 'more human' robots will become the norm not just in industry, government and service provision, but in our homes and cars too. Billions of devices and sensors will generate vast amounts of data that will be stored, processed and analysed.

Digitisation will directly or indirectly affect practically every opportunity and challenge faced by our society. From education to healthcare, from transport to housing, from service provision to media and entertainment, from agriculture to industry, and from infrastructure to the democratic rule of law, developments and opportunities that until recently would have seemed like science fiction are on the doorstep.

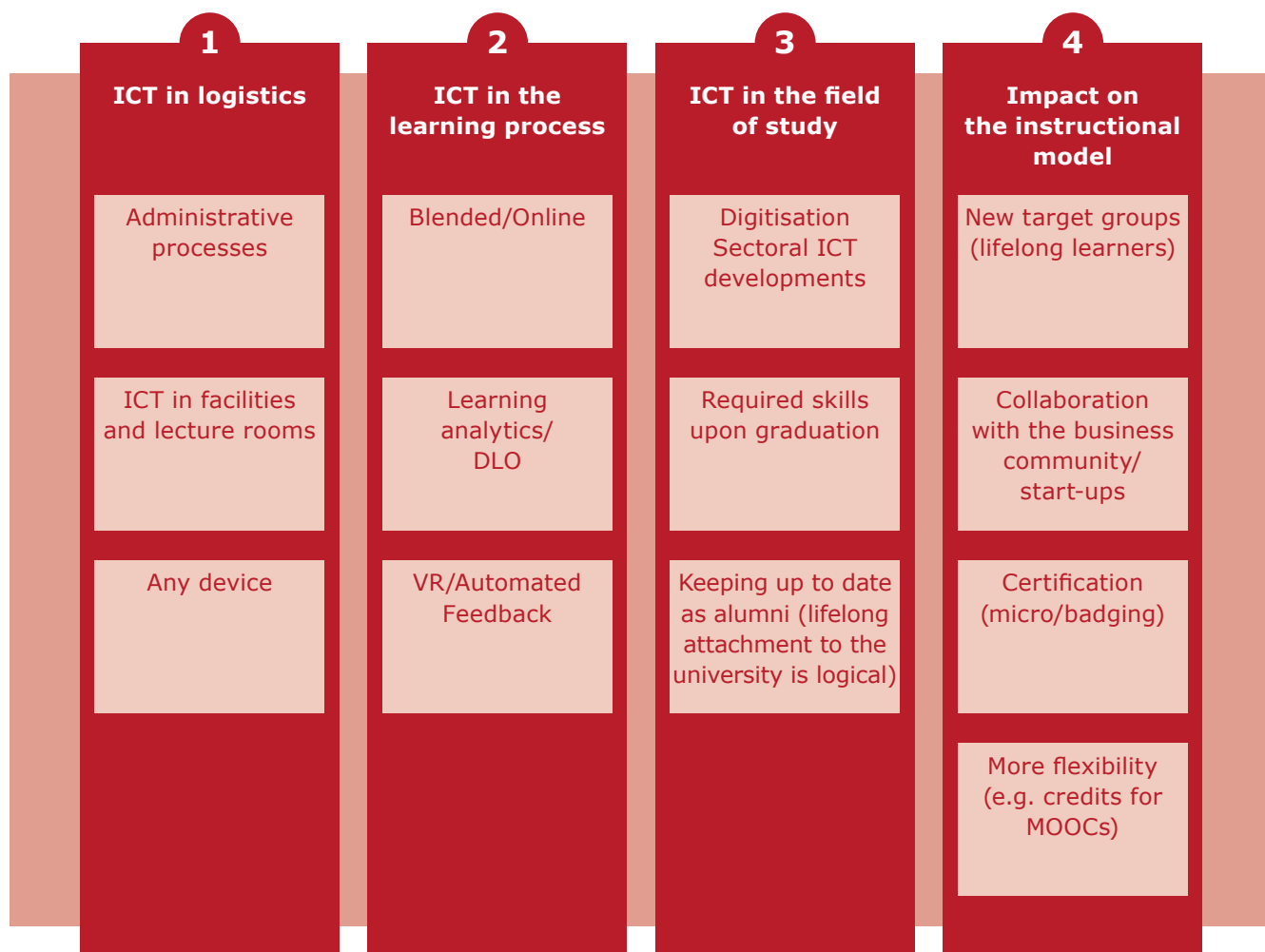
In its recent report entitled 'Thoughtful Digitilisation'², the Education Council of the Netherlands stated that in this era of rapid digitisation, the education sector is still searching for the appropriate level and appropriate methods of digitisation. The council put forward three recommendations: **(1)** reduce the burden on the education sector by guaranteeing technical preconditions and the privacy aspects of digitisation; **(2)** increase the sense of ownership of digitisation in the education sector; and **(3)** explore digital applications to build experience and to develop a vision.

The Dutch universities share the opinion of the Education Council that digitisation also has a significant impact on academic education. Digitisation is pertinent to all facets of academic education. It has an impact on education logistics, teaching methods, the skills graduates need on the fast-changing labour market - which means it also has an impact on curricular content. Even our instructional models, which are currently still primarily supply-oriented, are affected by digitisation. How should we manage these profound changes? What are the challenges facing us and how can we jointly find a solution?

² Thoughtful Digitilisation. Education Council of the Netherlands, May 2017
<https://www.onderwijsraad.nl/english/publications/2017/thoughtful-digitalisation/item7560>



Figure 1: The different roles of ICT in education at universities





The challenge

Digitisation brings both opportunities and threats for the quality, efficiency, innovation, positioning and visibility of higher education. What are the current trends in the Netherlands? And can the Dutch universities deploy digitisation in a joint effort to enhance higher education in the Netherlands and strengthen the position of the institutions?

A soaring number of students have entered higher education in recent years. Large university degree programmes, such as psychology, law and civil engineering, attract hundreds of new students every year with different backgrounds in terms of prior knowledge, talent and study pace. Nevertheless, they all attend the same lectures, need to study the same material and sit their examinations at the same time. The **massification** of higher education puts pressure on the 'master-trainee relationship'. Many lecturers, students and administrators would prefer a system that takes greater account of individual students' talents.

Digitisation has already enriched the teaching material and new teaching methods are being used. While developments in learning analytics and digital learning methods will not be able to restore the master-trainee relationship, they do facilitate **personalised education**, which takes greater account of the individual student. Thanks to concepts such as **flipping the classroom** and **blended learning** with a mix of online and offline courses, there is more room for interaction between students and lecturers.

With institutions increasingly offering online courses, students have more **options** to choose from. Without having to travel, they can obtain information or take courses at other universities. One such example is the **Credits for MOOCs programme** initiated by Delft University of Technology, which enables students to earn regular credits upon the successful completion of a MOOC at one of the five participating universities. This offers students a broader range of courses to choose from, and can to easily take a course offered by an Australian, European, American or Asian university.

Learning analytics and online education provide opportunities for conducting quantitative **research on education** because far more data, on large groups of students, can be obtained and processed in less time. For example, extensive research is already being carried out on how students taking MOOCs learn, what they understand and where they face obstacles. **Nudging** is another basic experimental tool being used to encourage continued or more in-depth learning among students. **Big data** research, combined with cognitive sciences, opens up new opportunities for educational research. As pointed out by MIT professor Sanjay Sarma, 'Pedagogy is becoming a hard science'.³ New educational research groups are emerging in the USA, and the universities in Rotterdam, Delft and Leiden in the Netherlands are jointly developing an educational research group. The Welten Institute, the research centre of the Open University of the Netherlands, is also focusing on the use of technology in education.

³ Sanjay Sarma, 3 April 2017. Presentation for the 'Personalised Learning' study trip to Boston organised by SURF.



Digitisation affects not just the format but also the type of education provided. Citing from our publication 'The Digital Society' ⁴: 'Every discipline in the field of science will need to develop digital knowledge, skills, methods and infrastructures'. However, **digital skills** are not only required in the field of science; they will also be needed in almost all **professions** in the near future. This implies that all students will need to develop sufficient digital knowledge and skills relevant to their future professional field.

Digitisation is not purely good news for students and lecturers. It also brings **risks**. The greatest apparent risk is that budget cutbacks will force institutions to deploy digital education as an **austerity measure** that will erode the curriculum.

The second risk has to do with **privacy**. Vast amounts of data will be amassed on learning behaviour and study success rates aimed at helping students, raising study success rates and improving courses and curricula. However, there are potential drawbacks. For instance, risks will arise if too much weight is placed on the predictive value of such data, or if privacy aspects are carelessly handled.

Unrealistic expectations constitute the third type of risk. Online education is a relatively new development involving experimentation, where things may from time to time turn out differently than expected. MOOCs are a good example. Millions of people embark on online courses, yet currently only a minor percentage actually complete them.

Serving the **lifelong learner** is and will continue to pose a significant challenge. Governments, employers and educational institutions highlight the importance of lifelong learning alongside work for broad groups. Even though the range of online lifelong learning courses has expanded in recent years, we have failed to adequately reach new target groups.

Added to that, the actual redesign of the existing curricula is not yet in the pipeline. Education for the working population should be available online, in more modular and demand-driven formats so that people can study in their own time and at their own place. The Open University of the Netherlands has already gained considerable experience in this area.

⁴ *The Digital Society - The Netherlands and its universities: international pioneers in human-centred information technology* VSNU, September 2016.
http://www.vsnunl.nl/files/documents/Publications/VSNU_The_Digital_Society.pdf



Approach

There are marked differences in the direction and pace at which universities are digitising education. Some institutions have opted to take a lead role while others have adopted a more wait-and-see approach that allows them to learn from the successes and failures of others. Besides differences in the envisaged level of digitisation, the objectives the universities primarily aim to achieve and their implementation methods also vary. Some universities focus mainly on enhancing the quality of education, while other institutions tend to emphasise international visibility by offering MOOCs to attract large numbers of 'students'. What opportunities does a more flexible curriculum offer? And what opportunities are there in the area of lifelong learning?

Some regard the digitisation of education as a paradigm shift necessitating a complete redesign of the curriculum. In this vision, there is a substantial role for EdTech companies and private education providers, which are partially taking over the higher education market. Others believe that digitisation will be absorbed within the current education paradigm (aside from a few specific areas) and that it will mainly be used as a tool to further enhance the quality of education and to facilitate greater personalisation and flexibility.

No one can predict just how digitisation will change higher education in the next decade. What we do know for certain is that digitisation has a significant impact on higher education. We are living in a dynamic era with new opportunities constantly emerging, and all parties are undertaking efforts to utilise them.

The universities' position is complex. Like banks, universities are systemic institutions. Society cannot do without them (at least not for the next decade). Failure, therefore, is not an option for a university. Nor is sitting idle. We should abandon what does not work and improve and incorporate what does work.

Given that we do not know what the future will bring, universities cannot create a blueprint for what needs to be done. What we can do, however, is use the room available to us to experiment. This is explicitly where we wish to seek out opportunities for collaboration. By experimenting collaboratively and investigating what does and does not work, we can help each other to scale up successful pilot projects. By offering scope within those experiments for the various choices that educational institutions make, we can learn from each other's experiences. By undertaking collaborative efforts in areas where this is essential, as a sector we can take on an initiating and directional role, including vis-à-vis the edtech companies. This will enable us to contribute to the shape of technology and higher education in the future. We will employ the public funds available to us in a responsible and effective manner to make the best possible use of the opportunities afforded by digitisation.

Hence, we will be entering an experimental era, and do so consciously, in which we will make the necessary investments to move forward and critically examine the existing rules and guiding principles. In four years' time, as Dutch universities we wish to be recognised, both in the Netherlands and abroad, as a sector that has been able to modernise public academic education by joining forces to deploy digitisation in a pragmatic and strategic fashion. And by taking a lead role in this area.



The agenda

In the proposition set out in 'The Digital Society', the joint Dutch universities have expressed their aspiration to create a new and appealing international profile for the Netherlands in the next decade: that of a leading nation in the field of digital technology oriented towards people and society.

The Netherlands owes its unique position in the digitisation of higher education to the fact that the Dutch universities have for many years made joint long-term investments in both the hardware and software of the digital backbone. Everything from Wi-Fi to data storage and the digital learning environment is very well organised. The research universities have been collaborating for years with the universities of applied sciences (and recently with the senior secondary vocational education sector) in SURF. Their collaborative efforts have resulted in the implementation of a state-of-the-art digital infrastructure. SURF additionally contributes to knowledge-sharing among lecturers, support staff and administrators, from which a 'soft' infrastructure of knowledge networks has evolved that will play a valuable role in accelerating the digitisation of education. The research universities will be able to benefit from this favourable starting position in their approach and will continue to collaborate with SURF and the universities of applied sciences. This will enable us to develop an ambitious national plan for accelerating the implementation of technology in higher education.

In order to take full advantage of the opportunities for the digitisation of education, we will work on the following ten points:

1. We will refer to the next four years as the '**experimental period**', in which we, as a sector, will jointly explore what works and what does not, and help each other to progress by scaling up successful pilot projects.
2. We will **strengthen graduates' digital skills**. This comprises basic ICT knowledge, information literacy and computation skills, the precise content of which will vary by degree programme. Given the scale of the Dutch higher education sector, modernising curricula and adapting the range of degree programmes so as to offer graduates optimal opportunities is a relatively clear-cut process. Agreements can be made at the national level on the digital skills graduates need. It would be logical to include this in the exit qualifications of the curricula. We will therefore consult lecturers, graduate/college directors and deans on the digital skills they consider to be relevant to specific degree programmes and how those skills can be incorporated into the curricula.
3. In addition to digital skills, attention should also be paid to the **digital resilience** of students and to ethical digitisation issues. Since universities play an important role in protecting our open liberal society, we must be fully aware of both the strengths and weaknesses of the Internet and digitisation. The only way to create this awareness is to highlight this issue in our degree programmes and to focus explicitly on digitisation issues as an integral component of academic skills. Especially in the digital era, **academic skills** are indispensable for making the right decisions on complex ethical issues.



4. We will perform a joint '**sectoral analysis**' of the range of digital programmes offered. Are we educating sufficient students in fields such as data science, informatics and computer science? And are we also involving students who are pursuing other degree programmes in the challenges and issues inherent in digitisation? Are there any blank and blind spots? Can we share knowledge and programme modules? This analysis may lead to proposals for new multidisciplinary courses for developing academic skills in all facets of digitisation.
5. Students' rising expectations and the expanding range of digital opportunities are putting increasing pressure on lecturers' **digital skills**: someone needs to perform an analysis of learning analytics, develop online material, etc. Experience has shown that considerable attention must be paid to lecturers and the manner in which they use (or plan to use) activating teaching methods. Teaching with digital technologies is not the preserve of a select group of education specialists, but is pertinent to each and every lecturer. Digitisation fosters closer teamwork in education, where lecturers receive support from specialists in areas such as online teaching methods, instructional design, and the use of video resources and social media. All these factors make considerable demands on lecturers' teaching skills and equally on the training and support they require. We will look into what digital teaching skills lecturers need for the various types of online education and will jointly undertake to create or adapt the range of lecturer courses offered (for example through the training programmes for the basic and advanced University Teaching Qualifications).
6. We will strengthen **research on academic education**. Digitisation expands the possibilities for quantitative research on higher education. The involvement of disciplines other than education sciences, such as neuroscience and cognitive science, in educational research can spur us to make evidence-based improvements to our programmes and to develop new teaching methods and practices. We will identify which research groups are engaged in examining the effects of new technologies on curriculum design. Collaboration among research groups in the Netherlands and abroad could put the country on the map in this context. We will make agreements with the government, the Netherlands Initiative for Educational Research (NRO) and the Netherlands Organisation for Scientific Research (NWO) on the funding of quantitative/big data research on higher education.
7. **We will open up universities as a testing ground for new forms of digitisation.** VSNU states in 'The Digital Society' that the Netherlands is well-placed to serve as a testing ground for new forms of digitisation: it is a compact, well organised country with excellent physical and digital infrastructures. Clearly, such a test grounding can also accommodate innovation in online education. More specifically, this means that:
 - a. we will organise an expert meeting with the institutions, SURF and the edtech companies to explore possibilities;
 - b. we will issue a joint statement to the effect that the Dutch universities will facilitate national and international edtech companies and will provide edtech start-ups with space and facilities in their incubators;
 - c. we will make agreements with SURF and the Netherlands Association of Universities of Applied Sciences (*Vereniging Hogescholen*) on how we can share collaborative platforms and best practices, and experiment with specific test-bed themes.



8. We will explore digitisation opportunities for **increasing flexibility in education structures**. Digitisation opens up opportunities for universities to create flexible programmes, and to offer programme components as remote courses. This presents opportunities for the range of programmes on offer for the working population and for specific student groups (such as top-class athletes) who have a need for such programmes. However, a specific range of programmes often requires substantial investments. We will jointly develop a knowledge base for switching from regular programmes to flexible, module-based, digital programmes.
9. We will ensure that **student data privacy issues** are handled with due care. Risks are inherent in digitisation, such as those relating to the administration of student data. Due attention will also be given to issues concerning the purposes for which the data are authorised to be used. Universities will join forces to make agreements and create a safe infrastructure, in collaboration with SURF (which already is extremely active in the area of security and privacy, including at a European level).
10. We will look into a practical **organisational format** which offers ample room for experimentation and allows us to quickly and easily share, and jointly build on, the knowledge and experience acquired.

More information about the Digital Society can be found at www.vsnu.nl/en_GB/digitalsociety



APPENDICES

Digitisation in higher education - a capsule history

It is difficult in this day and age to imagine carrying out the logistics processes surrounding education, such as timetabling courses and the student administration, without digital support. These developments enable institutions to improve **student services**. Whether it concerns study progress, the availability of study areas at the campus, registering for examinations and enrolling in courses, finding work placements or final projects - information is available any time on any device - and the range of functionalities is on the rise. The digitisation of the **education logistics support processes** helps institutions operate more **efficiently**. The availability of more and improved data on student conduct and attendance facilitates the scheduling of lecture and examination rooms and also helps to create improved student intake forecasts.

The emergence of digital resources in teaching has proceeded at a slower pace than the digitisation of the education-related processes. The digitisation of teaching has not always been successful and has stirred more emotions. Those emotions mainly concerned the role of lecturers (would they be replaced by computers?) and lecturer and student interaction (personal contact is crucial for the quality of teaching). Doubt was even cast on the motives: the digitisation of teaching was and to this day still is regarded by some parties as a covert efficiency operation. Similar to other sectors of society, in practice digitisation has slowly crept into education,

especially since the emergence of the World Wide Web in the 1990s. Scores of lecturers and institutions experimented with the possibilities of web-based **e-learning**, such as using instructional videos, digital tests and exercises, and gaming. Some of these experiments were successful, others less so and their use in any case was rather fragmented. In *'Omzien in Verwondering'* ('Looking back in amazement'), ⁵ Wilfried Rubens describes how a phase marked by extremely high expectations of e-learning at the close of the last century was followed by disillusionment around the turn of the new millenium. Technological progress had meanwhile considerably facilitated the advance of digitisation, along with growing insight into the potential of the Internet.

A substantial step followed in 2002 when the authoritative Massachusetts Institute of Technology (MIT) decided to make all of its courses available to the wider world free of charge via **OpenCourseWare**. A key factor was the mental leap entailing that knowledge and information evidently play a different role in the digital era: you do not necessarily need to pay for such things. And so OpenCourseWare opened up a new debate on what exactly is the added value of a university in the digital era. Universities across the globe joined MIT. The OpenCourseWare Consortium (later known as the Open Education Consortium) was founded to provide greater access to higher education.

⁵ Rubens, W. (2003). *Omzien in verwondering: de (prille) geschiedenis van e-learning?* ('Looking back in amazement: the early history of e-learning?') HRD Thema, 4(3), 9-7.



The **MOOC** movement followed in 2008. The Artificial Intelligence MOOC launched by Sebastian Thrun and Peter Norvig of Stanford University caused upheaval in the higher education sector in 2011. Unexpectedly, some 160,000 learners enrolled. The Coursera and edX MOOC platforms were soon established, with other, smaller platforms later following suit. “When outstanding becomes so easily accessible, average is over”, said Harvard University professor Clayton Christensen in 2013 at the first edX-conference in Boston when the MOOC movement was launched. The fact that universities made their teaching material available online to millions of learners through MOOCs for free would shake up the higher education sector. After all, why should students still pay for mediocre on-campus programmes if they can access top-quality online education free of charge? Christensen compared the higher education market with other sectors where digitisation had already caused disruption and the demise of large companies. Shortly after that, Moody’s published an analysis of the higher education market predicting that a handful of leading universities would win the digital war and that the average, non-MOOC-publishing universities would be the biggest losers. The New York Times declared 2012 the year of the MOOC. The Netherlands similarly saw the launch of highly successful MOOCs. The University of Amsterdam was the first university to launch a MOOC, with Delft University of Technology and Wageningen University & Research rapidly following suit. The econometrics MOOCs offered by Erasmus University Rotterdam, Leiden University’s terrorism MOOCs and Delft University of Technology’s solar energy MOOCs each attracted more than 100,000 participants.

MOOCs were just the start. They spurred a series of new initiatives, from **SPOCS** (Small Private Online Courses) to **ProfEd** (professional education intended for the working population) and **Micromasters** (online Master’s programmes awarding credentials for a specific employment market). Meanwhile the quality of online courses had improved. Whereas an abundance of ‘canned courses’ (digital reproductions of regular education) had initially been offered, increasing focus was placed on specific **digital teaching methods**, exploiting the possibilities of online communication to improve the quality of education.

Even though there still were opponents to online education, it was increasingly integrated in current higher education practice, a more recent example of which is the acceptance of **learning analytics**. The new generation of digital learning environments (DLOs) currently being purchased by the institutions feature far more functionalities than the old-generation DLOs. This offers all kinds of opportunities to improve student supervision, provide them with direct feedback and predict and raise study success rates. Moreover, this means that efforts can be undertaken towards personalised education, which takes greater account of the prior knowledge and talent levels of groups or even individual students. Institutions mainly in the USA are already conducting experiments in this area on a large scale and **edtech companies** are multiplying. SURF published a white paper ⁶ on this topic and recently organised a trip for administrators to study this development.

⁶ Whitepaper onderwijs op maat anno 2016, SURF, 2016.
<https://www.surf.nl/binaries/content/assets/surf/nl/kennisbank/2016/whitepaper-onderwijs-op-maat-2016-def.pdf>



The implications of digitisation for the higher education sector

Following the MOOC hype, in which Clayton Christensen, Thomas Friedman and Moody's predicted the **disruption** and even the demise of a segment of the higher education sector, it has become evident that digitisation will not bypass institutions, but the sea change they had prophesied has not yet materialised either. There are fundamental differences between education systems worldwide, which contribute to determining the effects of digitisation. In the USA, for instance, online Master's and Bachelor's programmes have enjoyed a growth spurt. A factor that plays a role here are the high tuition fees for mainstream higher education. Such financial incentives play a less prominent role in the EU, where tuition fees are comparatively low. This may change in the near future, however, if the funding of higher education shifts from the public to the private sector in Europe. According to Bert van der Zwaan ⁷, the next decades will be marked by progressive disengagement of the government in education, in light of the moderate economic growth and the escalating costs of public healthcare for ageing populations.

Moody's predicted that online education would fuel fiercer **competition between universities**. This trend is not yet evident in the Netherlands. What we are seeing, however, are the initial signs of the trend Moody's had predicted about the increasing visibility of institutions that produce online courses. A number of Dutch universities, such as Leiden University and Delft University of Technology, have made considerable investments in recent years in publishing online material and in strengthening the digital education infrastructure. They were among the top 100 universities that joined the first wave of MOOCs and they actively contribute to Coursera and edX. They are reaping the benefits and now rank among the trailblazers in the digitisation of education, domestically and internationally. Within a space of four years they have successfully developed a relevant network of top 100 universities in the area of educational innovation, bringing them **international recognition and visibility** plus access to knowledge worldwide. Those networks moreover are set to play a greater role in creating a global education pool, where the emphasis will shift from local learning sources to a global network of courses, a prime example of which is the credits for MOOCs programme offered by Delft University of Technology.

Clayton Christensen has attributed meaning to the term '**unbundling**', which literally means splitting into smaller parts. In the digital society this refers to a development where the establishment loses out to new players because those newcomers are encroaching on their product and market segments. Thanks to the Internet and social media they are able to offer far cheaper and scalable products. Moreover, Christensen predicted that online education, and MOOCs in particular, would lead to the unbundling of the higher education sector. A certain degree of unbundling is already evident in secondary education in the Netherlands, where private parties supervise pupils' homework and provide extra lessons and examination training. The higher education sector is similarly seeing the cautious

⁷ Haalt de universiteit 2040? Een Europees perspectief op wereldwijde kansen en bedreigingen.
(Will universities make it to 2040? A European perspective on opportunities and threats worldwide.)
Bert van der Zwaan, Amsterdam University Press, 2017.



emergence of such parties. **Publishing companies** are successfully developing digital teaching methods, including for higher education. These methods vary from traditional textbooks in that they provide far more than information alone, such as exercises, additional content, practice examinations and automated feedback. Other **private parties** are likewise developing digital education-related services, such as the Dutch start-up FeedbackFruits, with digital learning environments and software for direct feedback to lecturers, and 'I Hate Statistics' for assistance in the acquisition of knowledge and insights in the area of data and statistics. None of these parties are disruptive, however. The Dutch higher education sector has not yet gained a true rival.

An interesting development is employer **recognition of MOOC certificates**, a trend cautiously emerging in the USA and in other countries. Should this prove a real breakthrough as an alternative to mainstream education, it is bound to have implications for higher education institutions. The expectation is that mainly postgraduate programmes, specific disciplines such as IT, and perhaps Master's programmes are likely to see this development. It will pose less of a threat to undergraduate programmes, such as Bachelor's programmes, that offer more general courses and have other functions in the life of an 18-year-old.

While the precise impact of digitisation may not yet be crystal clear, the effects are expected to be profound. Online education expert and blogger Tony Bates refers to a paradigm shift: 'However, what distinguishes the digital age from all previous ages is the rapid pace of technology development and our immersion in technology-based activities in our daily lives. Thus it is fair to describe the impact of the Internet on education as a paradigm shift, at least in terms of educational technology. We are still in the process of absorbing and applying the implications.'

